MSRI
Mathematical Sciences Research Institute

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Annual Report on the Mathematical Sciences Research Institute 2020–2021 activities supported by NSF Grant DMS-1928930 June 1, 2020 to May 31, 2021

August 2021

Mathematical Sciences Research Institute Annual Report, 2020-2021

1. Overview of Activities

This annual report covers MSRI's projects and activities supported by the NSF core grant, DMS-1928930, during the period **June 1, 2020 to May 31, 2021**.

1.1 New Developments

Despite the challenges of the COVID-19 pandemic, 2020–21 proved to be a productive academic year. In fall 2020, MSRI held two virtual programs: *Random and Arithmetic Structures in Topology (RAS - Virtual Semester)* with de-facto lead organizers Martin Bridgeman (Boston College) and Dick Canary (University of Michigan) and *Decidability, definability and computability in number theory: Part 1 (DDC - Virtual Semester)* with lead organizers Valentina Harizanov (George Washington University) and Alexandra Shlapentokh (East Carolina University). In spring 2021 the program was *Mathematical problems in fluid dynamics (FD – Virtual Semester*) with lead organizers Mihaela Ifrim (University of Wisconsin, Madison) and Daniel Tataru (University of California, Berkeley). All three programs were primarily virtual, with small numbers of masked and socially-distanced researchers on site at MSRI.

From May to July 2020, MSRI's Scientific Advisory Committee met on several occasions to determine the best format for programs during the COVID-19 pandemic. The organizers of the three programs were thereafter given the opportunity to hold their program in one of two formats: 1) a hybrid format with an in-person one-month reunion at a future date, or 2) a minimal program mentoring postdocs with the option to reapply for a full program in a subsequent year (2024 or later given the then-slate of scheduled programs at MSRI).

The DDC program and the FD programs opted for the hybrid format with a reunion while the RAS program opted for the minimal mentorship option.

The DDC program – Virtual, Part I – was mostly online with a very small presence of postdocs at MSRI. By the members' accounts, this program was an astounding success despite its virtual nature. This is in large part due to the dedication and organizational skills of the lead organizers, Alexandra Shlapentokh and Valentina Harizanov. As of July 2021, plans are underway for an in-person reunion to be held at MSRI in summer 2022.

The organizing committee of the planned in-person RAS program chose to forgo participation in the online program and restricted their activities to mentoring postdocs. Despite the organizers' choice, many of the members expressed a strong demand to have online activities. Dick Canary and Martin Bridgeman, two Research Professors, stepped in to organize the online activities in place of the original organizers. This unanticipated change in leadership naturally had an effect on the scientific direction of the program; the online program was much appreciated with strong participation on the part of most of the members. Additionally, they had the foresight to encourage the postdocs to organize a special biweekly career development seminar covering subjects such as CV writing; research, teaching, and diversity statements; grant writing; the interview process; and opportunities outside academia. This seminar, while organized by the postdocs of the RAS program, also included the postdocs of the concurrent DDC program. It is worth noting that this is

the only program for which two of the postdocs reported an unsatisfactory scientific experience. It might also be worth mentioning that one of them lived through particularly harsh circumstances due to the pandemic, compounded by the California wildfires that further confined us indoors. At the same time, other postdocs have mentioned both of them as co-authors or as collaborators on projects started during the semester.

The Spring 2021 FD program's lead organizers Mihaela Ifrim and Daniel Tataru were exceptionally dedicated to making the program a resounding success despite its virtuality. The two organizers were deeply engaged with all activities as well as the mentoring program, often working upwards of 12-hour days on both administration and research. The postdocs themselves were also deeply engaged and, following the example of the RAS program, mounted a biweekly career development seminar. A reunion for the FD program will take place at a date to be determined.

All three programs were very popular, and their workshops well-attended. Due to the organizers' dedication and MSRI's nimble IT and administrative infrastructure, the programs enjoyed a high level of engagement and the workshops had even greater attendance than usual.

All programs had stellar researchers, including three Clay Senior Scholars: Uri Bader from the Random and Arithmetic Structures in Topology virtual program, Francois Loeser from the Decidability, Definability and Computability virtual program, and Jean Marc Delort from the Mathematical Problems in Fluid Dynamics hybrid program.

Professor Bader is renowned for his several striking results in rigidity theory; his more recent work (with Furman) on algebraic representations of ergodic systems is yielding versatile applications and was presented at the 2014 ICM in Seoul. According to Alex Lubotzky, the Hebrew University of Jersusalem, the work of Bader and Furman is important and remarkable as what can be deduced from their methods could not have been obtained from Margulis' seminal work. His extraordinary expertise lent itself well to the Random and Arithmetic Structures in Topology virtual program. As Professor Marc Burger, ETH Zurich, wrote in his letter of recommendation, "[Bader's] research […] shows his versatility and good taste as well as breakthrough character. Of course, an important consideration for Clay Scholar in this context is personality and in this respect [he] is ideal: with his infinite energy, he will bring a wealth of activities to this program and will be an ideal mentor for students and postdocs alike."

Professor Loeser is a graduate of the Université Paris 7, having earned his PhD in 1983. Since 1989, he has been a Professor at the Université Pierre et Marie Curie. Loeser was awarded the CNRS Silver Medal in 2011 and the Charles-Louis de Saulces de Freycinet Prize of the French Academic of Sciences in 2007. He was also an invited speaker at the 2014 ICM in Seoul. He has written over 70 scholarly articles. In the organizers' nomination statement and recommendation letters, Professor Loeser is described as an "eminent mathematician with an impressive and impactful research" program; has the "driving force behind the development of Motivic Integration into a thriving branch of mathematic, with connections to model theory, number theory, algebraic geometry, and representation theory; without Loeser's leading efforts with Dr. Denef and subsequently Dr. Cluckers, "motivic Integration as conceived by Kontsevich might very well have gone undeveloped."

Professor Delort received his Ph.D in 1984 from l'École Normale Supérieure, Paris and his Habilitation in 1990. In 2003, he received the Langevin Prize of the Académie des Sciences de Paris, and in 2018 was an invited speaker at the ICM in Rio de Janeiro. Professor Delort is a leading expert in partial differential equations with a focus on evolution equations and micro-local analysis methods. His work has impacted this area for the past three decades with several ground-breaking contributions. His work exhibits exceptional technical strength as well as deep insight into this research area. His extensive and impressive contribution developed the field of quasilinear PDEs in multiple directions and his paradiagonalization method is now established as a key tool in normal forms for quasilinear problems.

Other luminaries, aside from the organizers listed in the program reports, were Yves Benoist (Centre National de la Recherche Scientifique (CNRS)), Martin Bridgeman (Boston College), Nicolas Burq (Université de Paris XI), Richard Canary (University of Michigan), Zoe Chatzidakis (Centre National de la Recherche Scientifique (CNRS)), Jean-Yves Chemin (Sorbonne Université), Anne-Laure Dalibard (Université de Paris VI (Pierre et Marie Curie)), Raphael Danchin (Université Paris-Est Créteil Val-de-Marne), Charles Doering (University of Michigan), David Fisher (Indiana University), Juhi Jang (University of Southern California), Julia Knight (University of Notre Dame), Herbert Koch (Rheinische Friedrich-Wilhelms-Universität Bonn), Irena Lasiecka (University of Memphis), Mahan Mj (Tata Institute of Fundamental Research), Florian Pop (University of Pennsylvania), Roman Sauer (Karlsruhe Institute of Technology), Vladimir Sverak (University of Minnesota Twin Cities), and Sijue Wu (University of Michigan).

In all, MSRI awarded twenty-three (23) researchers the distinguished Chern, Eisenbud and Simons Professorships.

A description of the research areas investigated during the 2020-21 academic year programs, together with a summary of the salient discoveries, can be found in the Appendix as part of the program organizers' reports. Here is a small sample that gives a glimpse into the effervescent research activities that took place throughout the year.

As mentioned earlier all programs were essentially virtual even though a few researchers were able to be in residence at MSRI. While the organizers recognized that virtual programs are poor substitutes for in-person interactions, several groups were nevertheless able to obtain interesting and significant results despite the extraordinary difficulties. For each program we choose some examples of these achievements.

Definability, Decidability and Computability in Number Theory. The organizers list more than 15 research groups with several results worth mentioning in this area of number theory and logic. One in particular is interesting as it provides a unified treatment to all previously known results on d-minimal curves. Kadets-Vogt's project entitled "Low degree points on algebraic curves" is concerned with curves X over a number field K, that have infinitely many points of degree d. The goal of the authors is to systematically study failures of the Abramovich Harris conjecture. For this they introduce a notion of a d-minimal curve: a curve that possesses infinitely many points of degree d yet has no degree $k > 1$ maps onto a curve Y that has infinitely many points of degree d/k. Their aim is to understand the geometry of d-minimal curves. So far, they have shown that d-minimal curves have bounded genus, d-minimal curves for d strictly less than 5 have been fully

classified, and a general curve of genus at most 12 is not d- minimal. Additionally, various special geometric features of d-minimal curves have been described. All of these results were obtained thanks to a new method that combines combinatorics of subspace configurations with geometry of special linear series. This unifying method appears very promising and the hope is that it will yield many more theorems.

Random Arithmetic Structures. As mentioned earlier, two research professors, Martin Bridgeman and Dick Canary, in response to a strong demand from the community, took the helm of the virtual program and created a vibrant online semester. Their interesting and informative report can be found in Section 13, Appendix.

Research Professor T. Gelander taught a minicourse on Invariant Random Subgroups and Lattices and used this opportunity to discuss a conjecture of Margulis on discrete group actions on Lie groups. The conjecture states that if Γ is a discrete infinite covolume subgroup of a Lie group G then the locally symmetric space $\Gamma\backslash G/K$ has injective balls of any radius. Following the minicourse, one if the junior participants, M. Fraczyk (Ph.D. 2017), initiated a collaboration with Gelander which resulted in a paper "Infinite Volume and Infinite Injectivity Radius" which proves the Margulis conjecture (https://arxiv.org/abs/2101.00640). The authors also establish similar results for higher rank semisimple groups with Kazhdan's property (T). We highlight this result as it demonstrates the synergy and networking that happened during the semester between senior and junior researchers.

Mathematical Problems in Fluid Dynamics. As the organizers report, one positive aspect of the virtual format on the program was an increase in informal interactions between junior and more senior participants. One interesting research outcome came from Albert Ai (a Postdoctoral Fellow), Mihaela Ifrim, and Daniel Tataru, who initiated a research seminar which involved graduate students in studying water-waves related problems. Three papers arose from this collaborative seminar, all co-authored with students. Even more important are the collaborations and multiple projects that emerged as a natural continuation of the initial problems assigned during the program. Interestingly, one of the key problems solved was the last assigned "homework problem" from an MSRI 2020 summer school, also led by Ifrim and Tataru which was meant to prepare graduate students for the program. This is a superb example of synergy and cross-pollination across various MSRI activities.

This year's Hot Topic workshop was on Topological Insights in Neuroscience led by Carina Curto (Pennsylvania State University), Chad Giusti (University of Delaware), Kathryn Hess (École Polytechnique Fédérale de Lausanne (EPFL), and Ran Levi (University of Aberdeen). Due to the pandemic, it was moved online and was open to all interested scientists. The workshop had a total of 218 participants, significantly more than could have been hosted in person at MSRI.

This program presented a wide and exciting array of current applications of topology in neuroscience, including classification and synthesis of neuron morphologies, analysis of synaptic plasticity, algebraic analysis of the neural code, topological analysis of neural dynamics, topological decoding of neural activity, diagnosis of traumatic brain injuries, and topological biomarkers for psychiatric disease. Research at the interface of topology and neuroscience is expanding rapidly and has produced many remarkable results in the past five years, and this

workshop provided an important platform to convene this growing community in order to survey recent advances, distinguish promising new research directions, and galvanize new collaborations.

The talks of all of our workshops were recorded and can be seen on our website at http://www.msri.org/web/msri/online-videos.

In 2020, the pandemic necessitated the cancellation of most of MSRI's summer graduate schools, except for two that were held online. One other summer school was postponed to 2021.

The first summer school was **Introduction to Water Waves**, led by Mihaela Ifrim (University of Wisconsin, Madison) and Daniel Tataru (University of California, Berkeley), took place virtually. The school was exceptionally successful due to the dedication of both the lecturers and students. With the support of the TAs, the problem sessions were extremely active. The 50 students were divided into ten groups, and the two lecturers and TAs rotated between the groups for problems sessions creating an unexpected and unprecedented level of engagement with students working late into the evenings to work on open problems. After the conclusion of the school, some groups continued to collaborate and solved some of the open problems, which resulted in a publication.

The other summer school, **Discrete Probability, Physics and Algorithms,** was a joint summer graduate school with the Séminaire de Mathématiques Supérieures, Montréal. It also took place virtually in summer 2020, under the leadership of Alexander Fribergh (University of Montréal).

The African Diaspora Joint Mathematics Workshop (ADJOINT) took place virtually (due to the COVID-19 pandemic) from June 15 – 26 during the summer of 2020. A total of 22 researchers (including five Research Leaders) participated in five working groups comprising mathematical and statistical scientists, predominantly of African descent and at various career stages. The five Research Leaders, accomplished researchers in their respective fields, were also predominantly of African descent. The 2020 ADJOINT Research Leaders included Tepper Gill (Howard University), Abba Gumel (Arizona State University), Ryan Hynd (University of Pennsylvania), Bonita V. Saunders (National Institute of Standards and Technology), and Craig Sutton (Dartmouth College). Their research projects were in the areas of mathematical physics, mathematical biology, analysis and PDEs, statistics, and differential geometry.

Since the two-week summer workshop, there have been at least seven distinct papers in progress by members of the research groups based on the research that was initiated with the ADJOINT program. To date, at least six of those papers have been submitted for publication, three of which have been accepted, including two that were published and now appear, and the rest are currently under review. Moreover, we know of at least one paper on a non-ADJOINT research topic written by an ADJOINT 2020 participant, which was recently accepted for publication. In addition to the papers, at least eight talks and one poster presentation were given by members of the ADJOINT 2020 research groups at various conferences and other venues. An in-person reunion event planned for ADJOINT 2020 participants will be held from June 26 - July 2, 2022 at MSRI in Berkeley.

The Mathematical Sciences Research Institute Undergraduate Program (MSRI-UP), a comprehensive program for undergraduates that aims to increase the number of students from underrepresented groups in mathematics graduate programs, ran from June 13 through July 26 with 17 students studying and researching problems in branched covers of curves. Due to the

COVID-19 pandemic, all activities took place virtually via Zoom. The summer program was staffed by Lead Director Duane Cooper, research leader Edray Goins of Pomona College, postdoctoral fellow Alexander Barrios of Carleton College, and graduate students Adrienne Sands of the University of Minnesota and Sofía Martínez of Purdue University.

All but one of the 17 MSRI-UP students were from groups historically underrepresented in mathematics and were diverse in terms of the types and geographic regions of their undergraduate institutions. The cohort composition was 53% male and 47% female. Seven students identified themselves as African American, six as Latino/Hispanic, one identified as both African American and Latino/Hispanic, two as Pacific Islander, and one as Asian.

Summer Research in Mathematics (SRiM). The COVID-19 pandemic prevented SRiM's 2020 cohort – primarily women and gender-expansive mathematicians – from convening on-site in Berkeley. In March 2020, MSRI consulted the 2020 invitees to determine whether they preferred to participate virtually in summer 2020 or postpone until summer 2021. An overwhelming majority (95%) preferred that the program be postponed until summer 2021, evincing the rare opportunity provided by collaborative research at MSRI. One group with participants on three continents shared: "We would much prefer to postpone since we would be unable to find a time for a virtual setting since we are [in] Asia, Europe and North America."

MSRI postponed SRiM and invited all cohorts (82 mathematicians) accepted for summer 2020 to participate in the summer 2021 session.

Funding. In 2020-21, of the support for program members (excluding Postdocs), approximately 49% came from the NSF and 51% from private funds. Since workshops were held online there were no participant costs, although MSRI incurred other costs related to additional IT needs. Of the support for summer graduate schools, 35% came from NSF, and 65% from private funds. These numbers demonstrate MSRI's ability to leverage the support that the NSF provides and thereby amplify its benefits; we feel that this is possible because the core NSF support provides such a strong foundation for, and endorsement of, MSRI's scientific quality.

Postdoctoral Program. Twenty-six (26) Postdoctoral Fellows participated in our three scientific programs and in the complementary program. Of those, thirteen (13) received funding from this NSF grant.

Hui Zhu was the Berlekamp Postdoctoral Fellow; Soumya Sankar the Gamelin Fellow; Yvon Verbene the Huneke Fellow; Nicholas Miller the McDuff Fellow; Martin Bobb the Strauch Fellow; Albert Ai the Uhlenbeck Fellow; Tommaso Cremaschi and Philip Dittmann the Viterbi Fellows; and Esther Elbaz and Matthew Novack the Della Pietra Fellows. For details, please see Section 3.

Collaborative Diversity Initiative. This Diversity Initiative, known as MSIDI, consists of a series of workshops for members of groups that have been historically underrepresented in the mathematical sciences. These workshops are sponsored by a collaborative grant involving NSF-funded US mathematical sciences institutes (AIM, IAS, ICERM, IPAM, MSRI, and SAMSI). During the 2020-21 academic year, the workshops that took place were held online. As the 2020 Modern Math Workshop was cancelled, some of the allocated funds were used to cover student

registration in the 2020 online Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) conference. The Blackwell-Tapia Conference was postponed until November 2021.

Critical Issues in Mathematics Education. The Critical Issues in Mathematics Education (CIME) series of workshops addresses key problems in education today. They are designed to engage professional mathematicians in discussions with education researchers, teachers, and policy makers to improve mathematics education. This year's topic was on *Initiating, Sustaining, and Researching Mathematics Department Transformation of Introductory Courses for STEM Majors*. Due to the COVID-19 pandemic, the introductory sessions for this workshop were held online, with additional workshop days planned for the coming year. There were 147 attendees of the virtual sessions, which is in line with our 5-year average attendance of 142. It was funded through a grant from Math for America.

Public Understanding of Mathematics. MSRI organizes activities each year that help the public understand the power, beauty, and fun of mathematics:

Mathical Book Prize: (www.mathicalbooks.org) MSRI, in coordination with the Children's Book Council (CBC) and in partnership with the National Council of Teachers of Mathematics (NCTM) and the National Council of Teachers of English (NCTE), continued the Mathical Book Prize for its seventh year. The prize aims to cultivate a love of mathematics in the everyday world in children ages 2-18 through fiction and literary nonfiction stories. A national committee of mathematicians, librarians, educators, and early childhood experts selects each year's winners.

The 2021 prize was supported by the Firedoll Foundation, the Patrick J. McGovern Foundation, and Joan and Irwin Jacobs. MSRI continues to partner with the nonprofit First Book to distribute Mathical titles and accompanying educational resources to schools and programs serving children in low-income communities. In 2020, MSRI began additional partnerships with several organizations to share Mathical titles with communities around the U.S. New partners include the Association of Children's Museums (ACM); the Books for Kids Foundation; Development and Research in Early Math Education (DREME); and School Library Journal (SLJ). In partnership with School Library Journal (SLJ), 25 libraries representing Title I K–12 schools in 17 states were selected in the second annual Mathical Book Prize Collection Development Awards as recipients of $700 grants to purchase titles from the Mathical list.

The 2021 Mathical Prize winners (published in 2020) are: **Pre-K**, *Lia & Luís: Who Has More?*, by Ana Crespo (Charlesbridge); **Grades K-2**, *The Animals Would Not Sleep*, by Sara Levine (Charlesbridge); **Grades 3-5**, *Seven Golden Rings: A Tale of Music and Math*, by Rajani LaRocca (Lee & Low Books); **Grades 6-8**, *How We Got to the Moon: The People, Technology, and Daring Feats of Science Behind Humanity's Greatest Adventure* by John Rocco (Crown Books for Young Readers / Random House Children's Books); and **Grades 9-12**, *Grasping Mysteries: Girls Who Loved Math*, by Jeannine Atkins (Simon & Schuster). The committee also selected eight honor books.

Films for Public Television: People who do and use mathematics often have fascinating stories and adventures to tell related to their work; and partly because their work itself is often hard for

non-mathematicians to comprehend, these stories can have a special interest. As part of MSRI's commitment to telling the story of mathematics, we have produced a number of films about mathematicians; many have been directed by George Csicsery of Zala Films, whose first film about a mathematician, *N is a Number*, has become a classic.

MSRI's 2020 feature-length documentary film, *Secrets of the Surface: The Mathematical Vision of Maryam Mirzakhani* (www.zalafilms.com/secrets) continued to screen in film festivals, the 2021 National Math Festival, and as part of May 12 International Women in Mathematics Day events held virtually throughout the world. Public screenings and panel discussions were held in April 2021 at the Jacob Burns Film Center (New York) featuring panelists Amie Wilkinson, Hélène Barcelo, Cumrun Vafa, George Csicsery, and David Eisenbud, as well as at the Kavli Institute for the Physics and Mathematics of the Universe and the University of Tokyo for Japanese audiences, featuring panelists Yukari Ito and Hideki Miyachi.

MSRI is currently in production on our next joint project with Zala Films, with the working title *Journeys of Black Mathematicians*. This film aims to share the largely untold history of African-Americans in science and mathematics, featuring interviews with prominent contemporary Black mathematicians and showcasing innovative educational programs in math for Black students from grade school through postsecondary and postdoctoral levels. The project aims to inspire young people, particularly African-Americans, to pursue careers in the mathematical sciences. The film's release date is tentatively scheduled for 2022.

Numberphile: (www.youtube.com/numberphile). Since January 2014, MSRI has contributed financial and intellectual support to Brady Haran's Numberphile YouTube channels and audio podcast. In this period, the number of subscribers has climbed from approximately 750,000 to 3.76 million, and the channel has had over 585 million views. Numberphile in all formats remains popular with people all around the world and of all ages.

In 2020, Numberphile uploaded 31 new videos, taking the total number to 609. It has accumulated a further 71 million video views, bringing the total to 585 million views. In addition, a further 30 supplemental videos and 16 podcast episodes were uploaded to the "extras channel" called Numberphile2, comprising a total of 194 bonus videos. Recent podcast episodes have featured lengthy interviews with statistician Jennifer Rogers (The Royal Statistical Society) about epidemiology and Dr. Vicky Neale (University of Oxford) about career opportunities in mathematics.

For a sample of recent additions to the video collection, we recommend "Square Tilings" featuring Fields Medalist Andrei Okounkov (Columbia University), "Hat Problems" with Professor Joe Buhler, "Coloring Knots" with Professor Sylvain Cappell (NYU), and "Butterflies and Gyroids" featuring Sabetta Matsumoto (Georgia Tech).

The CME Group-MSRI Prize in Innovative Quantitative Applications:
(www.msri.org/web/msri/activities/cme-prize) recognizes originality and innovation in the use of mathematical, statistical or computational methods for the study of the behavior of markets, and more broadly of economics. The 15th annual Prize was awarded to Daron Acemoglu, Institute Professor at MIT and an elected fellow of the National Academy of Sciences, the American

Academy of Arts and Sciences, the Econometric Society, and the Society of Labor Economists. His academic work covers a wide range of areas, including political economy, economic development, economic growth, inequality, labor economics, and economics of networks. Acemoglu is the author of five books, including *Why Nations Fail: Power, Prosperity, and Poverty* and *The Narrow Corridor: States, Societies, and the Fate of Liberty* (both with James A. Robinson). Acemoglu has received numerous awards and prizes, including the Carnegie Fellowship in 2017, the Jean-Jacques Laffont Prize in 2018, and the Global Economy Prize in 2019. He was awarded the John Bates Clark Medal in 2005, the Erwin Plein Nemmers Prize in 2012, and the 2016 BBVA Frontiers of Knowledge Award. An award ceremony and seminar were held virtually on May 5, 2021.

Congressional Briefings: (www.msri.org/congress) Since December, 2017, MSRI, in cooperation with the American Mathematical Society, has run twice-yearly congressional briefings in Washington highlighting the value to the U.S. of Federal funding for basic research.

The briefing planned for Spring 2020 was “Differential Privacy: Defending Large Datasets Against Powerful Attack”, featuring Cynthia Dwork, Gordon McKay Professor of Computer Science at the John A. Paulson School of Engineering and Applied Sciences at Harvard and the Radcliffe Alumnae Professor at the Radcliffe Institute for Advanced Study. This event was cancelled because of the pandemic; it was replaced by video conversations between Professor Dwork and key congressional staffers. The AMS-MSRI briefing program is poised to resume with in-person briefings whenever those begin again in Washington, D.C.

National Math Festival: (www.nationalmathfestival.org) The 2021 National Math Festival took place online due to COVID-19, with sessions occurring from December 2020 to March 2021, culminating in the NMF Live Online Weekend, Friday, April 16 - Sunday, April 18, 2021. The festival reached an estimated 17,800 live attendees, with thousands more engaging asynchronously throughout the school year.

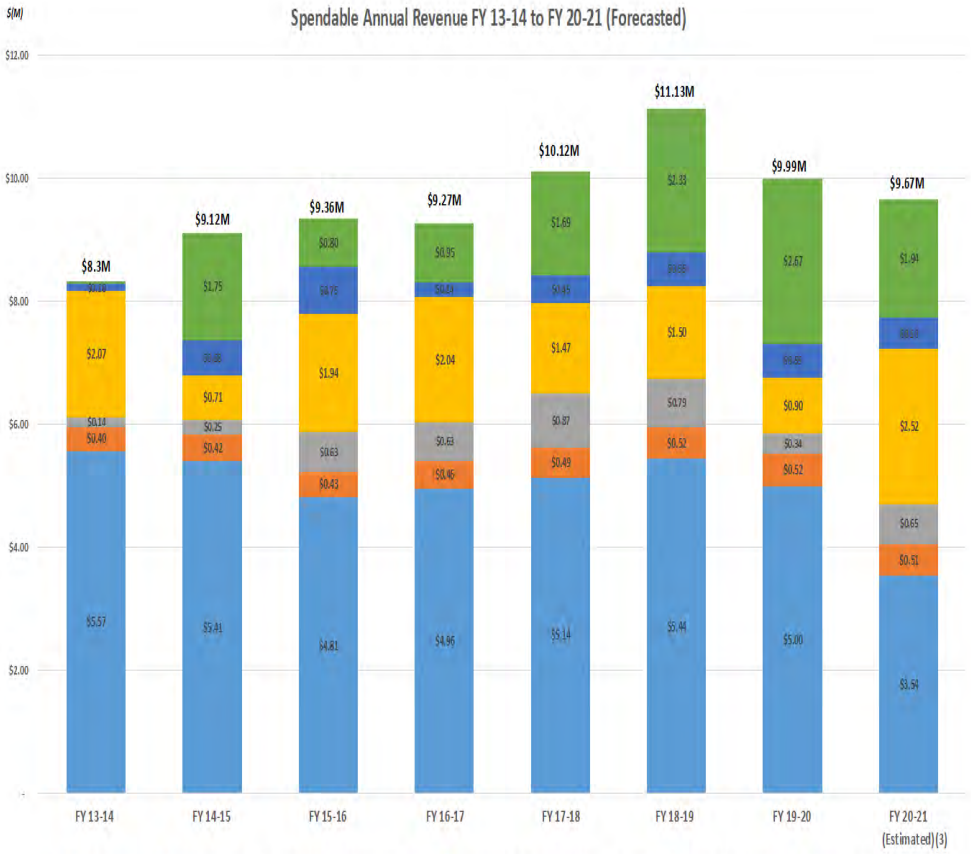
The festival program included the NMF Live Performance Series (with 4 school-day events attended by teachers and students of all ages); 4 Mathical Book Prize events featuring author readings of math-centered youth literature; 6 talks by mathematicians on the playful sides of math and/or the math behind the way the world works; and 5 film events with live panels.

Hands-on and small-group programs abounded, even online: during the festival weekend in April, 26 math organizations presented a total of 97 Sessions and offered 40 blocks of Booth time. These interactive programs served ages 2-4, 5-7, 8-10, 11-13, 14-18, 18+, and "all ages."

Private Fundraising: The private fundraising for MSRI continues to be a robust operation that leverages NSF support to enhance and grow both our scientific and public outreach programming. We continue to welcome new donors through annual fund drive efforts, as well as through targeted communication and networking.

As shown by the Spendable Annual Revenue Chart below, the total percentage of spendable funds from private donors (individuals, private foundations, and corporations) continues to increase. In 2013, approximately one-third of the revenue came from private sources. Today, we receive more

than half of the revenue from private sources. In addition to what is shown on the chart for FY 20-21, we have currently $3M in pledges that we anticipate receiving in the future as MSRI is beginning to launch a multiyear capital campaign with the intent to further increase the percentage of funding from private sources.



	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21 (Estimated) (3)
NSF & NSA (1)	$ 5.57	$ 5.41	$ 4.81	$ 4.96	$ 5.14	$ 5.44	$ 5.00	$ 3.54
Academic Sponsors (1)	$ 0.40	$ 0.42	$ 0.43	$ 0.46	$ 0.49	$ 0.52	$ 0.52	$ 0.51
Endowment Distributions (2)	$ 0.14	$ 0.25	$ 0.63	$ 0.63	$ 0.87	$ 0.79	$ 0.34	$ 0.65
Annual Giving & First Year of Recurring Gifts	$ 2.07	$ 0.71	$ 1.94	$ 2.04	$ 1.47	$ 1.50	$ 0.90	$ 2.52
National Math Festival	$ 0.10	$ 0.58	$ 0.75	$ 0.24	$ 0.45	$ 0.55	$ 0.55	$ 0.50
Multi-Year Gift Pledges	$ 0.05	$ 1.75	$ 0.80	$ 0.95	$ 1.69	$ 2.33	$ 2.67	$ 1.94
Total	$ 8.33	$ 9.12	$ 9.36	$ 9.27	$ 10.12	$ 11.13	$ 9.99	$ 9.67

(1) from audited financial trial balance/financial statements
(2) Audited financial statements footnote 11 "distributions"
(3) FY20-21 is an outlier year in % due to COVID

1.2 Summary of Demographic Data for 2018-19 Activities

During the academic year 2020–21, 199 members participated in MSRI's programs (26 of whom were Postdoctoral Fellows) and its workshops had 1,886 participants.

The Postdoctoral program was particularly successful, despite the challenges presented by COVID-19, and is described in detail in Section 3. Of the Fellows, 27% were women, 42% were U.S. Citizens or Permanent Residents, and 81% listed a U.S. university as their home institution. Of those institutions, 28.6% are located in the Northeast, 38.1% in the West, 28.6% in the Midwest, and the remaining 4.8% (one postdoc) in the South.

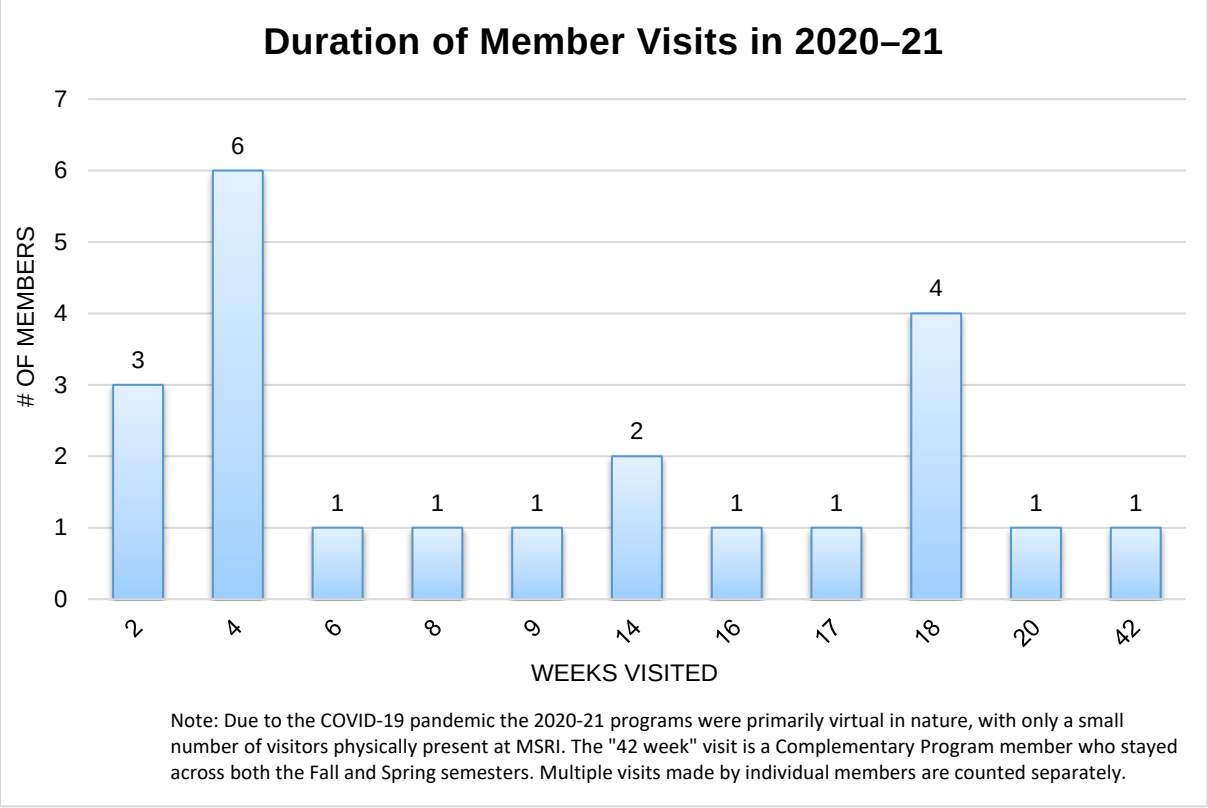
MSRI had a total of 199 members, of whom 20 spent time physically onsite at MSRI in a masked and socially-distanced capacity. Those members spent an average of 73 days (2.4 months) at MSRI per visit, with peak attendance in September 2020 for the fall semester and May 2021 for the spring semester. Of the members (both virtual and onsite), 32% were female, 39% reported being U.S. Citizens or Permanent Residents, and 56% listed a U.S. university as their home institution. Of those institutions, 26% are located in the West, 22% in the Northeast, 34% in the Midwest, and 18% in the South. Of the members, 54% received their Ph.D. during the year 2000 or later, 25% received one between 1981 and 1999, 5% received their Ph.D. in 1980 or earlier, and the remaining 16% were graduate students. Detailed demographic data can be found in Section 2.

MSRI's 2020–21 workshops were held online and had 1,886 participants (some individuals attended multiple workshops and are counted more than once). Registration was encouraged, but not required for the online workshops; therefore demographic information is not available for 356 unregistered participants. Of the 1,530 workshop participants for whom information is available, 32% were female and 47% were U.S. Citizens or Permanent Residents, of whom 12% reported being a member of an under-represented minority. In addition, 65% came from a U.S. institution. Demographic data on workshop participants can be found in Sections 2 and 4.

Member Visits Summary*

All program members	Summer 2020	Fall 2020	Spring 2021	2020-21	2004–21
Total Member Days	0	1,156	519	**1,675**	**289,630**
Total # of Member Visits	0	12	11	**23**	**4,024**
Average # of Days per Member Visit	0.00	96.33	47.18	**72.83**	**71.98**
Average # of Months per Member Visit	0.00	3.21	1.57	**2.43**	**2.40**
All female program members	**Summer 2020**	**Fall 2020**	**Spring 2021**	**2020-21**	**2009–21**
Total Member Days	0	684	239	**923**	**51,211**
Total # of Member Visits	0	6	4	**10**	**689**
Average # of Days per Member Visit	0.00	114.00	59.75	**92.30**	**74.33**
Average # of Months per Member Visit	0.00	3.80	1.99	**3.08**	**2.48**

**Please note that this table calculates member's visits, which can be multiple.*



Note: Due to the COVID-19 pandemic the 2020-21 programs were primarily virtual in nature, with only a small number of visitors physically present at MSRI. The "42 week" visit is a Complementary Program member who stayed across both the Fall and Spring semesters. Multiple visits made by individual members are counted separately.

1.3 Scientific Programs and their Associated Workshops

There were three major, one complementary, and one summer research programs that took place at MSRI during the 2020–21 year, as well as 4 programmatic workshops.

*Note: Full descriptions of each activity can be found the Appendix (Section 13) of this Annual Report. In the lists of organizers of each activity below, the name of the lead organizer(s) appears in **blue**.*

Program 1: Decidability, definability and computability in number theory: Part 1 – Virtual Semester

August 17, 2020 - December 18, 2021

*Organizers: **Valentina Harizanov** (George Washington University), Maryanthe Malliaris (University of Chicago), Barry Mazur (Harvard University), Russell Miller (Queens College, CUNY; CUNY, Graduate Center), Jonathan Pila (University of Oxford), Thomas Scanlon (University of California, Berkeley), **Alexandra Shlapentokh** (East Carolina University), Carlos Videla (Mount Royal University)*

DDC workshops were cancelled due to COVID-19.

Program 2: Random and Arithmetic Structures in Topology – Virtual Semester

August 17, 2020 - December 18, 2021

*De Facto Organizers of Virtual Program: **Martin Bridgeman** (Boston College), **Richard Canary** (University of Michigan)*

*Original Organizers of In-Person Program: Nicolas Bergeron (École Normale Supérieure), Jeffrey Brock (Yale University), Alexander Furman (University of Illinois at Chicago), Tsachik Gelander (Weizmann Institute of Science), Ursula Hamenstädt (Rheinische Friedrich-Wilhelms-Universität Bonn), Fanny Kassel (Institut des Hautes Études Scientifiques (IHES)), **Alan Reid** (Rice University)*

Workshop 1: Random and Arithmetic Structures in Topology: Introductory Workshop (Virtual)

September 05, 2017 - September 08, 2017

*Organizers: **Martin Bridgeman** (Boston College), **Richard Canary** (University of Michigan), Michelle Chu (University of Illinois at Chicago), Tommaso Cremaschi (University of Southern California), James Farre (Yale University), David Fisher (Indiana University)*

Program 3: Mathematical problems in fluid dynamics – Hybrid Semester

January 19, 2021 to May 28, 2021

Organizers: Thomas Alazard (Ecole Normale Supérieure Paris-Saclay; Centre National de la Recherche Scientifique (CNRS)), Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)), Mihaela Ifrim (University of Wisconsin-Madison), Igor Kukavica (University of Southern California), David Lannes (Institut de

*Mathématiques de Bordeaux; Centre National de la Recherche Scientifique (CNRS)), **Daniel Tataru** (University of California, Berkeley)*

Workshop 1: Connections Workshop: Mathematical problems in fluid dynamics (Virtual)
January 20, 2021 - January 22, 2021
*Organizers: Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)), Juhi Jang (University of Southern California), **Anna Mazzucato** (Pennsylvania State University), Sijue Wu (University of Michigan)*

Workshop 2: Introductory Workshop: Mathematical problems in fluid dynamics (Virtual)
January 25, 2021 - February 5, 2021
*Organizers: Nicolas Burq (Université de Paris XI), Anne-Laure Dalibard (Université de Paris VI (Pierre et Marie Curie)), Jean Marc Delort (Université de Paris XIII (Paris-Nord)), **Mihaela Ifrim** (University of Wisconsin-Madison), Irena Lasiecka (University of Memphis), Vladimir Sverak (University of Minnesota Twin Cities)*

Workshop 3: Recent Developments in Fluid Dynamics (Virtual)
April 12, 2021 - April 30, 2021
*Organizers: Thomas Alazard (Ecole Normale Supérieure Paris-Saclay; Centre National de la Recherche Scientifique (CNRS)), Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)), Mihaela Ifrim (University of Wisconsin-Madison), Igor Kukavica (University of Southern California), David Lannes (Institut de Mathématiques de Bordeaux; Centre National de la Recherche Scientifique (CNRS)), **Daniel Tataru** (University of California, Berkeley)*

Program 4: Complementary Program (2020–21)

August 17, 2020 to May 28, 2021

MSRI had a small Complementary Program comprised of a few researchers whose specialties aligned with those of the Director or Deputy Director, and mathematicians who are partners of invited members of a core program. The 2020-21 Complementary Program had one postdoctoral fellow, Juliette Bruce (University of California, Berkeley), who was mentored by Director David Eisenbud (see Section 3 for details).

Program 6: 2020 African Diaspora Joint Mathematics Workshops (ADJOINT) - Virtual

June 15, 2020 to June 26, 2020

A total of 22 researchers (including five Research Leaders) participated virtually in five working groups. The five Research Leaders included Tepper Gill (Howard University), Abba Gumel (Arizona State University), Ryan Hynd (University of Pennsylvania), Bonita V. Saunders (National Institute of Standards and Technology), and Craig Sutton (Dartmouth College). Their research projects were in the areas of mathematical physics, mathematical biology, analysis and PDEs, statistics, and differential geometry.

1.4 Scientific Activities Directed at Underrepresented Groups in Mathematics

Connections Workshops
During the 2020-21 academic year, MSRI hosted one virtual Connections workshop for the Mathematical Problems in Fluid Dynamics program. The Connections workshop has three overarching goals: (1) to give accessible introductions to the main themes of the program and exciting new directions in related research; (2) to provide participants the opportunity to become acquainted with the work of women in the field; and (3) to connect early-career researchers, especially women, gender-expansive individuals, and minorities, to potential senior mentors. A typical workshop consists of introductory lectures, presentations by post-doctoral researchers and graduate students, and a panel discussion addressing the challenges faced by all young researchers, but especially by women, in establishing a career in mathematics. Participants of the Connections Workshop are encouraged to participate the following week in the Introductory Workshop for the semester's program. For more information regarding the workshop, please refer to Section 1.3 above as well as the Appendix (Section 13).

2020 African Diaspora Joint Mathematics Workshops (ADJOINT)
June 15, 2020 – June 26, 2020

The main objective of ADJOINT is to provide opportunities for in-person research collaboration to U.S. mathematicians, especially those from the African American mathematics community, who work in small groups with research leaders on various research projects. Through this effort, MSRI aims to establish and promote research communities that will foster and strengthen research productivity and career development among its participants. The ADJOINT workshops are designed to catalyze research collaborations, provide support for conferences to increase the visibility of the researchers, and to develop a sense of community among the mathematicians who attend. This program will enhance the mathematical sciences and its community by positively affecting the research and careers of African-American mathematicians and supporting their efforts to achieve full access and engagement in the broader research community.

The ADJOINT 2020 program took place virtually and hosted a total of 22 researchers divided into five groups, including five prominent African American mathematicians acting as Research Leaders. All teams were predominantly comprised of African American mathematicians at various stages in their careers. Their research projects were pursued further during the academic year via periodic virtual meetings. For more information regarding this program, please refer to Section 7 of this annual report.

Please note: ADJOINT was funded by an independent NSF grant, DMS-2016406. The report was filed independently to the NSF, thus there is no report attached in Section 13: Appendix.

Undergraduate Program: MSRI-UP 2020: Branched Covers of Curves
June 13, 2020 – July 26, 2020
*Organizers: Federico Ardila (San Francisco State University), **Duane Cooper** (Morehouse College), Maria Mercedes Franco (Queensborough Community College (CUNY)), Rebecca Garcia (Sam Houston State University), Edray Goins (Pomona College), Suzanne Weekes (Worcester Polytechnic Institute)*

The MSRI Undergraduate Program (MSRI-UP) is a comprehensive summer program designed for undergraduate students who have completed two years of university-level mathematics courses and would like to conduct research in the mathematical sciences. The main objective of the MSRI-UP is to identify talented students, especially those from underrepresented groups, who are interested in mathematics and make available to them meaningful research opportunities, the necessary skills and knowledge to participate in successful collaborations, and a community of academic peers and mentors who can advise, encourage and support them through a successful graduate program. The 2020 MSRI-UP took place virtually due to COVID-19.

Please note: MSRI-UP is funded by an independent NSF grant, DMS-1659138. The report was filed independently to the NSF, thus there is no report attached in Section 13: Appendix.

1.5 Summer Graduate Schools (Summer 2020)

SGS 1: Séminaire de Mathématiques Supérieures 2020: Discrete Probability, Physics and Algorithms (Montréal, Canada) [Virtual Summer Graduate School]
June 29, 2020 – July 10, 2020
Location: Centre de Recherches Mathématiques, Montréal, Canada
Organizers: Gerard Ben Arous *(New York University, Courant Institute),* **Alexander Fribergh** *(University of Montreal),* Lea Popovic *(Concordia University)*

SGS 2: Introduction to Water Waves [Virtual Summer Graduate School]
July 27, 2020 – August 07, 2020
Organizers: **Mihaela Ifrim** *(University of Wisconsin-Madison),* **Daniel Tataru** *(University of California, Berkeley)*

1.6 Other Scientific Workshops

Workshop 1: Mathematical Models for Prediction and Control of Epidemics [Virtual]
August 12, 2020 – August 14, 2020
Organizers: Christian Borgs (University of California, Berkeley), Abba Gumel (Arizona State University), Maya Petersen (University of California, Berkeley), Amin Saberi (Stanford University), Katherine Yelick (University of California, Berkeley; Lawrence Berkeley Laboratory)

Workshop 2: Hot Topics: Topological Insights in Neuroscience [Virtual]
May 04, 2021 – May 11, 2021
*Organizers: Carina Curto (Pennsylvania State University), Chad Giusti (University of Delaware), **Kathryn Hess** (École Polytechnique Fédérale de Lausanne (EPFL)), Ran Levi (University of Aberdeen)*

1.7 Education & Outreach Activities

Critical Issues in Mathematics Education 2021: Initiating, Sustaining, and Researching Mathematics Department Transformation of Introductory Courses for STEM Majors [Virtual]
April 29, 2021
Organizers: Naneh Apkarian (Arizona State University), David Bressoud (Macalester College), Pamela Burdman (Just Equations), Jamylle Carter (Diablo Valley college), Ted Coe (Northwest Evaluation Association), Estrella Johnson (Virginia Polytechnic Institute and State University), W. Gary Martin (Auburn University), Michael O'Sullivan (San Diego State University), William Penuel (University of Colorado), Chris Rasmussen (San Diego State University), Daniel Reinholz (San Diego State University), Wendy Smith (University of Nebraska), David Webb (University of Colorado)

Note: The 2021 CIME workshop is ongoing. The introductory sessions for this workshop were held online the morning of April 29th. Additional sessions will be held in the coming year.

Celebration of Women in Mathematics [Virtual]
May 12, 2021
Organizers: Hélène Barcelo (Mathematical Sciences Research Institute), Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)), Mihaela Ifrim (University of Wisconsin-Madison), Ornella Mattei (San Francisco State University), Julia Plavnik (Indiana University)

1.8 Program Consultants List

Consultant Name(s)	Consultant Specialty	Consultant Employer	Activity Title
Douglas Diamond	Economics	University of Chicago	MSRI-CME Group Prize
Darrell Duffie	Ecomonics	Stanford University	MSRI-CME Group Prize
John Ewing	Math, Education	Math for America	Critical Issues in Math Education
Jack Gould	Economics	University of Chicago	MSRI-CME Group Prize
Sanford Grossman	Econ, Neuroscience	self	Neuroscience meeting
Lars Hansen	Economics	University of Chicago	MSRI-CME Group Prize
Nicholas Jewell	Biostatistics	UC Berkeley / London School of Hygiene & Tropical Medicine	Speaker at March 2020 BoT Mtg
Albert S. (Pete) Kyle	Finance	University of Maryland	MSRI-CME Group Prize
Jane Long	Education	Stephen F. Austin State University	National Association of Math Circles
William Macallum	Education	University of Arizona	Educational workshops
Robert Megginson	Fuctional analysis	University of Michigan	Critical Issues in Math Education
Leo Melamed	Economics	CME Group	MSRI-CME Group Prize
Paul Milgrom	Economics	Stanford University	MSRI-CME Group Prize
Roger Myerson	Economics	University of Chicago	MSRI-CME Group Prize
Mark Saul	Education	Education Development Center	Great Circles
Myron Scholes	Economics	Stanford University	MSRI-CME Group Prize
Tatiana Shubin	Number theory	San Jose State University	Navajo Math Circles and Alliance for Indigenous Math Circles
Michael Singer	Algebra	North Carolina State University	Advice on Diversity Issues
Jean Tirole	Economics	Toulouse School of Economics	MSRI-CME Group Prize
Pramod Achar	Representation theory	Louisiana State University	Simons PD Fellowship Selection
Vitaly Bergelson	Dynamical systems, ergodic theory, combinatorics	Ohio State University	Simons PD Fellowship Selection
Jian Ding	Probability theory, Lie groups	University of Pennsylvania	Simons PD Fellowship Selection
Matt Emerton	Number theory	University of Chicago	Simons PD Fellowship Selection
Maria Gordina	Probability	University of Connecticut	Simons PD Fellowship Selection
Eli Grigsby	Topology (low-dimensional)	Boston College	Simons PD Fellowship Selection
Max Lieblich	Algebraic Geometry	University of Washington	Simons PD Fellowship Selection
Ivan Losev	Representation theory	Yale University	Simons PD Fellowship Selection
Claudia Miller	Commutative Algebra	Syracuse University	Simons PD Fellowship Selection
Doug Ravenel	Topology (algebraic)	University of Rochester	Simons PD Fellowship Selection
Bob Strain	PDE, statistical mechanics	University of Pennsylvania	Simons PD Fellowship Selection
Weiran Sun	PDE, numerical analysis	Simon Fraser University	Simons PD Fellowship Selection
Stephanie van Willigenburg	Combinatorics (algebraic)	University of British Columbia	Simons PD Fellowship Selection
Guofang Wei	Differential geometry	UC Santa Barbara	Simons PD Fellowship Selection
Caleb Ashley	Geometry	Boston College	EDI Issues
Ron Buckmire	Applied mathematics	Occidental College	EDI Issues
Duane Cooper	Mathematics of voting	Morehouse College	EDI Issues
Monica Jackson	Statistics	American University	EDI Issues
Omayra Ortega	Computational biology, mathematical epidemiology	Sonoma State University	EDI Issues
Robin Wilson	Topology (low-dimensional), math education	California State Polytechnic University	EDI Issues
Edray Goins	Algebraic geometry, number theory, representation theory	Pomona College	EDI Issues
Naiomi Cameron	Combinatorics (algebraic and enumerative), number theory	Spelman College	EDI Issues
Jacqueline Hughes-Oliver	Statistics, drug discovery, chemometrics	North Carolina State University	EDI Issues
Anisah Nu'Man	Geometric group theory	Spelman College	EDI Issues
Educational Advisory Committee (EAC)	See Section 10: Committee Membership		Criticial Issues in Mathematics Education
Human Resources Advisory Committee (HRAC)	See Section 10: Committee Membership		Scientific Programs & MSRI-UP
Scientific Advisory Committee (SAC) & Board of Trustees (BoT)	See Section 10: Committee Membership		Scientific Programs & Summer Graduate Schools

2. Program and Workshop Data

2.1 Program Member List

(See email attachment)

2.2 Program Members Summary

Programs	Distinct Members**	Women	%	Minorities*	%	US Home Inst.	%	US Citizens & Perm. Res.
Random and Arithmetic Structures in Topology -- Virtua	57	15	*26.3%*	5	*21.7%*	34	59.6%	23
Decidability, definability and computability in number the	51	20	*39.2%*	1	*4.5%*	27	52.9%	22
Mathematical problems in fluid dynamics	88	26	*29.5%*	2	*6.7%*	48	54.5%	30
Complementary Program 2020-21	3	2	*66.7%*	0	*0.0%*	2	66.7%	2
Total # of Distinct Members	**199**	**63**	***31.7%***	**8**	***10.4%***	**111**	***55.8%***	**77**

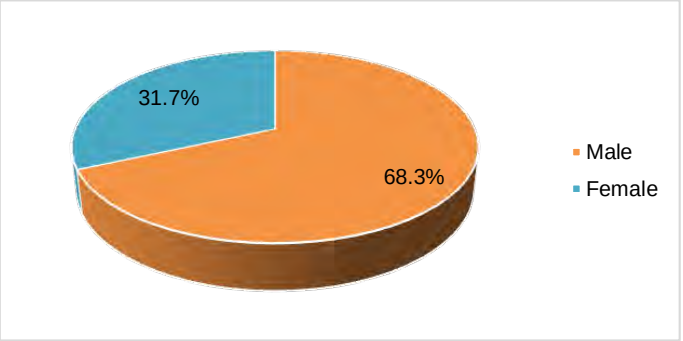
**Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

***There were an additional 3 members per main program and 9 members of the Complementary Program for whom we cannot confirm virtual participation. They are excluded from these statistics.*

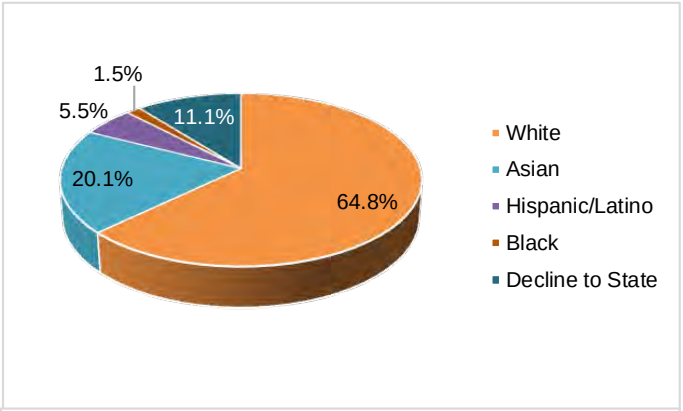
2.3 Program Members Demographic Summary

2020-21 Program Members Demographic Summary

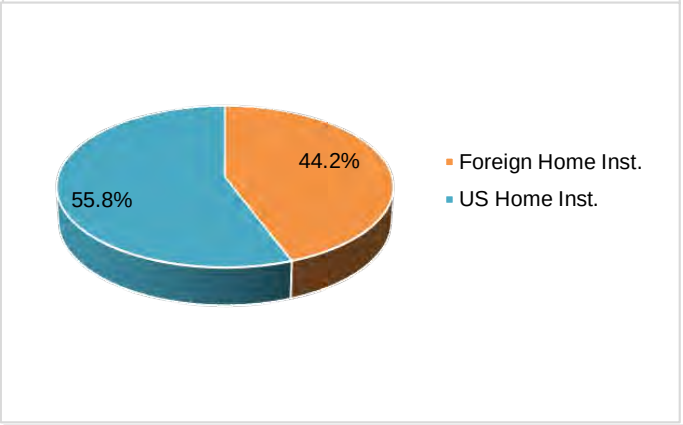
Gender	#	%
# of Distinct Members	199	100.0%
Male	136	68.3%
Female	63	31.7%
Decline to State	0	0.0%



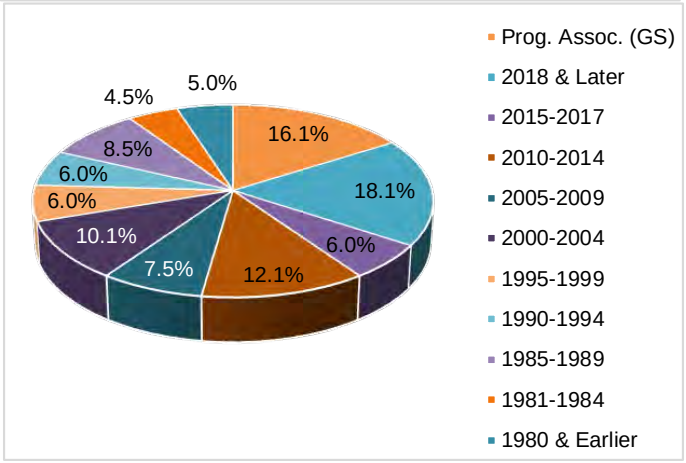
Race/Ethnicity*	#	%
White	129	64.8%
Asian	40	20.1%
Hispanic/Latino	11	5.5%
Black	3	1.5%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	22	11.1%
Unavailable Info.	0	0.0%
Minorities**	8	10.4%



Citizenships	#	%
Foreign Home Inst.	88	44.2%
US Home Inst.	111	55.8%
Foreign Citizens	122	61.3%
US Citizen & Perm. Residents	77	38.7%
US Citizens	65	32.7%
US Permanent Residents	12	6.0%



Year of Ph.D	#	%
Prog. Assoc. (GS)	32	16.1%
2018 & Later	36	18.1%
2015-2017	12	6.0%
2010-2014	24	12.1%
2005-2009	15	7.5%
2000-2004	20	10.1%
1995-1999	12	6.0%
1990-1994	12	6.0%
1985-1989	17	8.5%
1981-1984	9	4.5%
1980 & Earlier	10	5.0%
Total # of Distinct Members	199	100.0%

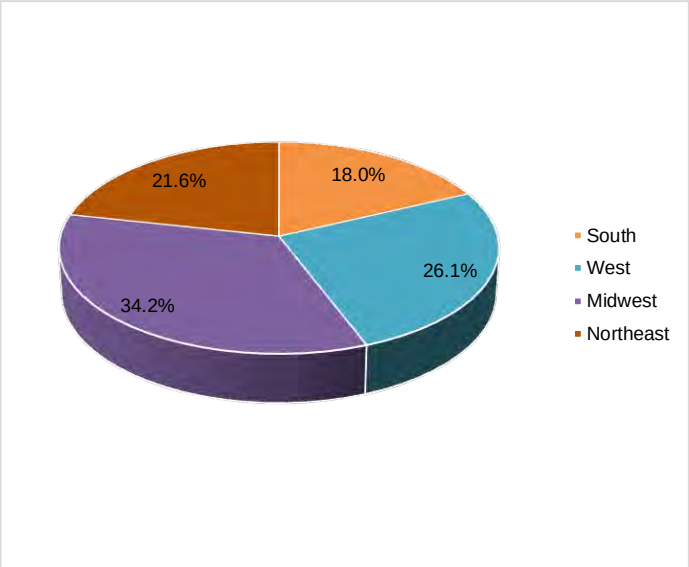


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020-21 Program Members Classified by State

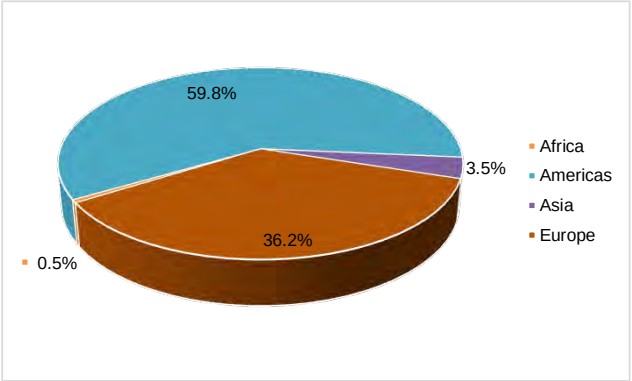
State	#	%	*2020 Census*
South	**20**	**18.0%**	*38.1%*
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	2	1.8%	*0.2%*
FL	1	0.9%	*6.5%*
GA	4	3.6%	*3.2%*
KY	0	0.0%	*1.4%*
LA	1	0.9%	*1.4%*
MD	3	2.7%	*1.9%*
MS	0	0.0%	*0.9%*
NC	1	0.9%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	3	2.7%	*2.1%*
TX	4	3.6%	*8.8%*
VA	1	0.9%	*2.6%*
WV	0	0.0%	*0.5%*
West	**29**	**26.1%**	*23.7%*
AK	0	0.0%	*0.2%*
AZ	1	0.9%	*2.2%*
CA	26	23.4%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	1	0.9%	*1.0%*
WA	1	0.9%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**38**	**34.2%**	*20.8%*
IA	0	0.0%	*1.0%*
IL	16	14.4%	*3.9%*
IN	6	5.4%	*2.0%*
KS	0	0.0%	*0.9%*
MI	8	7.2%	*3.0%*
MN	2	1.8%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	2	1.8%	*3.6%*
SD	0	0.0%	*0.3%*
WI	4	3.6%	*1.8%*
Northeast	**24**	**21.6%**	*17.4%*
CT	3	2.7%	*1.1%*
MA	5	4.5%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	1	0.9%	*2.8%*
NY	7	6.3%	*6.1%*
PA	8	7.2%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	*0.0%*
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**111**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020-21 Program Members Classified by Countries

Africa			**1**
	Western Africa	Senegal	1
Americas			**119**
	North America	Canada	5
		United States	111
	South America	Chile	2
		Uruguay	1
Asia			**7**
	East Asia	China	2
	Western Asia	Israel	3
		United Arab Emirates	1
	Southern Asia	India	1
Europe			**72**
	Northern Europe	Sweden	1
		United Kingdom	2
		Norway	1
	Southern Europe	Spain	1
		Greece	1
		Italy	7
	Western Europe	Belgium	1
		France	41
		Germany	14
		Switzerland	2
	Eastern Europe	Russian Federation	1
Oceania			**0**
Grand Total			**199**



**Regions based on United Nations classification*

2.4 Workshop Participant List

(See email attachment)

2.5 Workshop Participant Summary*

Scientific Workshops	Total Participants	Available Demographics*	US Citizens & Perm. Res.	%‡	Women	%‡	Minorities†	%‡	US Home Inst.	%‡
6 Virtual Workshops										
Connections Workshop: Mathematical problems in fluid dynamics	161	152	48	*31.6%*	42	*27.6%*	5	*10.4%*	96	63.2%
Introductory Workshop: Mathematical problems in fluid dynamics	239	216	73	*33.8%*	57	*26.4%*	6	*8.2%*	123	56.9%
Recent Developments in Fluid Dynamics	239	180	57	*31.7%*	42	*23.3%*	2	*3.5%*	97	53.9%
Random and Arithmetic Structures in Topology: Introductory Workshop	175	144	64	*44.4%*	35	*24.3%*	10	*15.6%*	98	68.1%
Hot Topics: Topological Insights in Neuroscience	218	197	76	*38.6%*	66	*33.5%*	7	*9.2%*	98	49.7%
Mathematical Models for Prediction and Control of Epidemics	484	484	272	*56.2%*	163	*33.7%*	40	*14.7%*	336	69.4%
All 6 Workshops Total	**1,516**	**1,373**	**590**	***43.0%***	**405**	***29.5%***	**70**	***11.9%***	**848**	***61.8%***

Education & Outreach Workshops	Total Participants	Available Demographics*	US Citizens & Perm. Res.	%‡	Women	%‡	Minorities*	%‡	US Home Inst.	%‡
2 Virtual Workshops										
Critical Issues in Mathematics Education 2021: Initiating, Sustaining, and Researching Mathematics Department Transformation of Introductory Courses for STEM Majors	147	145	126	*86.9%*	78	*53.8%*	15	*11.9%*	131	90.3%
Celebration of Women in Mathematics**	223	12	8	*66.7%*	10	*83.3%*	1	*12.5%*	9	75.0%
All 2 Workshops Total	**370**	**157**	**134**	***85.4%***	**88**	***56.1%***	**16**	***11.9%***	**140**	**89.2%**

All 8 Workshops Total	**1,886**	**1,530**	**724**	***47.3%***	**493**	***32.2%***	**86**	***11.9%***	**988**	***64.6%***

† Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.

‡ Percentage among those for whom information is available.

** Registration for virtual workshops was encouraged, but not required. Therefore while total participant counts are comprehensive, demographic information is only available for registered participants.*

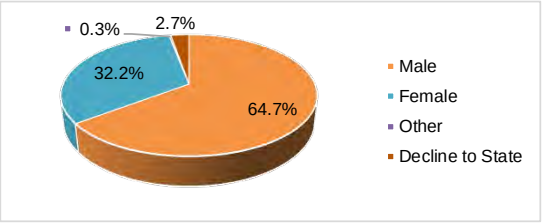
*** In order to make the Celebration of Women in Mathematics accessible to as many people around the world as possible, we did not ask participants to register. Therefore we have demographic information only for those who also registered for another MSRI workshop.*

*Note that the overall workshop data in section 2.5 is not distinct as some participants attended multiple workshops, but the statistics of individual workshops found in Section 13, Appendix, were calculated on distinct participant data.

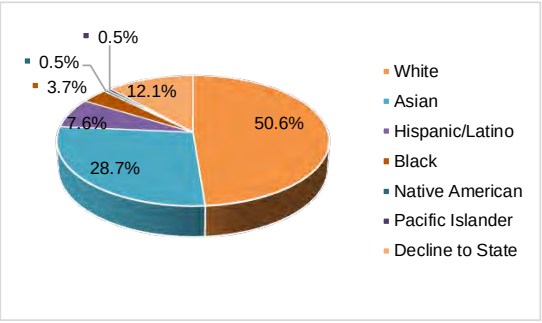
2.6 Workshop Participant Demographic Data

2020–21 Workshop Participants Demographic Summary

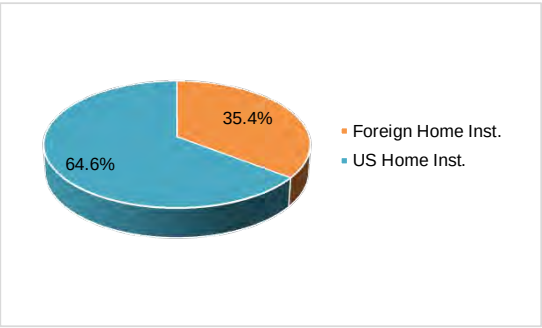
Gender	#	% excl. unavail.‡	% overall
# of Participants	1886	100.0%	100.0%
Male	990	64.7%	52.5%
Female	493	32.2%	26.1%
Other	4	0.3%	0.2%
Decline to State	42	2.7%	2.2%
Unavailable Info.‡	357	n/a	18.9%



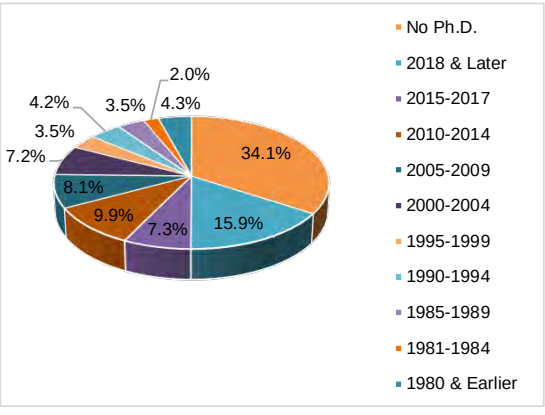
*Race/Ethnicity**	#	% excl. unavail.‡	% overall
White	773	50.6%	41.0%
Asian	439	28.7%	23.3%
Hispanic/Latino	116	7.6%	6.2%
Black	57	3.7%	3.0%
Native American	8	0.5%	0.4%
Pacific Islander	8	0.5%	0.4%
Decline to State	185	12.1%	9.8%
Unavailable Info.‡	358	n/a	19.0%
Minorities**	86	12.6%	12.6%



US Based/Citizenship	#	% excl. unavail.‡	% overall
Foreign Home Inst.	542	35.4%	28.7%
US Home Inst.	988	64.6%	52.4%
Unavailable Info.‡	356	n/a	18.9%
US Citizen & Perm. Residents	685	44.8%	36.3%
Foreign Citizens	845	55.3%	44.8%
Unavailable Info.‡	356	n/a	18.9%
US Citizen	592	38.7%	31.4%
Perm. Residents	93	6.1%	4.9%



Year of Ph.D.	#	% excl. unavail.‡	% overall
No Ph.D.	521	34.1%	27.6%
2018 & Later	243	15.9%	12.9%
2015-2017	111	7.3%	5.9%
2010-2014	151	9.9%	8.0%
2005-2009	124	8.1%	6.6%
2000-2004	110	7.2%	5.8%
1995-1999	53	3.5%	2.8%
1990-1994	64	4.2%	3.4%
1985-1989	54	3.5%	2.9%
1981-1984	30	2.0%	1.6%
1980 & Earlier	65	4.3%	3.4%
Unavailable Info.‡	360	n/a	19.1%
Total # Participants	1886	100.0%	100.0%



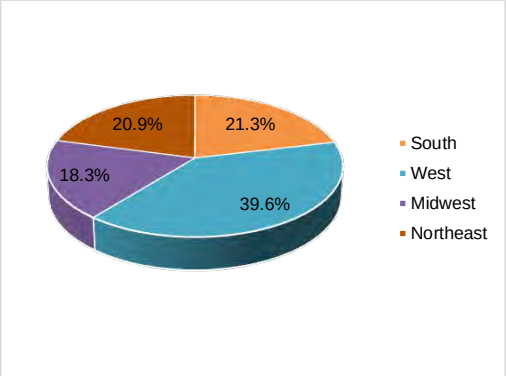
**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

‡ *Workshops were held online due to the COVID-19 pandemic. Registration was encouraged, but not required; therefore while total participant counts are comprehensive, demographic information is only available for registered participants. Percentages are calculated from among those for whom demographic information is available.*

2020–21 Workshop Participants Classified by State

State	#	%	*2020 Census*
South	**210**	**21.3%**	***38.1%***
AL	2	0.2%	*1.5%*
AR	6	0.6%	*0.9%*
DE	5	0.5%	*0.3%*
DC	4	0.4%	*0.2%*
FL	19	1.9%	*6.5%*
GA	32	3.2%	*3.2%*
KY	1	0.1%	*1.4%*
LA	4	0.4%	*1.4%*
MD	24	2.4%	*1.9%*
MS	1	0.1%	*0.9%*
NC	40	4.0%	*3.1%*
OK	3	0.3%	*1.2%*
SC	2	0.2%	*1.5%*
TN	11	1.1%	*2.1%*
TX	39	3.9%	*8.8%*
VA	17	1.7%	*2.6%*
WV	0	0.0%	*0.5%*
West	**390**	**39.5%**	***23.7%***
AK	1	0.1%	*0.2%*
AZ	16	1.6%	*2.2%*
CA	297	30.1%	*11.9%*
CO	11	1.1%	*1.7%*
HI	5	0.5%	*0.4%*
ID	2	0.2%	*0.6%*
MT	1	0.1%	*0.3%*
NM	5	0.5%	*0.6%*
NV	1	0.1%	*0.9%*
OR	24	2.4%	*1.3%*
UT	11	1.1%	*1.0%*
WA	16	1.6%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**180**	**18.2%**	***20.8%***
IA	3	0.3%	*1.0%*
IL	49	5.0%	*3.9%*
IN	15	1.5%	*2.0%*
KS	3	0.3%	*0.9%*
MI	42	4.3%	*3.0%*
MN	11	1.1%	*1.7%*
MO	12	1.2%	*1.9%*
ND	1	0.1%	*0.2%*
NE	5	0.5%	*0.6%*
OH	7	0.7%	*3.6%*
SD	0	0.0%	*0.3%*
WI	32	3.2%	*1.8%*
Northeast	**206**	**20.9%**	***17.4%***
CT	6	0.6%	*1.1%*
MA	49	5.0%	*2.1%*
ME	5	0.5%	*0.4%*
NH	2	0.2%	*0.4%*
NJ	28	2.8%	*2.8%*
NY	54	5.5%	*6.1%*
PA	54	5.5%	*3.9%*
RI	8	0.8%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**2**	**0.2%**	***0.0%***
PR	0	0.0%	*0.0%*
Unavailable	2	0.2%	*0.0%*
Total	**988**	**100.0%**	***100.0%***

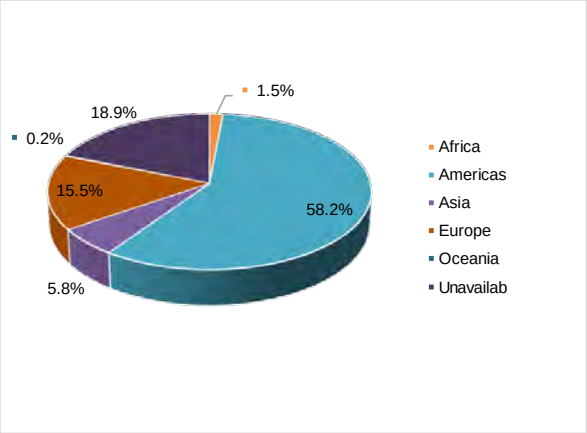


**Regions based on US Census classification*

2020–21 Workshop Participants Classified by Country

Africa			**28**
	Eastern Africa	Kenya	1
		Zimbabwe	2
	Northern Africa	Algeria	9
		Egypt	1
		Morocco	1
		Tunisia	1
	Southern Africa	South Africa	1
	Western Africa	Nigeria	7
		Senegal	2
		The Gambia	3
Americas			**1097**
	Central America	Mexico	22
	North America	Canada	48
		United States	988
	South America	Argentina	3
		Brazil	28
		Chile	3
		Colombia	4
		Uruguay	1
Asia			**109**
	East Asia	China	12
		Japan	1
	South-central Asia	India	41
		Iran, Islamic Re	7
		Pakistan	4
	South-eastern Asia	Philippines	12
		Viet Nam	4
	Western Asia	Israel	5
		Lebanon	2
		Saudi Arabia	3
		Turkey	10
		United Arab Em	8
Europe			**293**
	Eastern Europe	Poland	1
		Romania	3
		Russian Federa	3
	Northern Europe	Denmark	2
		Finland	1
		Ireland	1
		Latvia	1
		Norway	6
		Sweden	18
		United Kingdom	48
	Southern Europe	Albania	1
		Croatia	1
		Italy	19
		Portugal	6
		Serbia	4
		Spain	13
	Western Europe	Austria	8
		Belgium	2
		France	103
		Germany	40
		Luxembourg	1
		Netherlands	2
		Switzerland	9
Oceania			**3**
	Australia & NZ	Australia	3
Unavailable Info.[‡]			**356**
Grand Total			**1886**

‡ Workshops were held online due to the COVID-19 pandemic. Registration was encouraged, but not required; therefore while total participant counts are comprehensive, demographic information is only available for registered participants.



Regions based on United Nations classifications.

2.7 Program Publication List

(Deposited in NSF Public Access Repository)

2.8 Program Publication Work-In-Progress List

(Emailed separately to program officer)

3. Postdoctoral Program

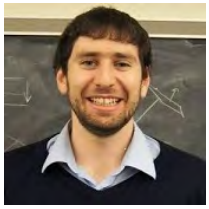
3.1 Description of Activities

The postdoctoral program at MSRI is central to MSRI's mission of continued excellence in research in the mathematical sciences. Today, MSRI's programs bring together researchers from all over the world to discuss developments in the most exciting areas of fundamental mathematics. They strongly catalyze research and generate many new collaborations. The programs provide extraordinary opportunities and training for young researchers. MSRI is also recognized for its groundbreaking work on inclusivity and for its public programs. Perhaps the most important way in which MSRI enhances the world's mathematical research is as an incubator. Participants in MSRI's programs form intense new collaborations that lead to fundamental advances in the field, maturing over a period of years or even decades. MSRI's postdocs engage with fellow mathematicians from all over the world to develop their interests and contribute to the Science community.

During the 2020-21 academic year, MSRI selected 26 postdoctoral scholars with research interests in the programs that MSRI offers. All postdocs were assigned mentors and received their full fellowship benefits whether they visited MSRI or participated remotely. Of the 26 Postdoctoral Fellows at MSRI, 7 (27%) were women, 11 (42%) were U.S. Citizens or Permanent Residents, and 22 (81%) came from a US institution.

Following are additional details on the Postdoctoral Fellows for each program.

Decidability, Definability and Computability in Number Theory: Part 1 – Virtual Semester



Corwin, David

Name: David Corwin
Year of Ph.D.: 2018
Institution of Ph.D.: Massachusetts Institute of Technology (MIT)
Dissertation title: Obstructions to Integral and Rational Points
Ph.D. advisor: Bjorn Poonen
MSRI Mentor: Prof. Barry Mazur

Institution prior to MSRI: University of California, Berkeley
Position at that institution: RTG Postdoctoral Scholar
Mentor: Martin Olsson

Post MSRI institution: University of California, Berkeley
Position: RTG Postdoctoral Scholar
Anticipated length: 6 months (will then go to a different position)

Postdoctoral fellow's comments:
I attended various seminars, especially the Diophantine Problems seminar. I also gave a couple of introductory talks about rational points on algebraic curves.

I got the most out of my conversations with my mentor, Barry Mazur. He asked me questions about work of Bas Edixhoven on geometric quadratic Chabauty, which led to a note I wrote about the limits of geometric non-abelian Chabauty's method. He also went over my work on motivic non-abelian Chabauty's method for a punctured elliptic curve and asked various helpful questions.

That gets us to the biggest focus of my time at MSRI, which was on research projects that I had previously started. I was especially working on a project to rigorously determine the set of Z[1/2]-points on a punctured elliptic curve using non-abelian Chabauty's method of Minhyong Kim. This is interesting because it's a case in which quadratic Chabauty does not apply, while quadratic Chabauty accounts for almost all examples in which one has been able to explicitly determine the set of integral or rational points on a variety using non-abelian Chabauty's method.

I also have made some progress on a project to compute etale homotopy obstructions to rational points on del Pezzo surfaces over a p-adic function field. I had the basic idea for this for a while and had written some ideas on paper. But I wrote up a lot of these ideas during my time at MSRI, now having a 21-page writeup. I also came to better understand how gerbes might relate to the question of lifting points to

the universal torsor. There's still a lot more to do before this project is complete, but I made a lot of progress on it.

I also made some progress on a project I had been working on for a while regarding cuspidal fundamental group sections on higher-dimensional varieties. But rather than solve the problem, I noticed a problem with my method, and I haven't yet been able to fix it. I also added some material this semester to my writeup (which I had started long before MSRI) about how the subject relates to logarithmic fundamental groups.

Did you find your experience at MSRI beneficial? Why or why not?
I would say it was especially beneficial in that: 1) I got to talk to Barry Mazur one hour every week and 2) I had a semester where my only focus was on research, so I advanced much more on research than in previous semesters.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
It definitely helps me in finding a future position with all the research progress I made!

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
As I've told the administration, I think it was unfortunate that: 1) The RAS and DDC teas were separate (really not sure why this happened) and 2) there was no DDC introductory workshop (I know this was because they wanted to have a DDC Part II in 2022).

I would say that 2) was unfortunate specifically because DDC was bringing together people from somewhat different fields. I think there were roughly three areas that people came from: 1) computability theory 2) model theory and valuation theory 3) number theory. These three groups spoke different languages. In the end, I felt like the program was dominated by 2). It would have been great to have some introductory lectures in 1) and 2) so that a number theorist like me could get the basics down.

There was an introductory series in model theory, although I already knew basic model theory, and I felt that more was needed. And there wasn't really anything on valuation theory or computability theory. In theory, I should re-watch some of the talks from earlier in the semester after having seen those lectures.

Here's another result of the online format: The seminars could invite anyone to speak, not just people who were in Berkeley. The result was that the quality of the research presented was probably a lot higher. The downside was that there was less focus on the people who were actually in the program. I was not asked to speak in anything other than the junior seminar, until late in the semester when the leadership of MSRI intervened and made sure that I got invited to something. I don't think anyone intended to leave me out; rather, there was so much focus on outside speakers that some of the program participants fell through the cracks.

Dittman, Philip

Name: Philip Dittmann
Year of Ph.D.: 2018
Institution of Ph.D.: University of Oxford
Dissertation title: A model-theoretic approach to the arithmetic of global fields
Ph.D. advisor: Jochen Koenigsmann
MSRI Mentor: Florian Pop

Institution prior to MSRI: TU Dresden
Position at that institution: wissenschaftlicher Mitarbeiter (roughly a postdoctoral position with some teaching duties)
Mentor (if applicable): Arno Fehm

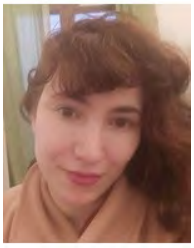
Post-MSRI institution: TU Dresden
Position: wissenschaftlicher Mitarbeiter (returning to my pre-MSRI position)
Anticipated length: 1.5 years
Mentor (if applicable): Arno Fehm

Postdoctoral fellow's comments:
During the MSRI programme, I co-organised one of the weekly seminars (on valuation theory), and regularly attended many others. I finished a paper which I had started writing with my MSRI mentor Florian Pop, "Characterizing finitely generated fields by a single field axiom".
I also wrote two short notes as a direct result of the programme. One of them, "Odoni's conjecture on arboreal Galois representations is false", is joint with fellow MSRI postdoc Borys Kadets and was suggested by him, disproving an old conjecture. The other, "Non-definability of rings of integers in most algebraic fields", is joint with Arno Fehm, who is also a programme participant. It was directly inspired by two MSRI talks on a closely related result.

Did you find your experience at MSRI beneficial? Why or why not?
I found the seminar series very interesting. They were especially helpful since, working in a small subject area, it is normally rare to get an opportunity to hear such a large number of specialised talks. On the other hand, I did find myself working exclusively with people whom I already knew. A part of this is surely the lack of the immersive experience normally provided by an in-person programme, combined with the time difference which makes working collaboratively across continents happen much less spontaneously.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I am unable to evaluate the "CV value" of having been MSRI postdoc, and don't realistically think that I have made many new personal connections - partly because I was already reasonably well connected within the field. On the other hand, the MSRI fellowship has enabled me to be productive scientifically over the past months, also because of the lack of teaching duties.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
It is surely a benefit of an online programme that audience members and speakers can attend from all over the world without having to commit to physically come for a period of time. On the other hand, for my own scientific work I found the programme much less useful than I would have imagined it to be in person, due to the lack of immersion with other mathematicians in the field. The time difference and the difficulty of low-key "chat" increase the barriers to casual conversation - even simple questions or clarifications often require drafting a formal email or setting up a meeting. In this sense, the "teas" sadly did not live up to their promise, although I am unsure what could be done to remedy this genuinely difficult problem. I must stress in any case that I have felt well supported and looked after by MSRI throughout the entire semester.



Elbaz, Esther

Name: Esther Elbaz Saban
Year of Ph.D.: 2018
Institution of Ph.D.: Université Paris 7 (Paris, France)
Dissertation title: Grothendieck rings in model theory
Ph.D. advisor: Françoise Delon
MSRI Mentor: David Marker

Institution prior to MSRI: University Ben Gurion of the Negev (Beer Sheva, Israel)
Position at that institution: Post doctorant
Mentor (if applicable): Moshe Kamenski

Post-MSRI institution: unknown

Postdoctoral fellow's comments:
On top of having attended the many talks through which I learned a lot, I benefited very much from the help of my mentor Dave Maker. Thanks to his advices, I submitted two preprints during this semester. He read them and made suggestions to improve them. He also offered suggestions as to which journals I could send my preprints to. I sent him a third print that he kindly offered to have a look at. This semester also gave me the opportunity to give two talks. Again I appreciated having my mentor having me rehearsed and giving feedback on my slides.

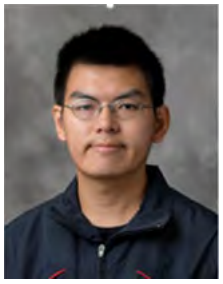
The discovery of Computability theory which I found to be a very interesting area was also a big benefit for me. (When I learned that "Introductory courses in model theory" were scheduled, I thought that it would have been great to also have this for Computability theory.) I began working on a new project ("Enriched Grothendieck rings") with Yves de Cornulier.

Did you find your experience at MSRI beneficial? Why or why not?
I found it to be very beneficial. I learned a lot out of the many talks. I also discovered new areas of mathematics (especially computability which I found particularly exciting).

Although it is not strictly speaking mathematics, I found the career development panel to be very interesting and beneficial. Overall I was very impressed by all the effort put by the organizers and the MSRI's directors to make this experience as beneficial as possible despite the situation of the Covid 19. I had the impression there was a lot of benevolence from everyone (including of course the staff). Overall I experienced a very emulating and favorable environment to work in.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
The advice and general "tips" I got from the career development panel especially the one devoted to the application to post-doc helped me understand better what is expected to form an applicant.
Overall being part of this semester was very emulating and it definitely boosted my confidence to apply for future postdocs.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in-person meeting? How could the experience be improved?
I found that all was done to make the format as beneficial as possible despite the conditions. I attended several teas and always found it enjoyable to have informal chats with the participants. Nevertheless, I didn't feel very comfortable speaking to people I didn't have in front of me. It made things more difficult for me to meet new persons and to have informal chat. But I believe this was inevitable in a virtual seminar.



Ho, Meng-Che

Name: Meng-Che Ho
Year of Ph.D.: 2017
Institution of Ph.D.: University of Wisconsin-Madison
Dissertation title: Randomizing and Describing Groups
Ph.D. advisor: Uri Andrews and Tullia Dymarz
MSRI Mentor: Theodore Slaman

Institution prior to MSRI: Purdue University
Position at that institution: Golomb Visiting Assistant Professor
Mentor: Thomas Sinclair and Ben McReynolds

Post-MSRI institution: California State University - Northridge
Position: Assistant Professor
Anticipated length: Tenure-track
Mentor (if applicable): N/A

Postdoctoral fellow's comments:
I started a collaboration with Julia Knight and Johanna Franklin a short while before the program, which naturally continues during my fellowship. The project concerns understanding 0-1 laws in random structures in an algebraic variety (in the sense of Birkhoff in universal algebra). I am also collaborating with Julia Knight and Russell Miller on studying the complexity of the classification of torsion-free abelian groups. This grew out from Russell's mini-course at MSRI.
I have also continued working on some other projects that are tangentially related to the program. One is a project with Uri Andrews and Omer Mermelstein on theory spectra of strongly minimal abelian structures, another is with Mark Pengitore and Seongjun Choi on representative systems in torus bundle groups, and lastly a project with Wil Cocke on distribution in word maps. I have also had a weekly meeting with my mentor Ted Slaman and have talked about quite a few things including research ideas and career development, although we did start a collaboration on anything in particular. I have also helped with the organization of the Junior Seminar.

Did you find your experience at MSRI beneficial? Why or why not?
My experience at MSRI is really beneficial. It is mathematically stimulating, I have talked with many people and exchanged many new ideas. I also get to meet many experts in my field that I have not known before. The career development workshop series was also very helpful in getting a better picture of the math career.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I secured the position at CSUN back in April, before the start of the program, and deferred it because of the MSRI program. However, I am sure if I decide to be on the job market again in the future, my experience at MSRI will be greatly helpful as it allows me to start and continue on many research projects and also allows me to connect to other people in my area.

Please comment on your experience with the online format of the program.
While I did meet some other people, I certainly feel meeting people is harder and the random discussion and exchange of ideas are not really possible for me. Some benefits include making it much easier to have "outside speakers", and the ability to pause when watching recordings of seminars or mini-courses.

Kadets, Borys

Name: Borys Kadets
Year of Ph.D.: 2020
Institution of Ph.D.: Massachusetts Institute of Technology
Dissertation title: Arboreal representations, sectional monodromy groups, and abelian varieties over finite fields
Ph.D. advisor: Bjorn Poonen
MSRI Mentor: Karl Rubin

Institution prior to MSRI: Massachusetts Institute of Technology
Position at that institution: Graduate student
Mentor (if applicable): Bjorn Poonen

Post-MSRI institution: University of Georgia
Position: Limited Term Assistant Professor
Anticipated length (or specify if tenure-track): 2-3 years
Mentor (if applicable): Daniel Litt

Postdoctoral fellow's comments:
One of the goals of the semester was to bring together people from different backgrounds who are interested in definability and decidability questions. Early in the semester I started collaboration with Philip

Dittman, who is also a postdoc at MSRI. We managed to construct a counter example to an old conjecture of Odoni in arithmetic dynamics. While the question itself is number-theoretic, it has clear relations to model theory, and MSRI was a perfect place for a number theorist and a model theorist to collaborate.

I have met regularly with Karl Rubin, and he helped me a lot with staying motivated and by giving career advice. He convinced me to apply for an NSF grant, and helped to prepare materials. Such applications are important even though the chances of getting a grant as an early-career mathematician are slim: by the end of the application period, I had a somewhat clear research plan for the next few years.
I worked on two more projects, one with Isabel Vogt and one with Daniel Litt, which were both successful, and are continuing today.
Besides doing research, I went to a large number of talks, and gave two talks and a short presentation at MSRI seminars myself.

Did you find your experience at MSRI beneficial? Why or why not?
My MSRI experience was excellent. Even though many things were naturally missing due to the online format, just being able to talk to others at MSRI and focus on my research for a semester was wonderful. It is rare opportunity for an early career researcher. Regular meetings with my postdoc mentor were also very motivating.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
Being at MSRI gave an opportunity to focus on my research, find new collaborators, and talk to senior people in the field. All of which, I think, will help me finding a future position. The career development events were also very useful.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
One benefit of having meetings online are the talk recordings. The main drawback was the lack of in person social interaction. The social mixer events that started happening regularly later in the semester were nice, so in hindsight it would have been good to start them early on.

Photo Not Available

Ye, Jinhe

Name: Jinhe "Vincent" Ye
Year of Ph.D.: 2020
Institution of Ph.D.: University of Notre Dame
Dissertation title: Analytification and its model theory
Ph.D. advisor: Sergei Starchenko
MSRI Mentor: Francois Loeser

Institution prior to MSRI: University of Notre Dame
Position at that institution: Postdoc

Post-MSRI institution (or company): Sorbonne University
Position: Postdoc
Anticipated length (or specify if tenure-track): 3 years
Mentor (if applicable): Antoine Ducros and Francois Loeser

Postdoctoral fellow's comments:
The program I am in brings people of various background in mathematics to talk together. I have met several interesting people and learned quite a lot concerning generalizations of Hilbert's 10th problem. I have not really started any new project since I am pretty occupied with several unfinished projects from my Ph.D.

Did you find your experience at MSRI beneficial? Why or why not?
Yes, I have learned a lot of the things that I wanted to for a while. Of course, the program would be more beneficial if it is held in person. I personally find it difficult to start a collaboration online.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I am not sure. My position after MSRI has been offered to me before the start of the postdoc at MSRI. But I think in the long run, it will help me finding a position in the sense that I have gained contact with several people in the field, and learned the state of art in several topics that I was not so familiar with.

Please comment on your experience with the online format of the program.
I think a benefit possibly from the online format is that the program attracted quite a number of people that are not associated to the program, both as audiences and speakers. But I do feel that random conversations in the hallways with my colleagues is where most of my research collaboration started, which is a missing component in the online format. That being said, I am not so sure about how the experience in this regard can be improved.

Random and Arithmetic Structures in Topology – Virtual Semester

Bobb, Martin

Name: Martin Bobb
Year of Ph.D.: 2020
Institution of Ph.D.: University of Texas, Austin
Dissertation title: Cusps and Codimension-1 Flats in Convex Projective Geometry
Ph.D. advisor: Jeff Danciger
MSRI Mentor: Richard Canary

Institution prior to MSRI: University of Texas
Position at that institution: Graduate Student
Mentor (if applicable): Jeffrey Danciger

Post-MSRI institution: University of Michigan
Position: Postdoctoral Researcher
Anticipated length (or specify if tenure-track): 3 years
Mentor (if applicable): Richard Canary

Postdoctoral fellow's comments:
The MSRI provided an opportunity to network and learn from my peers and more experienced colleagues, despite the difficulties produced by the global pandemic. I have begun working on two new projects during my time at the MSRI, and learned a great deal from the many seminars held during the fall semester. I appreciate the amount of work the administration at the MSRI put in to overcome the many challenges this semester.

Did you find your experience at MSRI beneficial? Why or why not?
The RAS program at MSRI provided a structured environment to meet and learn from my fellow researchers. It was beneficial to communicate with my contemporaries and learn the scope of their interests. These human connections are absolutely essential in math research, and are not possible without programs like those at MSRI.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
Opportunities provided by institutions like MSRI are necessary for math research. The postdoc period is when researchers are establishing the basis of their career, and the direction of research. This is a crucial moment for researchers such as myself, and programs like the MSRI's semester-long programs provide the springboard to launch new projects, and make new connections.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online

meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
It is undeniable that an in-person semester is preferable to an online program. However, it is also true that we have a social responsibility during a pandemic to our mathematical community, and the world as a whole. As mathematicians we have the privilege to work from home, and I was very pleased that the MSRI adapted to the difficult challenge. I believe one aspect which could really improve the online experience is a way to have drop-in meetings. I would like a virtual office that I can virtually sit in while at my real office in my real house. I would like for other MSRI members to be able to knock on my virtual door at any time. I'm not sure exactly what this looks like, but I think this was a real key missing from this semester; the unscheduled meetings.
Once more, I would like to acknowledge the amount of work that this semester undoubtedly was for the organizers and administrators, and express my appreciation for their efforts.

Photo Not Available

Carvajales, Leon

Name: Leon Carvajales
Year of Ph.D.: 2020
Institution of Ph.D.: Universidad de la República (Uruguay) and Sorbonne Université (France)
Dissertation title: Quantitative aspects of Anosov subgroups acting on symmetric spaces
Ph.D. advisor: Rafael Potrie (Universidad de la República) and Andrés Sambarino (Sorbonne Université).
MSRI Mentor: Fanny Kassel

Institution prior to MSRI: Universidad de la República and Sorbonne Université
Position at that institution: Teaching Assistant and Ph.D. Student

Post-MSRI institution: Heidelberg University (Germany)
Position: Postdoctoral position
Anticipated length (or specify if tenure-track): 1 and 1/2 years
Mentor (if applicable): Anna Wienhard and Beatrice Pozzetti

Postdoctoral fellow's comments:
During my fellowship I worked on 3 different research projects, and I participated in the different seminars and minicourses that were held throughout the semester, as well as in other informal activities. I also collaborated with the organization of the postdoc seminar.

The three projects I worked on are:

1) During the whole semester I had weekly meetings with my mentor Fanny Kassel (Institut des Hautes Études Scientifiques). At the beginning of the semester we decided to focus on the reading of a very recent paper of our interest. Beatrice Pozzetti (Heidelberg University) was also interested in these topics, so in fact the three of us worked together in the reading of the paper having weekly meetings and extremely interesting discussions. These discussions lead to a research project that we just started to work on in collaboration. We hope to continue working on this project over the next months.

2) I started a collaboration with Nguyen-Thi Dang (Heidelberg University) on problems related to ergodic theory in higher rank semisimple Lie groups. This looks like a long-term project, but we have already a concrete question to answer, as well as a possible strategy to attack the problem.

3) I continued a collaboration with Florian Stecker (University of Texas at Austin). This collaboration started during my PhD, and particularly during this semester we arrived at a conjectural picture of what we want to understand, and we also found evidence for that conjecture in concrete examples that allow us to expect that a general proof may be found soon. If we arrive to find it, this should end up in the publication of a preprint.

Finally, I would like to express here that I invited Feng Zhu to give a talk in the Postdoc Seminar, and that the discussions after that talk may end up in a future collaborative research project.

Did you find your experience at MSRI beneficial? Why or why not?
The experience has been extremely beneficial to me. Particularly, the work with my mentor Fanny Kassel, and with Beatrice Pozzetti has been the highlight of the semester. They both have been constantly available to discuss all kinds of questions and problems and this has had a great impact in my growth as a researcher.

I also found very beneficial several minicourses, research talks and other activities I attended during the semester. The excellent quality and the diversity of subjects treated during the semester is remarkable and for sure I had the possibility of learning a lot of new math.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
The fellowship allowed me to work closely with excellent mathematicians and this has enormously contributed to my growth as a researcher. From that viewpoint, the fellowship should help me to get a position in the future. The international prestige of the Institute should also contribute in that direction.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
I feel that the Institute made an enormous effort to make the experience as beneficial as possible, and I am extremely grateful for that. The staff is constantly present and ready to help with all kinds of problems that may arise. However, there are some issues regarding virtual format which I haven't been able to solve throughout the semester. I find it particularly difficult to meet people I have not met before, and to engage in informal discussions with other participants. There are moments where I also find it very difficult to focus during virtual talks and this has been a problem to me in some parts of the semester.

Cremaschi, Tommaso

Name: Tommaso Cremaschi
Year of Ph.D.: 2019
Institution of Ph.D.: Boston College
Dissertation title: Hyperbolization of infinite-type 3-manifolds
Ph.D. advisor: Ian Biringer and Martin Bridgeman
MSRI Mentor: Nathan Dunfield

Institution prior to MSRI: University of Southern California
Position at that institution: Assistant Professor (NTT)
Mentor (if applicable): Francis Bonahon

Post-MSRI institution: University of Southern California
Position: Assistant Professor (NTT)
Anticipated length (or specify if tenure-track): 18 months
Mentor (if applicable):

Postdoctoral fellow's comments:
I helped organize the semester and participated in the seminar. I initiated no new project/collaboration connected to the semester activities.

Did you find your experience at MSRI beneficial? Why or why not?
I think that the virtual nature of the semester has made it so the whole program was not beneficial for my research nor helped me develop as a mathematician.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I am not sure, I think it looks nice on a CV but due to the pandemic and the virtual nature of the semester I could not broaden my research horizon nor network with people.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
Due to the format the whole "collegiality'' aspect of the MSRI semester was missing and the opportunities of meeting new people and learn new topics was also greatly diminished. I found no real benefits of the online meeting platform nor do I have suggestions for solving the most apparent issues.

The only upshot I can think of is that for the Career Development Panel we had the opportunity of inviting people outside of the program which would have been harder, if not impossible, had it been an in-person semester.

Farre, James

Name: James Farre
Year of Ph.D.: 2019
Institution of Ph.D.: University of Utah
Dissertation title: Bounded cohomology of finitely generated Kleinian groups
Ph.D. advisor: Kenneth Bromberg
MSRI Mentor: None.

Institution prior to MSRI: Yale University
Position at that institution: NSF postdoctoral scholar
Mentor (if applicable): Yair Minsky

Post-MSRI institution (or company): Yale University
Position: Gibbs assistant professor
Anticipated length (or specify if tenure-track): 2.5 years
Mentor (if applicable):Yair Minsky

Postdoctoral fellow's comments:
During my fellowship, I worked on research projects that I had already been working on with collaborators (pre- MSRI) and started some new ones with them. I participated in reading groups organized with MSRI postdocs, members, and the general community. I organized some events, including the PA seminar. I attended many research talks or watched recorded versions.

Did you find your experience at MSRI beneficial? Why or why not?
Unfortunately, I did not find it beneficial. There was plenty of research activity around the world that I was happy to participate in without the

events at MSRI this semester. I think the community would have been better served by cancelling the semester completely, instead of having a virtual semester. Logistically, the semester was also extremely challenging (because I moved to and away from the Berkeley area).

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I think the line may look good on my CV, but I did not make new connections this semester through the MSRI program.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
I've already commented on this, but let me be very clear that I think that the MSRI did a disservice to the mathematical community by not cancelling the semester outright or postponing it indefinitely. The seminars were distracting, and there was very little opportunity for meaningful interaction. I think that the MSRI staff were very helpful in trying to make the virtual format work, and I applaud and appreciate their efforts. However, it is something that I would not participate in again; at least not any time soon.

Miller, Nicholas

Name: Nicholas Miller
Year of Ph.D.: 2017
Institution of Ph.D.: Purdue University
Dissertation title: The Geodesic Geometry of Arithmetic Orbifolds
Ph.D. advisor: David Ben McReynolds
MSRI Mentor: David Fisher

Institution prior to MSRI: University of California, Berkeley
Position at that institution: Morrey Visiting Assistant Professor
Mentor (if applicable): Ian Agol

Post-MSRI institution (or company): University of California, Berkeley
Position: Morrey Visiting Assistant Professor
Anticipated length (or specify if tenure-track): 3 years total (1.5 more)
Mentor (if applicable): Ian Agol

Postdoctoral fellow's comments:
I have spent the semester working on a few projects as well as being involved in several organizing aspects for the MSRI program. I was a lead organizer of the RAS Research seminar, the main seminar in which

senior members of the program presented their research, and I was also a co-organizer of the SOQUAGAT seminar, a seminar meant to foster collaboration between junior members of the program by exposing them to some open questions in arithmetic, geometry, and topology. I have also been a frequent attendee of several other RAS seminars over the course of the semester.

As for research projects, being at MSRI has afforded me the luxury of finishing some old projects as well as the time to explore the beginnings of new projects. Briefly, I am in the process of finishing a paper regarding Azumaya algebras and once punctured torus bundles, which studies Azumaya algebras over the character variety of certain hyperbolic 3-manifolds and is a follow-up to the work of Chinburg-Reid-Stover on similar topics. This paper was written entirely this semester. I have also begun working on projects with Fisher, Lafont, and Stover trying to understand higher dimensional hyperbolic manifolds as well as with Lafont and McReynolds trying to recursively enumerate certain classes of higher rank arithmetic lattices. In addition to this, I have been talking with Soumya Sankar, another postdoc of the RAS program, about some problems regarding congruence covers of hyperbolic 3-manifolds, a conversation directly related to a talk in the SOQUAGAT seminar. On my own, I have also immersed myself in learning about deformations of representations, such as bending constructions and their cohomological interpretation. For those topics, I have some potential projects for myself that I would like to work on in the future and very much value having been afforded the time to learn about this topic.

Did you find your experience at MSRI beneficial? Why or why not?
I think the experience at MSRI was as beneficial as it could be during the pandemic. Though the activities and collaboration were inherently not the same as they could have been during a time when everyone could be present in the building, I think the flexibility it afforded me as well as the activities that did arise were incredible beneficial to me. Moreover, the ability to have a physical office at MSRI during the pandemic was extremely helpful for me to be able to focus and get work done.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I definitely think that my MSRI position will help me find a permanent position in the future. The MSRI position has provided me with an opportunity to have a full semester of research, when I normally would be teaching two upper division undergraduate courses. This is a huge relief, especially during the pandemic, as it has allowed me to focus on research which may be vital to me getting a job when I apply next fall. Additionally, I have been fortunate enough to be named the McDuff

postdoctoral scholar for this program and I believe that this named position will be evaluated favorably for me when I am being reviewed for jobs.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
In general, I thought the online format of MSRI was decent and the actual seminars ran as they would have if the semester were in person. I think there were relatively few technical hiccups, entirely user error when they did exist, so in that sense the amount of talks was relatively similar. I personally do not necessarily benefit from having online meetings, I find it hard to focus at a screen for several hours a day so from that perspective I think there weren't necessarily benefits. I also think it's relatively hard to have spontaneous collaboration in an online format. In that regard, it might be nice if collaboration was a bit more forced in the future to account for this. For example the organizers could construct small reading groups (say, 3-7 people) that meet every week, allowing them to choose something to read, and force small group interactions that way. Perhaps more spontaneous collaboration or at least smaller group discussions would then grow out of those groups.

Sankar, Soumya

Name: Soumya Sankar
Year of Ph.D.: 2020
Institution of Ph.D.: University of Wisconsin-Madison
Dissertation title: Arithmetic statistics of algebraic curves
Ph.D. advisor: Jordan Ellenberg
MSRI Mentor: Alan Reid

Institution prior to MSRI: University of Wisconsin-Madison
Position at that institution: Graduate Student
Mentor (if applicable): Jordan Ellenberg

Post-MSRI institution (or company): The Ohio State University
Position: Ross Assistant Professor (postdoc)
Anticipated length (or specify if tenure-track): 3 years
Mentor (if applicable): Jennifer Park

Postdoctoral Fellow's Comments:
My fellowship at MSRI had two components - one was the progression of my existing research projects and the second, the start of various MSRI-related projects. With respect to the former, I have been working on a project on the rationality of conic bundles that started at an ICERM

workshop over the summer, with S. Frei, L. Ji, B. Viray and I. Vogt. I also finished a paper on derived categories on certain stacks, joint with L. Taylor.

I also learned a lot of new topics at MSRI, especially since most participants in the program had research interests quite different from mine. My postdoc mentor, Alan Reid, was excellent at translating between number theory (my research area) and topology/geometry. My interactions with him also helped me understand some of the big questions in geometry/topology that were connected to or could be answered with number theoretic methods, and vice versa. I also had many mathematical conversations with Michelle Chu, a research member in the program, from whom I learned a great deal.

I started two collaborations during my time in MSRI. The first is with Yvon Verberne, on certain representations of the Braid group and generators of certain Torelli subgroups. The second is with Nicholas Miller, on Iwasawa theory for hyperbolic 3-manifolds. I also organized a few seminars in the program. I was a co-organizer of the RAS Postdoctoral Seminar, as well as SOQUAGAT, the Series on Open Questions in Arithmetic, Geometry And Topology. I also co-organized an informal seminar, 'This week I'm thinking about..' where members could talk about math in small, friendly groups.

Did you find your experience at MSRI beneficial? Why or why not?
My experience at MSRI was extremely beneficial and will probably have a positive effect on my career in the long run as well. Since my research area was different from that of a lot of people in the program, I was able to learn a great deal, as well as gain new perspective on some problems I was already familiar with. I also started multiple collaborations and came to learn about many new and open questions that I might work on in the future. Having graduated recently, it was also a good way to ease into the independence of a postdoc - since now I will go into my next job armed with a lot more questions and ideas than before.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
Having an MSRI postdoctoral position will probably help with future job applications. Apart from the fact that such a position is considered prestigious, I was able to meet many people outside of my usual area of research, i.e. arithmetic and algebraic geometry. I made a lot of new connections. I was also able to learn how to speak to geometers and topologists and how to translate between number theory and geometry/topology - a skill that I am certain will help when I apply for tenure-track positions.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
The online format is a bit strange, especially for MSRI programs, which are meant to encourage interactions and collaborations. It was much harder to get people to interact with each other. The fact that people were in different time zones and had their own responsibilities, made it even harder. The greatest factor that made a difference, in my opinion, was not having everyone in the same space at the same time.

The online experience could probably be improved by having a more specific plan and informing members about the plan ahead of time. A specific plan could include, for instance, a set of working groups with areas of research set ahead of time (with some flexibility of course); or a pre-decided space for informal interactions; or a separate space for advertising and finding interest in reading groups. Of course, I understand that this semester was unprecedented and people had to make things up as it went on. We all did the best we could.

Vargas Pallete, Franco

Name: **Franco Eloy Vargas Pallete**
Year of Ph.D.: 2018
Institution of Ph.D.: UC Berkeley
Dissertation title: On Renormalized Volume
Ph.D. advisor: Ian Agol
MSRI Mentor: Martin Bridgeman

Institution prior to MSRI: Yale University
Position at that institution: Gibbs Assistant Professor
Mentor (if applicable): Jeffrey Brock

Post-MSRI institution (or company): Yale University
Position: Gibbs Assistant Professor/NSF Postdoctoral Fellow
Anticipated length (or specify if tenure-track): June 2023
Mentor (if applicable): Jeffrey Brock

Postdoctoral fellow's comments:
Started close collaboration with Martin Bridgeman, who was assigned as a mentor. We have one paper (detailed at the end of this section) which we have not posted yet since we are currently exploring if we can prove it with more general assumptions. We have some other questions in mind to keep exploring after the program. Given the program, we have tried to use some dynamical ideas to prove some bounds on

uniformization maps. This has suggested some ideas/future projects to explore in this direction

I also participated in two reading/working groups. One was with Tommasso Cremaschi (postdoc of the same MSRI program, USC, and a co-author on a previous paper) Didac Martinez-Granado (UC Davis, also co-author on a previous paper) and Yannick Krifka (PhD student at ETH Zürich under the supervision of Prof. Alessandra Iozzi) on Benjamini-Schramm theory. This has led to a project on random volume and geodesic length, as well as some ideas on how to build on Yannick's thesis, although still on an early stage.

The other reading group was with Michelle Chu (research member, UIUC), James Farre (research member, Yale university, and co-author on an ongoing paper) and Sami Douba (program associate). We read work of Kahn and Wright, and are now planning to continue with our meetings starting January.

During the program also interacted with some program associates, mainly Homin Lee (Indiana Univerity) and Xiaolong Han (UIUC). With Homin Lee had some conversations where he explained some geometric questions motivated by dynamics (which is one of his fields). I benefited from gaining some perspective on the topic of the program that were not from my area. With Xiaolong Han discussed some topics related to his research (harmonic maps), where I helped him out to expand some content on his thesis work.

Below are the papers worked on relation to the MSRI program

1. The Weil-Petersson flow for Bers slices is a contraction (j. with Martin Bridgeman) Having conversations as well with Kenneth Bromberg (Utah).
2. Minimal area surfaces and Pseudo-Anosov maps (j. with James Farre). Finalizing write-up, to be posted soon. Explored some question about existence and uniqueness of minimal surfaces in hyperbolic mapping torus.
3. Isoperimetric interpretation for the Renormalized volume of convex co-compact hyperbolic 3-manifolds (j. with Celso Viana). Currently finalizing write-up condensing our joint work during the last year and a half. Presented our research in the Members Seminar at MSRI in September. This work and discussion with Martin Bridgeman and Jeff Brock motivated further question for Renormalized Volume and minimal surface theory for hyperbolic 3-manifolds.
4. The extremal length systole of the Bolza surface (j. with Maxime Fortier Bourque, Didac Martinez Granado). Currently exploring if there is a general principle that applies to extremal length of

arithmetic surfaces. Consulted with Soumya Sankar (also a MSRI postdoc) about it, specifically about the algebraic/number theoretic properties of these lengths.

5. The length of the shortest closed geodesic on positively curved 2-spheres (j. with Ian Adelstein). Strengthened an inequality by carefully bounding a first eigenvalue problem. Discussed this approach with fellow members during a MSRI informal seminar.

More informal interaction includes participation at the "This week I'm thinking of.." informal seminar organized by Soumya Sankar and Martin Bridgeman. This was helpful to gain intuition from other members expertise, especially when trying to understand what questions other fields are trying to solve.

I should also mention interaction with the math department at UC Berkeley, even if just virtually. This included attending the 3-manifold seminar organized by my PhD advisor Ian Agol, a reading group organized by his current students and the geometry seminar organized by Richard Bamler. I think it was great to reconnect with my PhD institution. After developing some research, it was beneficial to receive feedback from Ian Agol, where he posed some questions and ideas that I am excited to follow.

Did you find your experience at MSRI beneficial? Why or why not?
I found it beneficial, mainly by the mentorship provided by Martin Bridgeman. The research contribution alone made it remarkable, but also extended to advice on career advancement. I believe that the perspective that Martin provided will have me better prepared when I apply for tenure-track positions. He also gave counsel for every-day situations on the career, and together with Jeff Brock were my contacts to go. Having not to teach (especially online) should not go without a mention. Finally, expanding my network of collaborator and contacts is crucial for a career in mathematics, so I am glad I did progress on that.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
As mentioned above, potential projects, contacts and invaluable mentorship are elements that I believe will have me in a better standing when applying to permanent position.

Please comment on your experience with the online format of the program.
On the good side, it was a particularly good decision from MSRI to have us buy tablets, since they facilitated connectivity a lot.

Main difference with an in-person program is that conducting collaborative research online is much harder. It also did not help that many senior faculty members retained their standard duties during the semester, so interaction with them (with some few exceptions) got diluted.

One big problem in my opinion has been scheduling. I understand that it was planned to accommodate researchers at different time-zones, but this led to a situation where each day had only 3 effective hours, where all seminars were mostly programmed then. This degree of condensing led to burnout, plus it blocked a lot of the time when members could organize reading groups. I think in retrospective it was a bad choice to distribute the program on this way. I seriously must wonder if it would have been better to organize events that either fit better time for US or Europe time. Maybe the version of the program will have a higher variation depending on the time-zone, but I find that potential better than an overall standard condensed experience that does not leave much room to process each event.

Verberne, Yvon

Name: Yvon Verberne
Year of Ph.D.: 2020
Institution of Ph.D.: University of Toronto
Dissertation title: Pseudo-Anosov homeomorphisms constructed using positive Dehn twists
Ph.D. advisor: Kasra Rafi
MSRI Mentor: Mahan Mj

Institution prior to MSRI: University of Toronto
Position at that institution: Graduate student
Mentor (if applicable): Kasra Rafi

Post-MSRI institution (or company): Georgia Institute of Technology
Position: NSERC Postdoctoral Scholar
Anticipated length (or specify if tenure-track): 3 years
Mentor (if applicable): Dan Margalit

Postdoctoral fellow's comments:
While I've been a postdoc for the Random and Arithmetic Structures in Topology program at MSRI, I have been able to make a considerable amount of progress on the following four research projects.

"Asymptotic dimension of big mapping class groups" with Curtis Grant and Kasra Rafi. This project is currently in the final stages of being written. In this project, we show that the asymptotic dimension for big mapping class groups is infinite for surfaces which satisfy a particular

topological criterion. This is in contrast to the mapping class group of surfaces of finite type where the asymptotic dimension is always finite.

"Finite image homomorphisms of the braid group and its generalizations" with Nancy Scherich. Nancy and I were able to complete this project and post it to the arXiv during my time at MSRI. In this project, we find bounds for the finite quotients of the braid group, welded braid group, and virtual braid group by using the theory of totally symmetric sets.

Assaf Bar Natan and I have been working on finding a combinatorial object for big mapping class groups. For mapping class groups of finite type surfaces, the complex of curves is a helpful combinatorial tool we use to help solve problems. There have been some attempts to find such an object for mapping class groups of surfaces of infinite type, but so far these objects cannot cover all infinite type surfaces. We believe that we are able to define a complex which could be applied to more infinite type surfaces than the previous attempts.

Dan Margalit and I have been working on a project where we are proving that pseudo-Anosov elements are generic in the pure braid group. We began this project just before the start of the program, and we believe that we have an approach which has a high chance of being successful. In addition, Soumya Sankar and I have been meeting weekly to discuss the overlap between mapping class groups and arithmetic geometry. We have found a few directions we are interested in pursuing. We've recently decided to start a project where we attempt to find finite generating sets for Torelli subgroups of mapping class groups of surfaces of genus g with n>1 punctures.

In addition to research, I have also been active in helping to organize some of the events for the Random and Arithmetic Structures in Topology program. I have helped to organize the Postdoc and "This week I'm thinking about..." seminars. In addition, I have helped to organize a career development series for both the members of the Random and Arithmetic Structures in Topology program, and the Decidability, Definability, and Computability in Number Theory program.

Did you find your experience at MSRI beneficial? Why or why not?
I do think that the semester at MSRI has been beneficial for me. I have been able to spend a lot of time focusing on my own research program, as well as exposing me to different directions I could potentially take my research. Speaking to others and learning about the methods they are currently using in their research has also been beneficial since it has given me different ideas for how to solve pieces of my own research.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I do think that the fellowship with help me with finding a future position. This program has helped me make connections with many people who are in fields which are tangential to my own research. It is important to network and make connections in order to gain employment in the future. Additionally, I have had a lot of time to both complete and get research projects off the ground during this semester. One of the most important aspects to gaining employment in academia is completing research projects, and this program really gave me the time to focus on my research. I also suspect that in the future, there is a high possibility that projects may start up due to the math I've been exposed to and connections I've made this semester.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
Considering this is the first fully virtual semester run by MSRI, I think this was fairly successful. I think we had a lot of great programming, and I did feel supported throughout. One of the benefits I found from the semester being online is having so much access to the materials used in the program. Having the slides be made available before a talk made it much easier to follow along, since if you missed a detail, you could just look at the previous slides again.

What was missing most from an in-person semester were the casual math conversations you would have with others throughout the day. It has been much harder to start up collaborations as you aren't having the same natural interactions as you would in person. This has tried to be rectified by having virtual teas and through the "This week I'm thinking about…" seminar, but it doesn't seem to have the same results.

Something which would have benefitted my experience would have been to receive some resources before the semester started so that I could be on the same page as the other mathematicians at the semester. For the RAS semester, the organizational aspect changed drastically, and so did the content that the semester was based on. It made sense considering the average mathematician in the program, but I wish I would have received some recommended reading or other resources before the semester began so that I could have been on the same page as the other participants.

Mathematical Problems in Fluid Dynamics

Agrawal, Siddhant

Name: Siddhant Agrawal
Year of Ph.D.: 2018
Institution of Ph.D.: University of Michigan
Dissertation title: On the Motion of Angled Crested Type Water Waves
Ph.D. advisor: Sijue Wu
MSRI Mentor: Thomas Alazard

Institution prior to MSRI: University of Massachusetts Amherst
Position at that institution: Visiting Assistant Professor
Mentor (if applicable): Andrea Nahmod

Post-MSRI institution: ICMAT (Spain)
Position: Postdoc
Anticipated length (or specify if tenure-track): 3 years
Mentor (if applicable): Alberto Enciso

Postdoctoral fellow's comments:
At my time at MSRI, I attended essentially all talks and participated in most of the tea times and postdoc social hours. I gave a talk in the water waves seminar and I along with another postdoc (Thibault de Poyferre) organized the career development seminar. Most importantly I am collaborating with my postdoc mentor Thomas Alazard on a project. Although the project is not finished, I think we are making progress and I am hopeful that we will be able to write a paper on it.

Did you find your experience at MSRI beneficial? Why or why not?
I found my experience at MSRI quite helpful. I think the most important thing for me personally was the fact that I was able to talk to some of the most senior people in the field even in an informal setting. Probably the most beneficial connection I made was with my mentor Thomas Alazard. He helped me a lot from preparing my talk at MSRI to collaborating in the project that we are working on.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I am not sure how impactful this fellowship will be in finding me a tenure track position later on. I think it looks good on the CV and I have indeed made some connections with senior faculty in the program. However I think I did not make as many connections as I would have liked which could affect my future employment opportunities. This was mostly due to the online nature of the program.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online

meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
One benefit of the online nature of the program was that the lectures were recorded and so I could watch them later on, or if I missed some due to other conflicts. I really missed the informal math conversations we generally have after a talk when things are in person. Generally after an in person talk, people who are interested and have questions will approach the speaker near the blackboard/screen to ask questions and these interactions are very helpful (and a great way to introduce yourself to the speaker). This then leads to more conversation later on which can build up. In this online setting, we either have to ask formal questions during the talk (which is scary in general) or after the talk we meet in Gathertown. However in Gathertown, most of the time there are only one or two groups which are formed and all of them are only social conversations without much mathematical discussion related to the talk. Gathertown is definitely better than nothing but is clearly a poor substitute for in person interactions. I am not sure if there is any way to improve the situation.

Ai, Albert

Name: Albert Ai
Year of Ph.D.: 2019
Institution of Ph.D.: University of California, Berkeley
Dissertation title: Low Regularity Solutions for Gravity Water Waves
Ph.D. advisor: Daniel Tataru
MSRI Mentor: Jean-Marc Delort

Institution prior to MSRI: University of Wisconsin-Madison
Position at that institution: Postdoctoral
Mentor: Mihaela Ifrim

Post-MSRI institution: University of Wisconsin-Madison
Position: Postdoctoral
Anticipated length (or specify if tenure-track): 1 year
Mentor: Mihaela Ifrim

Postdoctoral fellow's comments:
I participated in the daily morning seminar talks, speaking at one of the seminars (Water Waves and other Interface Problems seminar), as well as at the workshop (Recent Developments in Fluid Dynamics) in April.

I worked with a group of graduate students and senior advisors (Mihaela Ifrim and Daniel Tataru) to study several problems related to water waves and model problems. With Ovidiu-Neculai Avadanei, we wrote a paper studying the well-posedness of the dispersive Hunter-Saxton

equation, a model equation which exhibits quasilinear behavior in a novel way.

My MSRI mentor introduced me to several of his research areas, including the long-time behavior of periodic capillary-gravity water waves, and the stability of kink solutions for the phi^4 model. We have also started looking at low regularity well-posedness results for the Klein-Gordon equation.

I have been working with Grace Liu on a project involving well-posedness for dispersive generalizations of the Benjamin-Ono equation.

Did you find your experience at MSRI beneficial? Why or why not?
Yes. I think I had a productive semester continuing and starting several research projects, sharing my research, and meeting other members of the fluids research community.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I think the fellowship may help, by introducing me to professors and researchers at other universities.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
The online format of the problem allowed us to form a weekly student working group across universities, that otherwise likely would not have been possible, or would have been more costly.

Meeting other researchers was naturally more challenging with the online format. I think that improving the software could have helped. I found that I and some other users often had connectivity difficulties with Gathertown for the virtual teas.

de Poyferré, Thibault

Name: Thibault de Poyferré
Year of Ph.D.: 2017
Institution of Ph.D.: École Normale Supérieure
Dissertation title: On the Cauchy Problem for the Water Waves Equations
Ph.D. advisor: Thomas Alazard
MSRI Mentor: Nicolas Burq

Pre-MSRI Institution: UC Berkeley
Position at that institution: Miller Fellow
Mentor (if applicable): Daniel Tataru
Post-MSRI institution: Not known yet

Postdoctoral fellow's comments:
During my MSRI fellowship, I started a project with my mentor Nicolas Burq on studying double exponential growth solutions for the 2D Euler equations. I also co-organized the career development seminar for the program. Finally I finished and submitted an article with Colin Guillarmou on the use of paradifferential calculus for Anosov dynamical systems.

Did you find your experience at MSRI beneficial? Why or why not?
I enjoyed the MSRI program; I feel it gave me more scientific interactions that I would otherwise had during this pandemic.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I am planning on leaving academia; I think the fellowship helped me develop some contacts.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
The online format was well-organized I think; the main benefit of the online format for me was that it seemed easier to book speaker for the seminar I organized that if they had had to travel.

He, Jiao

Name: Jiao He
Year of Ph.D.: 2019
Institution of Ph.D.: Institute Camille Jordan, University Bernard Claude Lyon 1
Dissertation title: Motion of a small rigid body in an incompressible viscous fluid, convection problems and dynamics of falling films
Ph.D. advisor: Lorenzo Brandolese; Dragos Ifitimie
MSRI Mentor: David Lannes

Institution prior to MSRI: University of Evry; Paris-Saclay
Position at that institution: Postdoc
Mentor: Diego Chamorro

Post-MSRI institution: University of Evry & amp; Paris-Saclay
Position: Postdoc
Anticipated length (or specify if tenure-track): 10 months
Mentor: Diego Chamorro

Postdoctoral fellow's comments:
During my fellowship at MSRI, I benefit a lot, not only for my research career but also my personal development. I attended the course "Free surface flows in fluid dynamics" given by Thomas Alazard during all this Spring program, in which I learned/reviewed a lot mathematical tools and I also studied several new theories developed in this domain. I met with my Postdoc mentor David Lannes regularly, and I worked with two collaborators on the subject that David proposed to us. We worked on the interaction vagues-structure, which is a continuation of one of my last research work, but I still learned several things of value during the collaboration. For example, to understand the necessity of "uniform Kreiss-Lopatinskii condition" for the our hyperbolic system, how to treat the PDE-ODE coupled system and how to deal with the trace, etc. I am also very happy that we already submitted that paper to a journal last month. Not only the existing work with my collaborators, I also established some collaborations with the other Post-doc in the program. After the first Post-doc online meeting, Weinan and Wen contacted me and we began to read some papers that we are all interested in. We three met together regularly, discussed math and exchanged ideas. Even we didn't meet each other physically before, we can work together without any barriers. I find this experience is very valuable and I learned so much from the other members in this programs.

Did you find your experience at MSRI beneficial? Why or why not?
I find my experience at MSRI is very beneficial. Reasons:
1. I learned a lot from the course of Thomas Alazard.
2. During my fellowship, I participated almost all the weekly seminars and two high quality conferences, these made the experience so valuable for my future research.
3. I enjoy Sococo, where I can discuss with other members in the Program, for example, Didier Bresch, Thomas Alazard, etc. They gave me lots of suggestions for my research and for finding jobs.
4. During the Post-doc social hour, I could discuss with other post-doc as me in this program. We exchanged ideas for our research as well as our lives, which made me feel warm in this lock-down situation (I was in France and worked at home alone during all this program, thanks all the members. Their warmth clear up my loneliness in this especial situation).

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?

Yes. During this program, I met lots of junior and senior researchers in this research domain, discussing with them is very beneficial. They gave me lots of useful suggestions for finding a job. I think this experience at MSRI is of great value and will be helpful for me to find a future position.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
I find the online meeting at MSRI is already the best online meeting that I've never participated before. I really enjoy the virtual tea time after the seminar. This is a great way to know each other and we get a chance to talk to other members in this program. I find it is very beneficial.

Leslie, Trevor

Name: Trevor Leslie
Year of Ph.D.: 2018
Institution of Ph.D.: University of Illinois at Chicago
Dissertation title: Regularity and Energy Laws in Hydrodynamic Models of Newtonian Fluids and
Collective Behavior
Ph.D. advisor: Roman Shvydkoy
MSRI Mentor: Hajer Bahouri

Institution prior to MSRI: University of Wisconsin, Madison
Position at that institution: Van Vleck Visiting Assistant Professor (postdoctoral)
Mentor (if applicable): Sergey Denisov

Post-MSRI institution: University of Southern California
Position: Assistant Professor (NTT) (postdoctoral)
Anticipated length (or specify if tenure-track): 1-3 years
Mentor (if applicable):

Postdoctoral fellow's comments:
During my fellowship, my primary focus was the work I performed with my mentor, Hajer Bahouri, and her collaborator, Galina Perelman. This project was relatively far from the main thrust of my previous research, and I had to devote a significant amount of time to learning the tools necessary to tackle the problem we were considering. However, we are relatively close to finishing a paper together, and I anticipate we will post it to the ArXiv in late June or July.

The fellowship also provided me the time to continue another project that was already in the works, but still in the early stages at the beginning of the program. My collaborator Changhui Tan (University of South Carolina) and I will likely post a preprint resulting from this project sometime in mid-June.

In addition to the two projects mentioned above, I attended many of the seminars hosted by MSRI (and spoke at one), and I attended some of the classes taught by Thomas Alazard.

Did you find your experience at MSRI beneficial? Why or why not?
Absolutely. By far the most beneficial part of the program for me was the mentorship component. As I mentioned above, the project that I worked on with Hajer Bahouri and Galina Perelman was relatively far from the kind of research I've been doing previously. Without their guidance in a mentorship capacity, I'm highly doubtful I would have ever seriously explored this area, as there is a relatively steep learning curve (up which they patiently guided me) that would have otherwise been a formidable barrier to entry. I remain far from an expert in this area, but I can now see myself completing future projects related to our joint work. Thus, this program opened an entirely new research direction for me, broadening the scope of my research interests and my collaborative network.

As I also mentioned above, the extra time that I was able to spend devoted solely to research was instrumental in speeding up the project I had already started before the program. Overall, my productivity this semester is probably the highest it has ever been.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
Yes. I accepted an offer for a postdoctoral position at USC in January. It's hard to know for certain whether the fact that the MSRI fellowship was on my resume played a role in that offer, but I'm sure it didn't hurt. When I apply for tenure-track jobs in the next job cycle(s), I'm convinced that the broadening of my collaborator network and my research profile, as well as my increased productivity, will positively affect the way my portfolio is viewed. The MSRI fellowship has been instrumental in all of those factors.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?

The online format was tough. I don't think I can say that the online meetings had any advantages over in-person ones (with the important exception, of course, of the fact that online meetings were safe and in-person meetings were not, during most of the time of this program). For example, being able to write on the same whiteboard or chalkboard would have been really helpful in back-and-forth exchanges of ideas. MSRI was kind enough to pay for me to purchase a tablet, which I used several times when talking with one of my collaborators (during these meetings, it was nice to use the JamBoard whiteboard, to which I had access through MSRI), but my other collaborators either did not have a tablet or were not comfortable enough with the technology for us to collaborate seamlessly. I commend MSRI for all the efforts it made to make the online experience as beneficial as possible, and I don't think it could have much differently in order to improve the experience. However, the online format just wasn't the same as in-person collaborations would have been.

Photo Not Available

Miller, Evan

Name: Evan Miller
Year of Ph.D.: 2019
Institution of Ph.D.: University of Toronto
Dissertation title: The Navier-Stokes strain equation with applications to enstrophy growth and global regularity
Ph.D. advisor: Robert McCann
MSRI Mentor: Jean-Yves Chemin

Institution prior to MSRI: McMaster University
Position at that institution: Postdoc
Mentor (if applicable): Eric Sawyer

Post-MSRI institution: University of British Columbia
Position: PIMS postdoc
Anticipated length (or specify if tenure-track): 2 years
Mentor (if applicable): Tai-Peng Tsai and Stephen Gustafson

Postdoctoral fellow's comments:
During this semester I have worked with Jean-Yves Chemin, focused to a large extent on an equation for the horizontal velocity in incompressible fluid dynamics that was derived as an asymptotic approximation of almost two dimensional solutions of the three dimensional Euler or Navier-Stokes equations. We have considered this equation in both the perturbative and non-perturbative regime. For the viscous horizontal velocity equation, there is global regularity in the perturbative regime, but it appears that there is likely finite-time blowup in the non-perturbative regime. This is very interesting, and could serve as a possible model for finite-time blowup for the full 3D Navier-Stokes equation. This research is a work in progress, but I expect that a high

quality paper will come out of this work in the next several months.

During this semester I have also continued to work on the role of the strain in the Navier-Stokes regularity problem. I strengthened the results in my preprint “Finite-time blowup for a Navier-Stokes model equation for the self-amplification of strain”, and posted an updated version of this preprint on arXiv and submitted this paper to Analysis & PDE. I have also been putting together further work on the interaction of strain and vorticity for the evolution of strain that is currently a work-in-progress, but should be posted on the arXiv and submitted in the next couple of months.

During the semester, I helped organize the postdoc talks in the various seminars, ensuring that every postdoc was able to give a talk in one of the seminars. I also refereed several articles.

Did you find your experience at MSRI beneficial? Why or why not?
Yes, my experience at MSRI was very beneficial. Working with Jean-Yves Chemin has been wonderful, and I think we have been able to make some real progress on a very interesting problem. The seminars have also been a great opportunity to learn so much about different aspects of fluid mechanics that aren’t my area of expertise, and to deepen my understanding of my own area, Navier-Stokes analysis. Finally, the institute itself is a wonderful and inspiring place to work. I look forward to returning in the Summer of 2023.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I definitely think that my postdoctoral fellowship will help me find a tenure track position. The chance to talk in one of the seminars with many of the leading experts in the world was a great opportunity to make the fluid dynamics community more aware of my research. My research has benefitted from the program, and the professional development events were also very helpful. And, of course, the MSRI postdoctoral fellowships are quite prestigious, so it will certainly be beneficial to have that on my CV when applying for tenure track positions.

Please comment on your experience with the online format of the program.
The online format meant wider participation in the seminars, which was great, and meant the postdocs were able to speak about our research to an even larger audience than would be possible otherwise. The zoom seminars were run very well, and I felt like this format worked well for the seminars. The tea rooms and postdoc social hours also helped to combat isolation. The biggest loss was the inability to discuss mathematics in detail without having to schedule an appointment. One of

the great things about conferences is the ability to catch someone in the hallways after a talk, and just go over to a chalk board and start talking about a problem. The zoom meetings with my mentor went well, but for the little questions that might lead somewhere or might not, it is much more intimidating to email a speaker (that I may not have met in person) to set up a zoom appointment to talk about the problem, than to just discuss informally during the breaks, so this sort of interaction didn't really happen.

Novack, Matthew

Name: Matthew Novack
Year of Ph.D.: 2019
Institution of Ph.D.: University of Texas-Austin
Dissertation title: A Study of the Three-Dimensional Quasi-Geostrophic System
Ph.D. advisor: Alexis Vasseur
MSRI Mentor: Igor Kukavica

Institution prior to MSRI: New York University
Position at that institution: Courant Instructor / Keller Postdoctoral Fellow
Mentor: Vlad Vicol

Post-MSRI institution: Institute for Advanced Study
Position: Member
Anticipated length (or specify if tenure-track): 1 year
Mentor: None

Postdoctoral fellow's comments:
My activities at MSRI this semester mostly consisted of attending seminars and working on a new direction of research with Igor and Vlad. I regularly attended several of the weekly seminar series, as well as the special conferences that were held during the program. With Igor and Vlad, we decided to work on a type of problem which is new to each of us, so we had to do a bit of background reading in order to choose a problem and understand some of the techniques in the field. But after a bit of effort, we've found some interesting problems and expect to be able to write one or more papers using these ideas.

Did you find your experience at MSRI beneficial? Why or why not?
My experience at MSRI was beneficial in many ways. The opportunity to start a new collaboration with Igor and Vlad was made possible by the MSRI program. In addition, MSRI's generous support provided me with a semester off from teaching, during which I was able to make good

progress on several other long-standing projects.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I think my fellowship will have helped me find a future position. For instance, I had the opportunity to speak about my work at one of the program seminars, which is always a good way to connect with new people. I also gave a short talk to a general mathematical audience about my work at MSRI's Academic Sponsors Day, which was my first chance to give a talk to such a broad audience and should help me with preparing job talks in the future. Finally, I expect the collaboration with Igor and Vlad to be fruitful, and I think having successful collaborations is an important part of advancing in the scientific community, both from a networking standpoint and also because it exposes me to new ideas that I wouldn't have discovered on my own.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
The most important thing missing in my opinion was of course the opportunities for informal chats in hallways, after seminars, during breaks, etc. The program organizers did a wonderful job trying to provide outlets for such interactions, but of course it's difficult or impossible to recreate with perfect accuracy such a setting over Zoom. I would say in general that smaller, scheduled research meetings (like the weekly meetings with Igor and Vlad) worked really well over Zoom, and I had no trouble with the online format there. The larger meetings (seminars, teas, etc.) were slightly more difficult to stay engaged with over Zoom, since of course interaction is a bit tricky with so many people trying to communicate through a screen.

Photo Not Available

Rao, Pooja

Name: Pooja Rao
Year of Ph.D.: 2016
Institution of Ph.D.: Stony Brook University
Dissertation title: Turbulent Mixing in Richtmyer-MeshkovInstability Using Front-Tracking
Ph.D. advisor: James Glimm
MSRI Mentor: Anne-Laure Dalibard

Institution prior to MSRI: Stony Brook University
Position at that institution: Postdoc
Mentor (if applicable): Dennis Sullivan
Post-MSRI institution: Seeking industry jobs

Postdoctoral fellow's comments:
I worked with my collaborators at UT Austin and U. Arkansas to develop coding infrastructure for an interface-tracking algorithm that can simulate interfacial instabilities accurately.

Did you find your experience at MSRI beneficial? Why or why not?
I found the talks and discussions at MSRI really useful. When I decided to pursue industry jobs, MSRI was very helpful in providing resources and support. They arranged mentors for me and put me in touch with people who transitioned from academia to industry successfully.
Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
Yes, it has. The fellowship exposed me to a variety of tools and techniques and research that I would not come across. It also provided a great way to talk and collaborate with others in the program. The career panel was also very helpful. Being able to interact with the other program participants was very helpful in figuring out career trajectory, etc.

Please comment on your experience with the online format of the program.
Online meetings were hard for me because the work that I was involved in was a little different than other members in the program, so the spontaneous interactions that often lead to collaborations were missing. The social calls with randomly chosen breakout rooms were helpful in talking to people in the program that one hadn't interacted with previously.

Photo Not Available

Stingo, Annalaura

Name: Annalaura Stingo
Year of Ph.D.: 2018
Institution of Ph.D.: Université Paris 13
Dissertation title: Global Existence Problems for Nonlinear Critical Evolution Equations with Small Data and Semiclassical Analysis
Ph.D. advisor: Jean-Marc Delort
MSRI Mentor: Mihaela Ifrim

Institution prior to MSRI: UC Davis
Position at that institution: Visiting Assistant Professor
Mentor (if applicable):

Post-MSRI institution (or company): ICERM
Position: Postdoc
Anticipated length (or specify if tenure-track): 6 months
Mentor (if applicable):

Postdoctoral fellow's comments:
During the program I mainly worked with my mentor on a project started in 2018 whose goal is to study the long-time existence of small solutions to strongly coupled wave-Klein-Gordon systems. For such system we previously proved almost-global existence and are now working on proving that global existence holds. During this semester we made important advances in that direction. I also attended most of the talks and lectures, and discussed with a couple of senior professors. This however didn't lead to any new project.

Did you find your experience at MSRI beneficial? Why or why not?
I did. It was very inspiring from a mathematical point of you and made me feel part of a dynamic community.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
I am not really sure about this.

Wang, Weinan

Name: Weinan Wang
Year of Ph.D.: 2020
Institution of Ph.D.: University of Southern California
Dissertation title: Regularity for the Boussinesq equations
Ph.D. advisor: Igor Kukavica
MSRI Mentor: Raphaël Danchin

Institution prior to MSRI: University of Arizona
Position at that institution: Postdoctoral Research Associate
Mentor (if applicable): Christopher Henderson

Post-MSRI institution (or company): University of Arizona
Position: Postdoctoral Research Associate
Anticipated length (or specify if tenure-track): 2 years
Mentor (if applicable): Christopher Henderson

Postdoctoral fellow's comments:
It has been pleasant for me to participate in this program! I met different people, including senior professors, postdocs, etc. I am collaborating with my MSRI postdoc mentor Raphaël Danchin to write a paper. The topic interests me and uses tools and theories that I learnt and developed during my Ph.D. studies. I am also collaborating with another MSRI postdoc on a different paper.

Did you find your experience at MSRI beneficial? Why or why not?
Yes, very beneficial. This experience helped me to grow as a mathematician and introduced me to know many more mathematicians in the field.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
Yes, MSRI is a world-leading mathematical institution and being able to participate in this program recognized me as an active and independent researcher which can potentially help me in the search of a future position.

Please comment on your experience with the online format of the program.
The organizers are really helpful and always try to help young people like me. However, a future in-person reunion at MSRI will be greatly appreciated!

Zhu, Hui

Name: Hui Zhu
Year of Ph.D.: 2019
Institution of Ph.D.: University Paris-Saclay
Dissertation title: Control, stabilization and propagation of singularities for dispersive PDEs
Ph.D. advisor: Thomas Alazard and Nicolas Burq
MSRI Mentor: Daniel Tataru

Institution prior to MSRI: University of Michigan
Position at that institution: James Van Loo Postdoctoral Fellow and Assistant Professor
Mentor (if applicable): Zaher Hani

Post-MSRI institution: University of Michigan
Position: James Van Loo Postdoctoral Fellow and Assistant Professor
Anticipated length (or specify if tenure-track): one year and a half
Mentor (if applicable): Zaher Hani

Postdoctoral fellow's comments:
I have been regularly attending the conferences and seminars of the Fluid Dynamics program. I have also given a talk on the control theory of water waves. I am also seeing my mentor Professor Daniel Tataru once a week discussing a question related to the talk I gave. In the meantime, I am continuing my research on the wave kinetic theory and the propagation of singularities.

Did you find your experience at MSRI beneficial? Why or why not?
My experience at MSRI is very beneficial. I listened to many interesting talks and have the fortune to discuss with leaders of the field. These experiences help me view my current projects in different perspectives.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?
My fellowship at MSRI will definitely help me find a future position. First, MSRI fellowships are very selective and have a global reputation. Second, the friendship I made with the professors and postdocs here also helps me build a connection with mathematicians around the world. Most importantly, I have learned from them in many different ways in how to become a better mathematician.

Please comment on your experience with the online format of the program. Were there any surprising benefits from an online meeting? What were the most important factors that were missing compared to an in person meeting? How could the experience be improved?
I had a very good experience with the online format of the program. To me, an online talk is generally better than regular in person talks except for the discussion experience after the talk. The number of participants is much larger in an online talk and the audience are much wider spread around the world. This creates a more diverse atmosphere of the program.

Complementary Program 2020-21

Bruce, Juliette

Name: Juliette Bruce
Year of Ph.D.: 2020
Institution of Ph.D.: University of Wisconsin - Madison
Dissertation title: Asymptotic Syzygies in Algebraic Geometry
Ph.D. advisor: Daniel Erman
MSRI Mentor: David Eisenbud

Institution prior to MSRI: University of Wisconsin - Madison
Position at that institution: Graduate Student
Mentor (if applicable): Daniel Erman

Post-MSRI institution: University of California Berkeley
Position: NSF Postdoc
Anticipated length (or specify if tenure-track): 2 years
Mentor (if applicable): David Eisenbud

Postdoctoral fellow's comments:
During my fellowship at MSRI I worked on several research projects in commutative algebra and algebraic geometry. Working with Lauren Heller, a student of my mentor David Eisenbud, I have been working on understanding the properties of a certain notion of complexity called multigraded Castelnuovo–Mumford regularity arising in multigraded commutative algebra and algebraic geometry. Additionally, working with another student of my mentor, Ritvik Ramkumar, I have been working on a few projects concerning classical objects in algebraic geometry. Throughout my fellowship I also participated in a number of seminars hosted by MSRI. For example, I actively participated in a learning seminar organized by my mentor focused on understanding recent work of Jerzy Weyman on free resolutions of length 3. I also frequently attended "The Fellowship of the Ring Seminar" the national commutative algebra seminar hosted by MSRI. Further, when possible, I frequently worked from my office at MSRI, which was an extremely nice option to have.

Did you find your experience at MSRI beneficial? Why or why not?
Yes, I found my experience at MSRI beneficial in several ways. Of course, the ability to meet with David and discuss mathematics was extremely useful. That said one of the biggest benefits was the ability to have an office that at times I was able to work from.

Do you feel your fellowship has helped (or will help) you with finding a future position? If so, in what way?

Yes, I think my fellowship will help with finding future positions. I think the primary benefit in this direction was the ability to focus on research and talk with my mentor David Eisenbud.

Please comment on your experience with the online format of the program.
I think the biggest things missing from the online format were the sense of community, networking, and casual mathematical conversations that I assume often occur when things are normal. I really appreciate all the work MSRI put into trying to replicate these things online, but I found that these aspects were really hard to achieve online.

3.2 Postdoctoral Fellow Placement List

2020-21 Postdoc Pre/Post-MSRI Institution Group					
Family Name	**First Name**	**Pre-MSRI Institution Name**	**Pre-MSRI Institution Group**	**Post-MSRI Institution Name**	**Post-MSRI Institution Group**
Corwin	David	University of California, Berkeley	Math Public Large Group	University of California, Berkeley	Math Public Large Group
Dittmann	Philip	Technische Universität Dresden	Foreign	Technische Universität Dresden	Foreign
Elbaz	Esther	University Ben Gurion of the Negev	Foreign	TBD	n/a
Ho	Meng-Che	Purdue University	Math Public Large Group	California State University, Northridge	Group M
Kadets	Borys	Massachusetts Insitute of Technology	Math Private Large Group	University of Georgia	Math Public Medium Group
Ye	Jinhe	University of Notre Dame	Math Private Large Group	Sorbonne University	Foreign
Agrawal	Siddhant	University of Massachusetts Amherst	Math Public Medium Group	ICMAT (Instituto de Ciencias Matemáticas, Spain)	Foreign
Ai	Albert	University of Wisconsin, Madison	Math Public Large Group	University of Wisconsin, Madison	Math Public Large Group
de Poyferré	Thibault	University of California, Berkeley	Math Public Large Group	TBD	n/a
He	Jiao	University of Evry; University Paris-Saclay	Foreign	University of Evry & AMP; University Paris-Saclay	Foreign
Leslie	Trevor	University of Wisconsin, Madison	Math Public Large Group	University of Southern California	Math Private Large Group
Miller	Evan	McMaster University	Foreign	University of British Columbia	Foreign
Novack	Matthew	New York University	Math Private Large Group	Institute for Advanced Study	Non-group
Rao	Pooja	Stony Brook University	Math Public Large Group	TBD - seeking industry positions	n/a
Stingo	Annalaura	University of California, Davis	Math Public Large Group	ICERM (Institute for Computational & Experimental Research in Mathematics)	Non-group
Wang	Weinan	University of Arizona	Math Public Medium Group	University of Arizona	Math Public Medium Group
Zhu	Hui	University of Michigan	Math Public Large Group	University of Michigan	Math Public Large Group
Bobb	Martin	University of Texas	Math Public Large Group	University of Michigan	Math Public Large Group
Carvajales	Leon	Universidad de la República & Sorbonne U.	Foreign	Heidelberg University (Germany)	Foreign
Cremaschi	Tommaso	University of Southern California	Math Private Large Group	University of Southern California	Math Private Large Group
Farre	James	Yale University	Math Private Large Group	Yale University	Math Private Large Group
Miller	Nicholas	University of California, Berkeley	Math Public Large Group	University of California, Berkeley	Math Public Large Group
Sankar	Soumya	University of Wisconsin, Madison	Math Public Large Group	The Ohio State University	Math Public Large Group
Vargas Pallete	Franco	Yale University	Math Private Large Group	Yale University	Math Private Large Group
Verberne	Yvon	University of Toronto	Foreign	Georgia Institute of Technology	Math Public Medium Group
Bruce	Juliette	University of Wisconsin, Madison	Math Public Large Group	University of California, Berkeley	Math Public Large Group

3.3 Postdoctoral Fellow Participant Summary

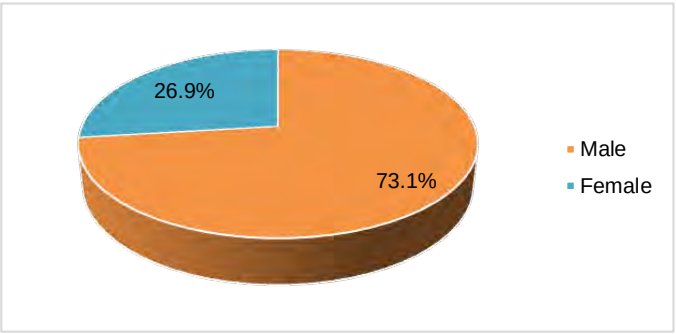
Programs	**Distinct Postdocs**	**Women**	**%**	**Minorities***	**%**	**US Home Institution**	**%**	**US Citizens & Perm. Res.**
Random and Arithmetic Structures in Topology	8	2	25.0%	1	25.0%	7	87.5%	4
Decidability, definability and computability in nur	6	1	16.7%	0	0.0%	4	66.7%	1
Mathematical problems in fluid dynamics	11	3	27.3%	0	0.0%	9	81.8%	5
Complementary Program 2020-21	1	1	100.0%	0	0.0%	1	100.0%	1
Total # of Distinct Postdocs	**26**	**7**	**26.9%**	**1**	**9.1%**	**21**	**80.8%**	**11**

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

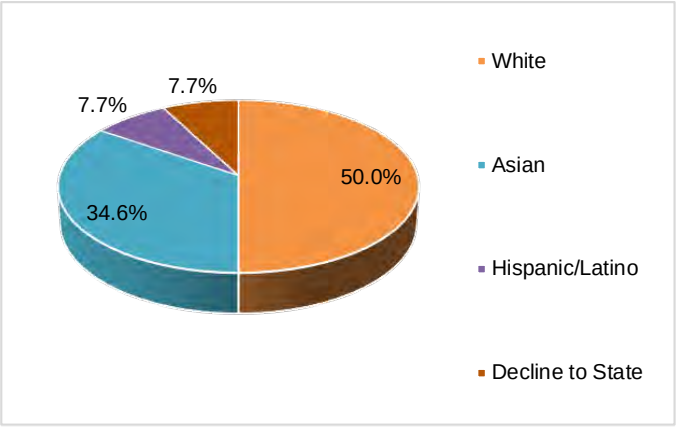
3.4 Postdoctoral Fellow Demographic Data

2020–21 Postdoctoral Fellows Demographic Summary

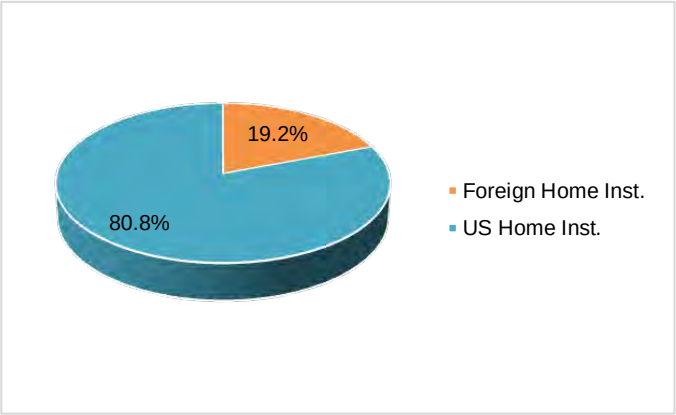
Gender	#	%
# of Distinct Members	26	100.0%
Male	19	73.1%
Female	7	26.9%
Decline to State	0	0.0%



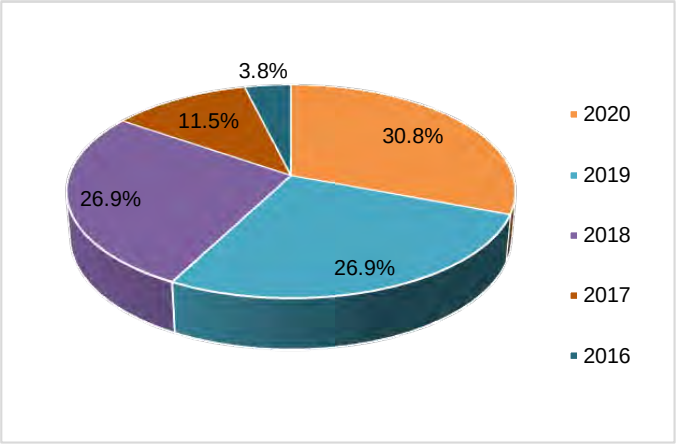
*Race/Ethnicity**	#	%
White	13	50.0%
Asian	9	34.6%
Hispanic/Latino	2	7.7%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	2	7.7%
Unavailable Info.	0	0.0%
Minorities**	1	9.1%



Citizenships	#	%
Foreign Home Inst.	5	19.2%
US Home Inst.	21	80.8%
Foreign Citizens	15	57.7%
US Citizens & Perm. Res.	11	42.3%
US Citizens	9	34.6%
US Permanent Residents	2	7.7%



Year of Ph.D	#	%
2020	8	30.8%
2019	7	26.9%
2018	7	26.9%
2017	3	11.5%
2016	1	3.8%
2015	0	0.0%
Total # of Distinct Members	26	100.0%

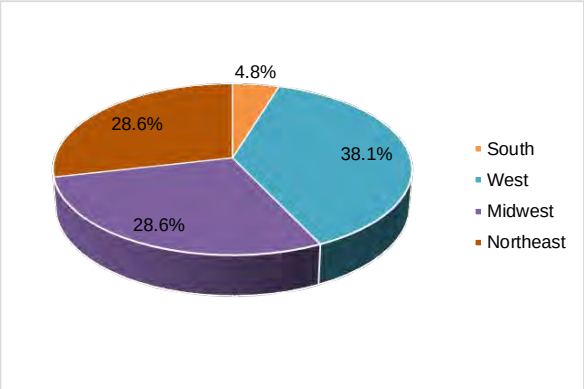


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020–21 Postdoctoral Fellows Classified by State

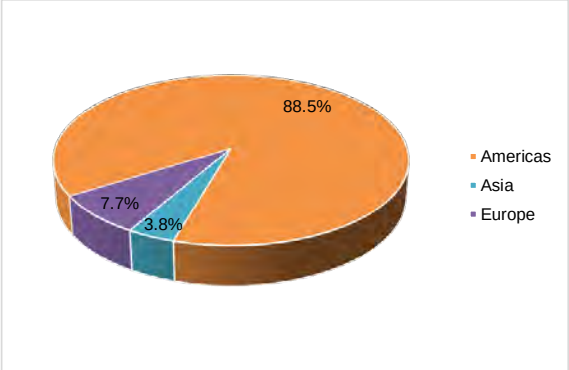
State	#	%	*2020 Census*
South	**1**	**4.8%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.5%*
GA	1	4.8%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	0	0.0%	*1.9%*
MS	0	0.0%	*0.9%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	0	0.0%	*8.8%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**8**	**38.1%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	1	4.8%	*2.2%*
CA	7	33.3%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**6**	**28.6%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	0	0.0%	*3.9%*
IN	2	9.5%	*2.0%*
KS	0	0.0%	*0.9%*
MI	2	9.5%	*3.0%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	1	4.8%	*3.6%*
SD	0	0.0%	*0.3%*
WI	1	4.8%	*1.8%*
Northeast	**6**	**28.6%**	***17.4%***
CT	2	9.5%	*1.1%*
MA	2	9.5%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	2	9.5%	*6.1%*
PA	0	0.0%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**21**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020–21 Postdoctoral Fellows Classified by Country

Africa			**0**
Americas			**23**
	North America	Canada	1
		United States	21
	South America	Uruguay	1
Asia			**1**
	Western Asia	Israel	1
Europe			**2**
	Western Europe	France	1
		Germany	1
Oceania			**0**
Grand Total			**26**



**Regions based on United Nations classification*

4. Graduate Program

In 2020-21, 577 graduate students participated in MSRI's scientific activities: 476 graduate students in our workshops, 64 graduate students in the summer graduate schools, and 37 graduate students in the programs.

4.1 Summer Graduate School (SGS)

Attending one of these two-week summer schools can be a very motivating and exciting experience for a student; participants have often said that it was the first experience where they felt like real mathematicians, interacting with other students and mathematicians in their field. MSRI originally organized 11 summer graduate schools for the summer of 2020, four of which were to be held at MSRI and the other seven were to be jointly held off-site with other institutions. Due to the COVID-19 pandemic, nine of the summer schools were cancelled or postponed to future years. The remaining two were shifted to a virtual format.

One of the virtual summer schools was the *Séminaire de Mathématiques Supérieures 2020: Discrete Probability, Physics and Algorithms* held in partnership with the Centre de Recherches Mathématicques (Montréal, Canada). The other virtual summer school, *Introduction to water waves*, was one of those originally planned as an onsite school at MSRI. It was led by Mihaela Ifrim (University of Wisconsin, Madison) and Daniel Tataru (University of California, Berkeley) and was exceptionally successful due to the dedication of both the lecturers and students. See the report in Section 13, Appendix for more details.

Graduate students from one of MSRI's Academic Sponsor Institutions or from Departments of Mathematics at U.S. universities are eligible to attend the summer schools. For each institution, MSRI provides support for up to two students per summer and, under our "2+1+1" policy, MSRI will support an additional student if one of the students is female and another one if s/he is from a group that is underrepresented in the mathematical sciences. MSRI covers travel and local expenses with the maximal allowance for travel reimbursement being $600 for students from U.S. and Canadian universities (depending on the point of origin), and $700 for students from other sponsoring institutions.

The summer graduate schools and the open enrollment period for the summer of year n+1 are announced in August of year n. Graduate students must be nominated by their Director of Graduate Studies during the enrollment period. MSRI accepts nominees on a first-come first-served basis up to the limits of the capacity of each school, which is around 40-50 for onsite schools. If the chosen school is already full, the students are either kept on a waiting list or the nominating institution may make nominations to other schools until their quota is reached.

Below, we list the two Summer Graduate Schools that took place during the summer of 2020. Altogether, 64 graduate students participated in these schools. Women comprised 27% of the students and of the 15 students who were U.S. citizens or Permanent Residents, one (7%) was from a historically underrepresented group (Pacific Islander). See the table in section 4.2 for detailed demographic data.

SGS 1: Séminaire de Mathématiques Supérieures 2020: Discrete Probability, Physics & Algorithms [Virtual]
June 29, 2020 – July 10, 2020
In partnership with the Centre de Recherches Mathématicques, Montréal Canada
*Organizers: Gerard Ben Arous (New York University, Courant Institute), **Alexander Fribergh** (University of Montreal), Lea Popovic (Concordia University)*

SGS 2: Introduction to Water Waves [Virtual]
July 27, 2020 – August 7, 2020
*Organizers: **Mihaela Ifrim** (University of Wisconsin-Madison), **Daniel Tataru** (University of California, Berkeley)*

4.2 Summer Graduate Schools 2020 Data

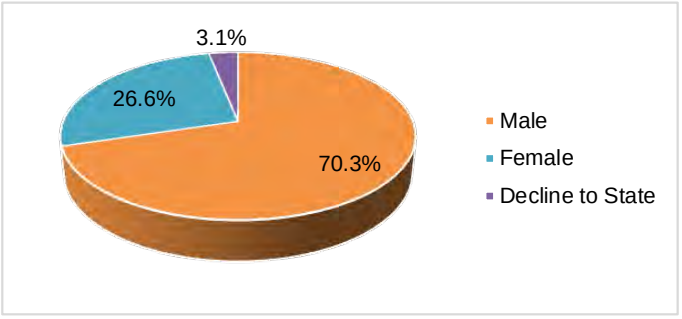
Virtual Summer Graduate Schools	# of Students	Women	%	Minorities*	%	US Home Institution	%	US Citizens & Perm. Res.
Introduction to water waves	49	13	26.5%	1	*8.3%*	40	81.6%	12
Séminaire de Mathématiques Supérieures 2020: Discrete Probability, Physics and Algorithms (Montréal, Canada)[‡]	15	4	26.7%	0	*0.0%*	11	73.3%	3
Total # of Students	**64**	**17**	***26.6%***	**1**	***6.7%***	**51**	***79.7%***	**15**

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.*

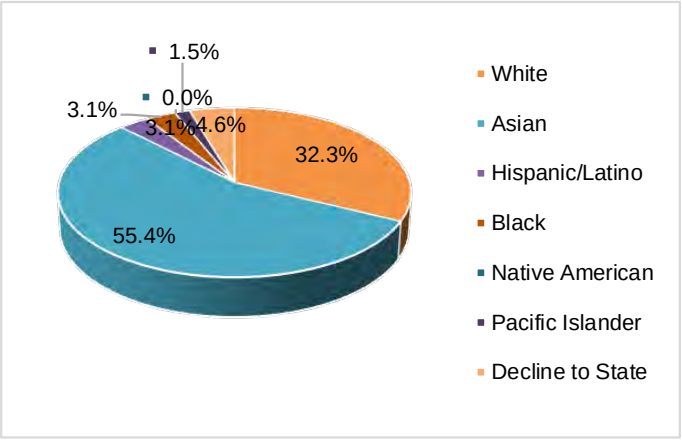
[‡] *The number of students listed were those sponsored by MSRI. Joint summer schools had at least as many other participants sponsored by the host institution.*

2020 Summer Graduate Schools Demographic Summary

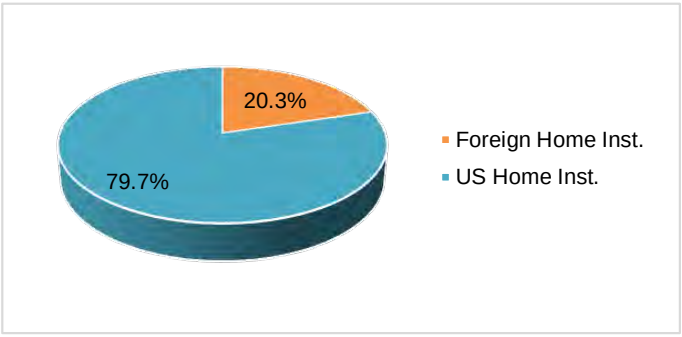
Gender	#	%
# of Students	64	100.0%
Male	45	70.3%
Female	17	26.6%
Decline to State	2	3.1%



*Race/Ethnicity**	#	%
White	21	32.3%
Asian	36	55.4%
Hispanic/Latino	2	3.1%
Black	2	3.1%
Native American	0	0.0%
Pacific Islander	1	1.5%
Decline to State	3	4.6%
Unavailable Info.	0	0.0%
Minorities**	1	8.3%



Citizenships	#	%
Foreign Home Inst.	13	20.3%
US Home Inst.	51	79.7%
US Citizens & Perm. Res.	12	18.8%
Foreign Citizens	52	81.3%
US Citizens	12	100.0%
US Permanent Residents	0	0.0%

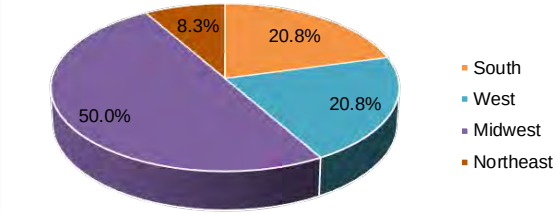


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020–21 Program Associates Classified by State

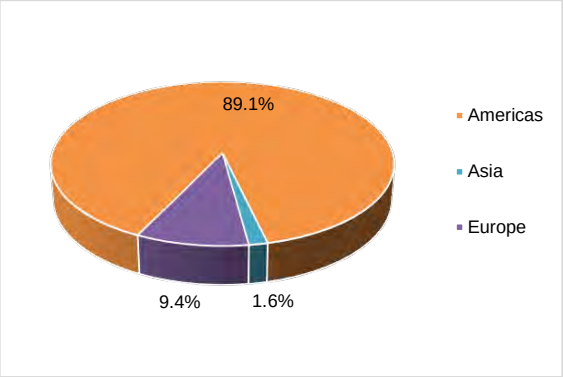
State	#	%	*2020 Census*
South	**5**	**20.8%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	1	4.2%	*0.2%*
FL	0	0.0%	*6.5%*
GA	1	4.2%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	1	4.2%	*1.9%*
MS	0	0.0%	*0.9%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	2	8.3%	*8.8%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**5**	**20.8%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.2%*
CA	5	20.8%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**12**	**50.0%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	5	20.8%	*3.9%*
IN	2	8.3%	*2.0%*
KS	0	0.0%	*0.9%*
MI	3	12.5%	*3.0%*
MN	1	4.2%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.6%*
SD	0	0.0%	*0.3%*
WI	1	4.2%	*1.8%*
Northeast	**2**	**8.3%**	***17.4%***
CT	0	0.0%	*1.1%*
MA	0	0.0%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	0	0.0%	*6.1%*
PA	2	8.3%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**24**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020 Summer Graduate School Students Classified by Countries

Africa			**0**
Americas			**57**
	North America	Canada	6
		United States	51
Asia			**1**
	Eastern Asia	Taiwan	1
Europe			**6**
	Southern Europe	Spain	3
	Western Europe	Germany	3
Oceania			**0**
	Australia & New Zealand	Australia	0
Grand Total			**64**



**Regions based on United Nations classification*

4.3 Program Associates

Program Associates (graduate students participating in the programs) benefit greatly from the opportunity to interact with postdoctoral fellows and leaders of a field, gaining intense exposure to current ideas and trends in their area of specialization. They were closely supervised by their advisor and benefited from all member privileges.

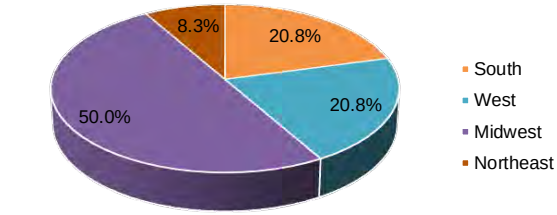
4.4 Program Associate Data

Programs	Distinct Prog. Assoc.	Women	%	Minorities*	%	US Home Institution	%	US Citizens & Perm. Res.
Decidability, definability and computability in number theory:	7	5	71.4%	1	50.0%	4	57.1%	2
Random and Arithmetic Structures in Topology -- Virtual Se	15	3	20.0%	2	40.0%	10	66.7%	5
Mathematical problems in fluid dynamics	15	3	20.0%	0	0.0%	10	66.7%	2
Complementary Program (2020-21)	0	0	0.0%	0	0.0%	0	0.0%	0
Total # of Distinct PAs	**37**	**11**	***29.7%***	**3**	***33.3%***	**24**	***64.9%***	***9***

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020–21 Program Associates Classified by State

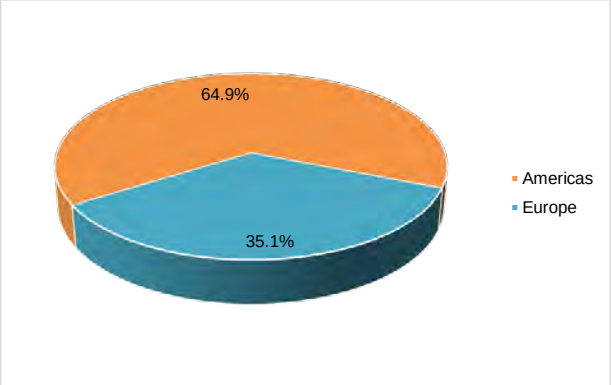
State	#	%	*2020 Census*
South	**5**	**20.8%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	1	4.2%	*0.2%*
FL	0	0.0%	*6.5%*
GA	1	4.2%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	1	4.2%	*1.9%*
MS	0	0.0%	*0.9%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	2	8.3%	*8.8%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**5**	**20.8%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.2%*
CA	5	20.8%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**12**	**50.0%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	5	20.8%	*3.9%*
IN	2	8.3%	*2.0%*
KS	0	0.0%	*0.9%*
MI	3	12.5%	*3.0%*
MN	1	4.2%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.6%*
SD	0	0.0%	*0.3%*
WI	1	4.2%	*1.8%*
Northeast	**2**	**8.3%**	***17.4%***
CT	0	0.0%	*1.1%*
MA	0	0.0%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	0	0.0%	*6.1%*
PA	2	8.3%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**24**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020–21 Program Associates Classified by Country

Africa			**0**
Americas			**24**
	North America	United States	24
Asia			**0**
Europe			**13**
	Southern Europe	Italy	2
	Western Europe	France	8
		Germany	3
Oceania			**0**
Grand Total			**37**



**Regions based on United Nations classification*

4.5 Graduate Student List

(Participants who attended 2020-21 workshops, excluding Summer Graduate Schools)
(See e-mail attachment)

4.6 Graduate Student Data*

(Participants who attended 2020-21 workshops, excluding Summer Graduate Schools)

Virtual Workshops	Participants	Women	%	Minorities*	%	US Home Institution	%	US Citizens & Perm. Res.
6 Scientific Workshops								
Connections Workshop: Mathematical problems in fluid dynamics	50	10	20.0%	2	15.4%	31	62.0%	13
Introductory Workshop: Mathematical problems in fluid dynamics	64	12	18.8%	2	11.1%	38	59.4%	18
Recent Developments in Fluid Dynamics	45	8	17.8%	0	0.0%	28	62.2%	12
Random and Arithmetic Structures in Topology: Introductory Workshop	54	11	20.4%	4	21.1%	34	63.0%	19
Hot Topics: Topological Insights in Neuroscience	78	24	30.8%	4	16.0%	34	43.6%	25
Mathematical Models for Prediction and Control of Epidemics	161	62	38.5%	18	23.4%	107	66.5%	77
All 6 Workshops Total	**452**	**127**	**28.1%**	**30**	**18.3%**	**272**	**60.2%**	**164**
1 Education & Outreach Workshop								
Critical Issues in Mathematics Education 2021: Initiating, Sustaining, and Researching Mathematics Department Transformation of Introductory Courses for STEM Majors	24	13	54.2%	2	11.8%	18	75.0%	17
All 7 Workshops Total	**476**	**140**	**29.4%**	**32**	**17.7%**	**290**	**60.9%**	**181**

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.*

*Note that the overall graduate student data in section 4.6 is not distinct as some participants attended multiple workshops, but the statistics of individual workshop found in Section 13, Appendix, were calculated on distinct participant data.

5. Undergraduate Program

5.1 Description of Undergraduate Program

Please note: MSRI-UP is funded by an independent NSF grant, DMS-1659138. The report was filed independently to the NSF in March 2021, therefore no report is attached in Section 13, Appendix.

The MSRI Undergraduate Program (MSRI-UP) is a comprehensive summer program designed for undergraduate students who have completed two years of university-level mathematics courses and would like to conduct research in the mathematical sciences. The main objective of the MSRI-UP is to identify talented students, especially those from underrepresented groups, who are interested in mathematics and make available to them meaningful research opportunities, the necessary skills and knowledge to participate in successful collaborations, and a community of academic peers and mentors who can advise, encourage and support them through a successful graduate program.

This objective is designed to contribute significantly toward increasing the number of graduate degrees in the mathematical sciences, especially doctorates, earned by U.S. citizens and permanent residents by cultivating heretofore untapped mathematical talent within the U.S. Black, Hispanic/Latino, and Native American communities.

MSRI-UP 2020 was held virtually due to the COVID-19 pandemic. See the separately submitted report for details. During the summer, each of the 18 student participants:

- participated in the mathematics research program under the direction faculty and graduate students mentors.
- completed a research project done in collaboration with other MSRI-UP students
- gave a presentation and write a technical report on his/her research project
- attended a series of colloquium talks given by leading researches in their fields
- attended workshops aimed at developing skills and techniques needed for research careers in the mathematical sciences and
- learned techniques that will maximize a student's likelihood of admissions to graduate programs as well as the likelihood of winning fellowships

After the summer, each student:

- had an opportunity to attend a national mathematics or science conference where students were able to present their research
- is part of a network of mentors that will provide continuous advice in the long term as the student makes progress in his/her studies
- will be contacted regarding future research opportunities

MSRI-UP 2020: Branched Covers of Curves
June 13, 2020 to July 26, 2020

The theme of the 2020 MSRI-UP was “Branched Covers of Curves" and the research leader was Dr. Edray Goins, Professor of Mathematics at Pomona College. The research program focused on Galois Theory of curves, i.e. the realization of certain finite groups as the symmetries of maps from one curve to another. Students worked on a variety of problems ranging from the explicit construction of covers for a given group to visualizing such covers as exotic surfaces which are self-intersections of the sphere and the torus. The research groups focused on Belyi maps, Dessin d’Enfants, Origami, and Shabat polynomials; while working in a variety of areas such as Galois theory, monodromy groups, number theory, and Riemann surfaces.

5.2 MSRI-UP Data

MSRI-UP 2020 Participant List

Last Name	First Name	Institution name
Arosemena	Nicholas	Morehouse College
Elzie	Deion	California State Polytechnic University, Pomona
Euceda	Yaren	University of Minnesota, Twin Cities
Gonzalez	Sarai	Eastern University
Heard	Samuel	University of Oklahoma
Lopez	Rebecca	Marist College
Muhammad	Ra-Zakee	Pomona College
Nishida	Mikaela	Pomona College
Okenwa	Chidera	University of California, Berkeley
Powell	Ashly	University of the Virgin Islands
Ramirez	Fabian	Sonoma State University
Rodriguez	Elisa	Ursinus College
Sablan	William	University of Guam
Santiago	Javier	University of Puerto Rico
Sun	Vanessa	Macaulay Honors College at Hunter College, CUNY
Thomas	Cameron	Morehouse College
Tsegaye	Eyob	Stanford University

6. Summer Research in Mathematics

6.1 Description of Summer Research in Mathematics

Existing women's mathematics conferences are valuable collaborative opportunities but they are also very short in duration, usually lasting only a week, meaning projects started during those conferences remain unfinished once the participants return to their usual professional and personal responsibilities. MSRI's Summer Research in Mathematics (SRiM) program was created in response to this problem. The program provides space, funding, and the opportunity for in-person collaboration to small groups of mathematicians, especially women and gender-expansive individuals, with established projects. Such groups may apply for funding to spend two weeks or more together at MSRI where they will live and work in close proximity to one another and can make use of the Institute's resources. This focused, distraction-free collaboration can accelerate the completion of their research project and provide an opportunity for a deeper research experience than may have been possible otherwise.

Unfortunately the COVID-19 pandemic prevented the SRiM 2020 cohort from convening onsite in Berkeley. MSRI consulted with the summer 2020 invitees to determine if they would prefer to participate in the activity virtually or postpone until summer 2021—an overwhelming majority preferred to postpone. The 82 mathematicians who were accepted for the summer 2020 program were invited to participate in the summer 2021 session.

7. African Diaspora Joint Mathematics Program

7.1 Description of ADJOINT

Please note: ADJOINT was funded by an independent NSF grant, DMS-2016406. The report was filed separately to the NSF in July 2021, thus there is no report attached in Section 13, Appendix.

The African Diaspora Joint Mathematics Program (ADJOINT) begins with a two-week summer workshop at MSRI, which is designed to provide the opportunity for in-person research collaboration to U.S. mathematicians, especially those from the African American mathematical community. Small groups of mathematicians work with research leaders on various research projects for an intense period of 2 weeks during the summer. The ADJOINT program continues throughout the academic year (and beyond) by providing the means for research teams to advance their projects after leaving MSRI. We provide support for periodic virtual meetings as well as travel funds to enable visits among collaborators. Additional support is provided so that results can be presented at national and international conferences and published in peer-reviewed journals.

The 2020 ADJOINT program ran from June 15th through June 26th with research groups participating virtually due to the COVID-19 pandemic. Twenty-two mathematicians (including five Research Leaders) participated in one of the five research groups, and each group was led by a respected African American mathematician with a well-established research program. The research projects were in areas of mathematical physics, mathematical biology, analysis and PDEs, statistics, and differential geometry. All teams were predominantly comprised of African American mathematicians at various stages in their careers. The 2020 ADJOINT program was highly successful, as illustrated by the following testimonials, despite the limitations of the virtual format. See the separately submitted report for more details on the program's activities.

8. Appendix – Final Reports of Activities in 2020-21

MSRI
Mathematical Sciences Research Institute

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Decidability, Definability and Computability in Number Theory: Part 1 Virtual Program

August 17, 2020 to December 18, 2020
MSRI, Berkeley, CA
USA

Organizers:

Valentina Harizanov* (George Washington University)
Maryanthe Malliaris (University of Chicago)
Barry Mazur (Harvard University)
Russell Miller (Queens College, CUNY; CUNY Graduate Center)
Jonathan Pila (University of Oxford)
Thomas Scanlon (University of California, Berkeley)
Alexandra Shlapentokh* (East Carolina University)
Carlos Videla (Mount Royal University)

MSRI REPORT

VALENTINA HARIZANOV AND ALEXANDRA SHLAPENTOKH

1. Introduction

1.1. **The Plan.** The topic of the semester was "Definability, Decidability and Computability in Number Theory". This area grew out of solution to Hilbert's Tenth Problem by H. Putnam, M. Davis, J. Robinson and Yu. Matiyasevich. Hilbert's Tenth Problem was a question posed by Hilbert about algorithmic solvability of polynomial equations. The authors of the solution to the problem showed that such an algorithm does not exist by showing that every computably enumerable set over integers is existentially definable over $\mathbb{Z}$. The resolution of Hilbert's question left open an analogous question for $\mathbb{Q}$. This question can also be phrased as a question whether one can determine algorithmically existence of rational points on an algebraic variety. This question is open to-date. It can be resolved by showing that $\mathbb{Z}$ is existentially definable over $\mathbb{Q}$, but there are serious doubts that such a definition exists. The question of existential definability of $\mathbb{Z}$ is typical of other questions in the area. In general, it is concerned with definablity and decidability in the first-order order language of rings over objects studied in Number Theory, as well as with the degree of unsolvability when it occurs. Thus from the beginning the area contained a mixture of problems from Computability Theory, Model Theory, Number Theory and Algebraic Geometry. The idea behind the semester was to bring together researchers from these areas in hopes engendering further progress.

1.2. **The Virtual Semester.** Since COVID 19 made travel to Berkeley impossible, the decision was made to shift the semester online. There was no hope of course that an online semester could produce the same type interaction, as an "in-person" semester. So, the organizers tried to salvage whatever they could from the original plan and to take advantage to whatever extent possible of the vastly improved accessibility of the semester. At the end, there was a unanimous sentiment shared by all members that a virtual semester was a very poor substitute for an in-person semester. The extent to which members were able to participate and take advantage of the semester varied widely amongst the members. For one thing, there was a problem with the time difference from California to Europe and point further east. All live activity had to take place between 8 am and 1 pm Berkeley time. Even so, it was too late for some European members. Without physically traveling to Berkeley, some members could not be relieved from their teaching loads and other job activities. Thus, they did not have enough time for a

Date: January 2021.

full load of semester activities, even on-line. Attempts for online "tea" were not successful, probably because members were suffering from "Zoom fatigue".

The organizers tried to leverage the on-line nature of the semester by involving many younger members in organization of seminars series and creating a seminar series where post-docs and graduate students could give talks. The seminars also featured many senior speakers. The live audience at the seminars varied from 10 to 80 people. Of course all talks were recorded, and it is impossible to say how many people viewed the recordings after the seminar. The semester created an extensive bank of talks on almost all aspects of the subject ranging from introductory to very advanced ones.

Despite the above-described difficulties, many collaborations took place on-line and are set to continue in the future. Some of these collaborating groups will be described in the later sections.

Particular care was taken to make sure that all post doctoral researchers supported by the institute were given every opportunity to advance. More details on this will be provided in the section devoted to these researchers.

2. Research Developments

Some of the main problems in the area of DDC NT include the following ones:

(1) Existential definability of $\mathbb{Z}$ over $\mathbb{Q}$ and the related problems of big rings.
(2) Existential definability of in the rings of integers number fields and applications of Diophantine stability to this question.
(3) First-order definability of $\mathbb{Z}$ and undecidability over infinite algebraic extensions of $\mathbb{Q}$ and applications of Diophantine stability.
(4) Definability of valuations in infinite algebraic extensions of $\mathbb{Q}$.
(5) Applications of Valuation Theory
(6) The "frequency" of computable infinite algebraic extensions of $\mathbb{Q}$ with undecidable theories.
(7) Finitely generated fields and definability of valuations.
(8) Hilbert's Tenth Problem over function fields of characteristic 0 and definability of valuations over these fields.
(9) Definability of polynomial rings over function fields of positive characteristic and definability of valuations over function fields of transcendence degree greater than 1.
(10) Definability over $\mathbb{C}(t)$ and other model-theoretic questions concerning first-order theory of $\mathbb{C}(t)$.
(11) Approximate computability of structures, including generic and coarse computability.
(12) Applications of Anabelian geometry to questions of definability over fields.
(13) (Un)decidability, definability and local/global principle over large fields and other fields "close" to algebraic closure of $\mathbb{Q}$.
(14) Problems reducible to Hilbert's Tenth Problem (e.g. Inverse Galois Problem)
(15) HTP over infinite algebraic extensions.

3. Organizational Structure

The Program had several components: 5-minute talks; Main Seminar, Junior Seminar, Introductory Seminar, and other more specialized seminars; two mini courses; one formal reading group; informal small research groups; regular social gatherings; a movie; and several panels. The traditional 5-minute talks were given over four days in the first week of September with the aim of introducing participants to each other research areas and problems.

(1) *Main Seminar*, run by Alexandra Shlapentokh (East Carolina University) and Valentina Harizanov (GWU), was given weekly and all the speakers were instructed to make their talks accessible to wide audience. The seminar started with a lecture by Martin Davis and ended with a lecture by Yuri Matyiasevich, the two living mathematicians among for who solved Hilbert's Tenth Problem. The other Main Seminar speakers included a number of very famous researchers from a variety of disciplines included in the Program.
(2) *Junior Seminar*, co-organized by Russell Miller (Queens College, CUNY) , Lynn Scow (California State University, San Bernardino), and a postdoctoral fellow Meng-Che Turbo Ho (California State University, Northridge). The Junior Seminar mainly featured talks by postdocs, graduate students, and more junior researchers, at the level accessible to people without extensive research experience.

Due to the truly interdisciplinary nature of the Program, it started with a relatively large number of weekly specialized seminars:

(1) *Diophantine Problems Seminar* organized by Hector Pasten (Pontificia Universidad Católica de Chile) and Natalia Garcia-Fritz (Pontificia Universidad Catolica de Chile);
(2) *Valuation Theory Seminar* organized by Franziska Jahnke (Westfälische Wilhelms-Universität Münster), Sylvy Anscombe (Institut de Mathematiques de Jussieu), and Philip Dittmann (TU Dresden);
(3) *Definability Seminar* organized by Kirsten Eisentraeger (Pennsylvania State University) and Jennifer Park (Ohio State University), and
(4) *Computability Seminar* organized by Valentina Harizanov (GWU).

All speakers were asked whether they allow their lecture to be recorded and posted, and were encouraged to submit their lecture notes to be posted. Later, after initial evaluation of the program and the feedback of the participants we added two more seminars: Introductory Seminar, and Model Theory Seminar.

(1) *Introductory Seminar* was run at different times and was of expository nature, and often featured a lecture series on a topic requested by participants, by an expert in the field known for clear and engaging exposition.
(2) *Model Theory Seminar* was a regular weekly seminar organized by Silvain Rideau-Kiku.

Franziska Jahnke (Westfälische Wilhelms-Universität Münster) organized a weekly reading group on *Valuations on dp-Finite Fields* since there was a considerable interest by many in this area. Other, smaller research groups were organized among a small group of interested researchers and were not announced to all participants.

There were two mini courses given: one in the first part, and the other in the second part of the program.

(a) The first mini course, *Applying Topology to Spaces of Countable Structures*, was given by Russell Miller (Queens College and CUNY Graduate Center). The course focused on the topology of the subrings of $\mathbb{Q}$, algebraic fields of characteristic zero, and other classes of algebraic structures, and on the connection between computability and continuity for functions between these spaces.

(b) The second mini course, *Picard-Fuchs Differential Equations*, was given by Charles Doran (University of Alberta). It was an introduction to the theory, computation, and applications of Picard-Fuchs differential equations, of interest to geometers, model theorists, and physicists. Each course consisted of five lectures, each followed by a regularly scheduled discussion session during the same week.

A series of virtual social gatherings, known as *teas*, was organized, in which participants could meet for informal conversation. Attendance was often low after the first few weeks of the program, but the venue continued throughout the semester as a valued meeting-place for many of the postdocs and other junior participants.

Several career development sessions and teaching panels were organized jointly with the other program, giving members of both groups for wider interaction. More specifically, Wesley Calvert worked with several postdocs from the simultaneous RAS program to organize a joint series of career development sessions for postdocs, program associates, and other junior personnel in both programs. Throughout the series, an effort was made to connect participants with a diverse group of highly successful mathematicians throughout many areas of the mathematical profession.

A total of eight sessions were held:

(a) Grant Applications (two events)
(b) How to apply to postdocs
(c) Superpower theory (developing unique marketable skills)
(d) Careers in industry (two events)
(e) Strategies for successful talks
(f) What to do once you have a job
(g) How to teach better

The panel on how to teach better included three Haimo Award recipients and one Adler Award recipient. The panels on grants included NSF program officers from both subject areas and successful recipients of several kinds of funding. The panel on superpower theory included specialists in K-12

teacher training, actuarial education, service course administration, and software engineering.

4. Postdoctoral Fellows

The postdoctoral fellows included: David Corwin (University of California, Berkeley), Philip Ditmann (TU Dresden), Ester Elbaz (Ben Gurion University of the Negev), Meng-Che (Turbo) Ho (California State University, Northridge), Borys Kadets (Massachusetts Institute of Technology), Jinhe Ye (University of Notre Dame). Every postdoctoral fellow gave a talk in the Junior Seminar.

In addition, David Corwin gave a talk "Beyond quadratic Chabauty" in the Definability Seminar; Philip Ditmann gave a talk "Defining subrings using Kato principles" in the Definability Seminar; Ester Elabaz gave a talk "Construction of a structure whose Grothendieck ring has finite characteristic" in the Model Theory Seminar; Meng-Che Ho gave a talk "The word problem for groups" in the Computability Seminar; Borys Kadets gave a talk "Improving Weil bounds for abelian varieties in the Definability Seminar;" and Jinhe Ye gave a talk "The étale open topology" in the Valuation Theory Seminar.

David Corwin also gave a three-lecture series on rational and integral points on algebraic curves in the Introductory Seminar. (**MSRI will insert or append the reports from post-docs.**)

5. Graduate Students

Officially associated with the program were: Rachael Alvir (University of Notre Dame), Blaise Boissonneau (Westfälische Wilhelms-Universität Münster), Martina Liccardo (Università di Napoli Federico II), Anna De Mase (Università degli Studi della Campania Luigi Vanvitelli), Gabriela Pinto (University of Chicago), Gihanee Senadheera (SIU), Dario Verta (GWU),

A number of other graduate students participated taking advantage of the virtual program; for example, Caleb Springer (Pennsylvania State University), Keshav Srinivasan (GWU), Philip White (GWU). Caleb Springer gave a talk "A topological approach to undefinability in algebraic extensions of the rationals" in the Junior Seminar. Gijanee Senadheers gave a talk "Two effective concept classes of PACi incomparable degrees" in the Junior Seminar. Blaise Boissonneau gave a talk "Artin-Schreier extensions combinatorial complexity" in the Junior Seminar.

6. Inclusivity

The program included participants from various geographic areas, stages of their careers, and backgrounds. The time of the events was carefully chosen to allow US members from different times zones, as well as people from Europe and South America to participate in live events. Some of the participants were very senior, well-known researchers holding the most prestigious awards, but we also had many junior participants. Several

graduate students gave talks, and every postdoc gave a lecture in the Junior Seminar and also in a more specialized seminar close to their particular research interests.

We had a large number of female participants and speakers. Women played a prominent role in organizing seminars, and a relatively large number of invitations went to female speakers. For example, the Main Seminar featured 5 female speakers among its 17 speakers. Similarly, in the Computability Seminar, among 16 lectures, 4 were delivered by female speakers. Toward the end of the Program, we watched a movie "Julia Robinson and Hilbert's Tenth Problem," an inspiring film about the life and career of Julia Robinson and also starring several members of our program. Many of the panels we organized individually — and certainly the series collectively — included faculty at public and private research universities from AMS groups I, II, and III; public and private masters' and bachelors' universities; mathematicians in financial, biotech, and retail industries and in government labs; representatives of senior and middle career stages; and a mixture of genders, races, and ethnicities.

7. Highlights and Breakthroughs

Due to the size of the program it is not possible to describe all interesting research activities that took place during the semester. Below is a sample of such activities.

(a) *Mazur-Rubin-Shlapentokh* project concerned the connection between Diophantine Stability and Existential Definability over number fields. One of the main results of the project is the following theorem. Let L/K be a number field extension with O_L/O_K the corresponding extension of their rings of integers. Let A be an abelian variety defined over K such that $A(L)$ contains an element of infinite order and $[A(L) : A(K)] < \infty$. Then O_K has a Diophantine definition in O_L.

(b) *Kadets-Vogt* project (ongoing) is entitled "Low degree points on algebraic curves". The authors are interested in curves X over a number field K, that have infinitely many points of degree d. Their goal is to systematically study failures of the Abramovich Harris conjecture. For this they introduce a notion of a d-minimal curve: a curve that possesses infinitely many points of degree d yet has no degree $k > 1$ maps onto a curve Y that has infinitely many points of degree d/k. We aim to understand the geometry of d-minimal curves.
Their results thus far are as follows: they can show that d-minimal curves have bounded genus, can classify d-minimal curves for d at most 4, can show that a general curve of genus at most 12 is not d-minimal, can describe various special geometric features of d-minimal curves. All of these results are possible because of a new method that combines combinatorics of subspace configurations with geometry of special linear series. This method gives a unified treatment to all

previously known results on d-minimal curves, and they hope will yield more theorems in the future.

(c) *Eisentraeger-Miller-Springer-Westrick* completed a project concerning the algebraic extensions K of $\mathbb{Q}$ in which one cannot existentially or universally define the ring of integers O_K. A complete classification of such fields would have important consequences. For example, the existence of an existential definition of $\mathbb{Z}$ in $\mathbb{Q}$ would imply that Hilbert's Tenth Problem for $\mathbb{Q}$ is undecidable, resolving one of the biggest open problems in the area. However, a conjecture of Mazur implies that the integers are not existentially definable in the rationals. Although proving that an existential definition of $\mathbb{Z}$ in $\mathbb{Q}$ does not exist appears to be out of reach right now, the authors show that when we consider all algebraic extensions of $\mathbb{Q}$, this is the generally expected outcome. Namely, they prove that in most algebraic extensions of the rationals, the ring of integers is not existentially definable. To make this precise, they view the set of algebraic extensions of $\mathbb{Q}$ as a topological space homeomorphic to Cantor space. In this light, the set of fields which have an existentially definable ring of integers is a meager set, i.e., is very small. On the other hand, by work of Koenigsmann and Park, it is possible to give a universal definition of the ring of integers in finite extensions of the rationals, i.e., in number fields. Still, they show that their results do not extend to most algebraic infinite extensions: the set of algebraic extensions of $\mathbb{Q}$ in which the ring of integers is universally definable is also a meager set. The paper has been submitted to Arxiv.

(d) *Corwin* worked on a project entitled "Selmer Varieties for Elliptic Motives." The main point of the project is to take the explicit motivic Chabauty-Kim method developed in papers of Dan-Cohen–Wewers and Dan-Cohen and the author and make it work for non-rational curves. In particular, the author calculates the abstract form of an element of the Chabauty-Kim ideal for $Z[1/\ell]$-points on a punctured elliptic curve, and lay some groundwork for certain kinds of higher genus curves. For this purpose, the author develops an "explicit Tannakian Chabauty-Kim method" using $\mathbb{Q}[1/\ell]$-Tannakian categories of Galois representations in place of $\mathbb{Q}$-linear motives. In future work, the author intends to use this method to explicitly apply the Chabauty-Kim method to a curve of positive genus in a situation where quadratic Chabauty does not apply. While this will probably be a single-author paper by Corwin, some of it was inspired by conversations with Mazur. Those conversations were part of the DDC workshop.

(e) *Harizanov-Shlapentokh* project (ongong) is entitled "Automorphism Spectrum Problem for Fields". The automorphism degree spectum of a computable field is the set of the Turing degrees of all automorphisms of a field. They investigated the cases when the spectrum is

closed upwards such as when it consists of all Turing degrees. In particular, they worked on the problem of constructing computable fields that have continuum many automorphisms, but the only computable automorphism is the trivial one. Metakides and Nerode constructed an example of such a field using purely computablity-theoretic techniques, but the authors are working on developing a general algebraic structural result explaining this and similar phenomena in a clear algebraic way. There is a working draft of the project.

(f) *Calvert-Cenzer-Harizanov* project entitled "Densely Computable Structures" involved developing the theory of approximately computable structures, in particular, generically computable and coarsely computable structures, using the notion of asymptotic density. These notions have been developed for sets in recent years and have been used in generic case complexity of decision problems in groups theory. The authors defined general notions of these structures and introduced a graded family of definability conditions for substructures in which they required that the dense sets under consideration be a strong substructure of the original structure. The resulting paper is close to completion and will be submitted in the near future.

(g) *Elbaz* project involved Enriched Grothendieck rings that are defined below.

An *enriched ring* is a triple (A, a, P) where:

- A is a ring,
- $a \in A$,
- $P \subseteq A$ is a subset of A stable by addition and multiplication such that $P - P = A$.

To any structure M, we can associate the enriched ring $(K_0(M); [M]; P)$ where

- $K_0(M)$ is the Grothendieck ring of M,
- $[M]$ is the class of M in $K_0(M)$,
- $P \subseteq K_0(M)$ is the subset of elements of $K_0(M)$ that correspond to the class of a definable set.

This enriched ring is called the "enriched Grothendieck ring" of M.

We investigate which enriched ring can be obtained if the Grothendieck ring is $\mathbb{Z}$ or a quotient of $\mathbb{Z}$. It turns out that:

(i) For any integer $N \in \mathbb{N}^*$ and $k \in \mathbb{Z}/N\mathbb{Z}$, there exists a structure M whose enriched Grothendieck ring is $(\mathbb{Z}/N\mathbb{Z}; k; \mathbb{Z}/N\mathbb{Z})$.

(ii) There exists a structure M whose enriched Grothendieck ring is $(\mathbb{Z}; k; P)$ if and only if

- either $P = \mathbb{Z}$,
- or $k > 0$ and $P = \mathbb{N}$.

This project originally comes from a question of Yves de Cornulier (though we didn't work together on it eventually).

(h) *Stix* worked on the project entitled "Galois sections and p-adic period mappings." Let X be a variety over a number field k with absolute Galois group Gal_k. A Selmer sections is a section $\mathrm{Gal}_k \longrightarrow \pi_1(X)$ such that the restriction to decomposition subgroups comes from a local point of X for all places of k. We will show that for proper hyperbolic curves X and every finite place v of k the set of v-adic points of X that arise in this way is only a finite number. We will adapt the proof of Lawrence and Venkatesh of the Faltings-Mordell theorem based on p-adic period maps to the case of Selmer sections. Alexander Betts (Harvard) is a co-author on this project.

(i) *Dittmann and Fehm* submitted a paper to the arxiv entitled "Non-Definability of Rings of Integers in Most Algebraic Fields". The authors show that the set of algebraic extensions F of $\mathbb{Q}$ in which $\mathbb{Z}$ or the ring of integers of F are definable is meager in the set of all algebraic extensions.

(j) *Park-Shlapentokh* project (joint with Baliestrieri) concerned the relation between HTP and Inverse Galois Problem. The authors show that in many cases Inverse Galois Problem over a field can be reduced (in the Turing degree sense) to HTP over a subring of the field and in some cases to HTP over the field itself. The reduction to HTP over the field requires results of Dittmann.

(k) *Shlapentokh* project (joint with Langly). In this project the authors constructed a truncation closed embedding of an arbitrary field not algebraic over a finite field into a field of power series.

(l) *Calvert-Harizanov-Shlapentokh* project (ongoing) on Random Fields. A field K is defined to be random if $\mathrm{Gal}(\overline{\mathbb{Q}}/K)$ contains a random element. An element σ of $\mathrm{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$ is defined to be "random" if it is not an element of any computable subgroup of $\mathrm{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$ of Haar measure zero. Finally, a subgroup G of $\mathrm{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$ is defined to be computable, if there is and a computable function from $\bar{\mathbb{Q}}$ to finite subsets of $\bar{Q}$ computing all images of a given element α under the action of G.

(m) *Ho-Miller-Knight* project (ongoing) was on the Spaces of Torsion-Free Abelian Groups of rank n, for various finite n, following work of Hjorth, Thomas, and others, but as computable structure theory rather than descriptive set theory.

(n) *Calvert* worked on a project entitled "Degrees High for Isomorphism" and related notions, jointly with Franklin and Turetsky. The authors survey the relation between degrees that compute isomorphisms between arbitrary isomorphic pairs of computable structures, degrees that uniformly compute back-and-forth relations, degrees that compute jump structures on Harrison orderings, degrees that compute descending sequences in Harrison orderings, and related properties.

(o) *Calvert* worked on a book surveying work at the intersection of several fields, including the following: logics that encode probabilistic information, algorithmic randomness, pseudofinite and random structures, randomized and asymptotic computation, machine learning and finite VC dimension, and dynamical systems.

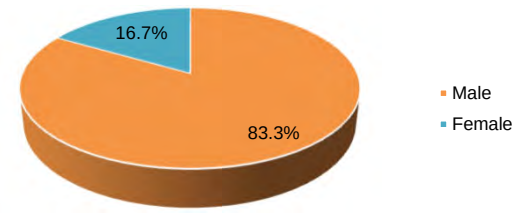
(p) *Cornelissen* worked on a project entitled "Moduli of diophantine maps". He considered triples $(M, \mathscr{L}, \phi)$, where $\mathscr{L} = P_{i,\alpha}$ is a first-order language given by countably many i-ary predicates $P_{i,\alpha}$ and M is a structure with an interpretation ϕ of L , so $\phi(P_{i,\alpha}) \subseteq M^i$ for all α. A subset of some cartesian power $(M^N, \mathscr{L}, \phi^N)$ is called diophantine if its membership can be described by a positive existential formula in $\mathscr{L}$. Given another such triple $(M'.\mathscr{L}', \phi')$, we call a set-theoretic map $f : M \longrightarrow M'^N$ for some integer $N \geq 1$ a diophantine map if $f(M)$ is diophantine in (M'^N) and, for all $\alpha, f^i(\phi(P_{i,\alpha}))$ are diophantine in M'^{Ni}. The goal of the project is to understand the set of such functions f not obtainable via an isomorphism of M or M'.

Postdoc Pre/Post-MSRI Institution Group

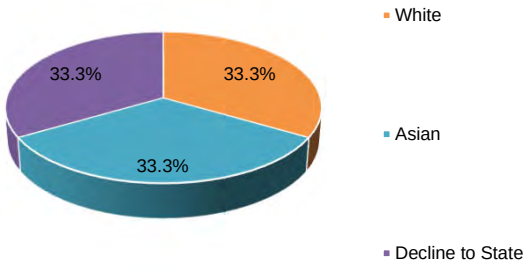
Family Name	First Name	Pre-MSRI Institution Name	Pre-MSRI Institution Group	Post-MSRI Institution Name	Post-MSRI Institution Group
Corwin	David	University of California, Berkeley	Math Public Large Group	University of California, Berkeley	Math Public Large Group
Dittmann	Philip	Technische Universität Dresden	Foreign	Technische Universität Dresden	Foreign
Elbaz	Esther	University Ben Gurion of the Negev	Foreign	TBD	n/a
Ho	Meng-Che	Purdue University	Math Public Large Group	California State University, Northridge	Group M
Kadets	Borys	Massachusetts Insitute of Technology	Math Private Large Group	University of Georgia	Math Public Medium Group
Ye	Jinhe	University of Notre Dame	Math Private Large Group	Sorbonne University	Foreign

2020-21 DDC Postdoctoral Fellow Demographic Summary

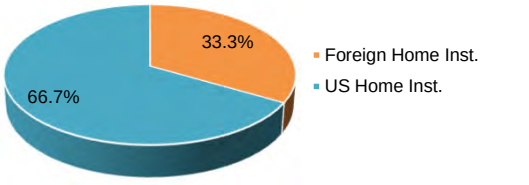
Gender	#	%
# of Distinct Members	6	100.0%
Male	5	83.3%
Female	1	16.7%
Decline to State	0	0.0%



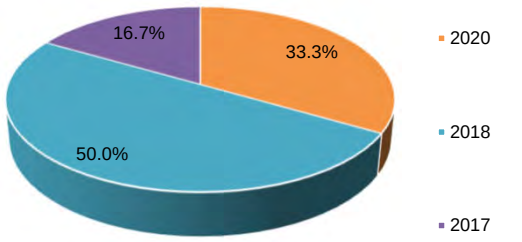
*Race/Ethnicity**	#	%
White	2	33.3%
Asian	2	33.3%
Hispanic/Latino	0	0.0%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	2	33.3%
Unavailable Info.	0	0.0%
Minorities**	0	0.0%



Citizenships	#	%
Foreign Home Inst.	2	33.3%
US Home Inst.	4	66.7%
US Citizen & Perm. Residents	1	16.7%
Foreign Citizens	5	83.3%
US Citizens	1	16.7%
US Permanent Residents	0	0.0%



Year of Ph.D	#	%
2020	2	33.3%
2019	0	0.0%
2018	3	50.0%
2017	1	16.7%
2016	0	0.0%
2015	0	0.0%
Total # of Distinct Postdocs	6	100.0%

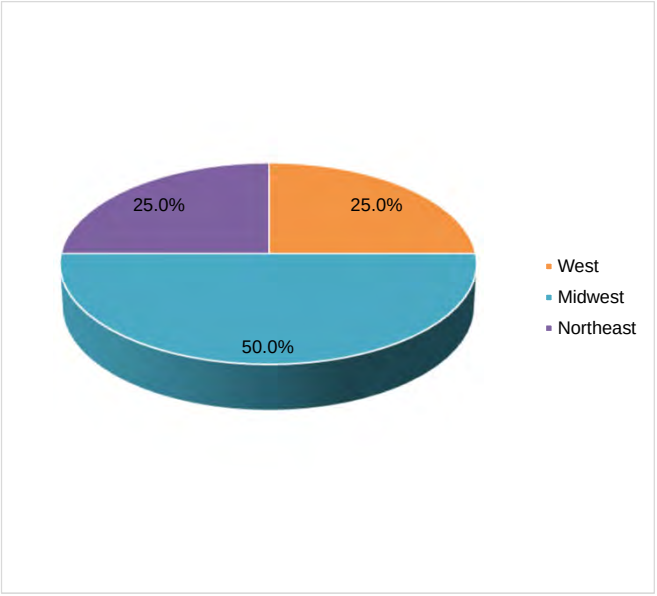


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020-21 DDC Postdoctoral Fellow Classified by States

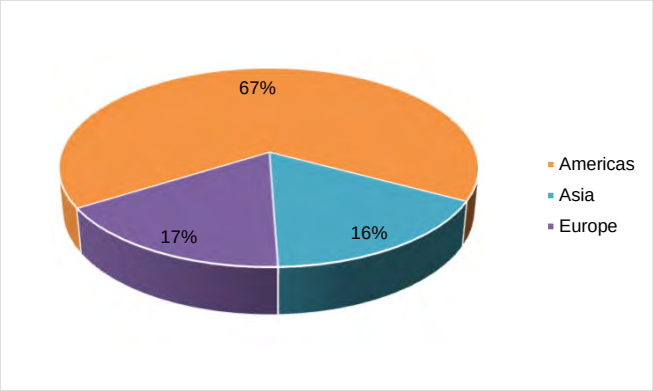
State	#	%	*2020 Census*
South	**0**	**0.0%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.5%*
GA	0	0.0%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	0	0.0%	*1.9%*
MS	0	0.0%	*0.9%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	0	0.0%	*8.8%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**1**	**25.0%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.2%*
CA	1	25.0%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**2**	**50.0%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	0	0.0%	*3.9%*
IN	2	50.0%	*2.0%*
KS	0	0.0%	*0.9%*
MI	0	0.0%	*3.0%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.6%*
SD	0	0.0%	*0.3%*
WI	0	0.0%	*1.8%*
Northeast	**1**	**25.0%**	***17.4%***
CT	0	0.0%	*1.1%*
MA	1	25.0%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	0	0.0%	*6.1%*
PA	0	0.0%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**4**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020-21 DDC Postdoctoral Fellow Classified by Country

Africa			**0**
Americas			**4**
	North America	United States	4
Asia			**1**
	Western Asia	Israel	1
Europe			**1**
	Western Europe	Germany	1
Oceania			**0**
Grand Total			**6**



**Regions based on United Nations classification*

Decidability, definability and computability in number theory: Part 1 - Virtual Semester

Program Summary

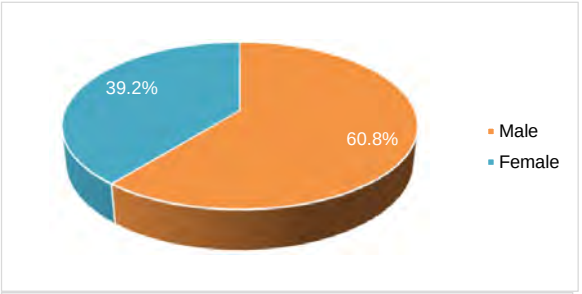
Role	Distinct Members**	%	US Citizens & Perm. Res.	%	Women	%	Minorities*	%
Organizers	6	11.8%	4	66.7%	2	33.3%	0	0.0%
Research Professors	12	23.5%	8	66.7%	4	33.3%	0	0.0%
Postdoctoral Fellows	6	11.8%	1	16.7%	1	16.7%	0	0.0%
Research Members	20	39.2%	7	35.0%	8	40.0%	0	0.0%
Program Associates	7	13.7%	2	28.6%	5	71.4%	1	50.0%
Total # of Distinct Members	**51**	**100.0%**	**22**	***43.1%***	**20**	***39.2%***	**1**	***4.5%***

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.*

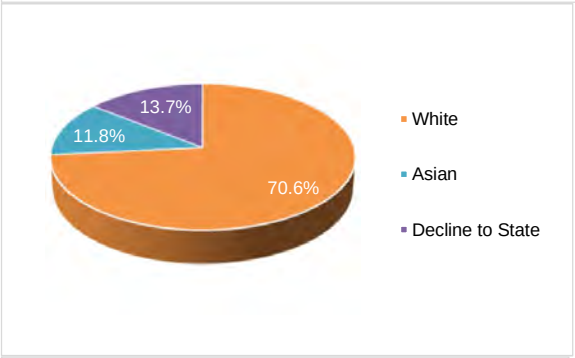
***There were an additional 3 members for whom we cannot confirm virtual participation. They are excluded from these statistics.*

2020–21 DDC Program Members Demographic Summary

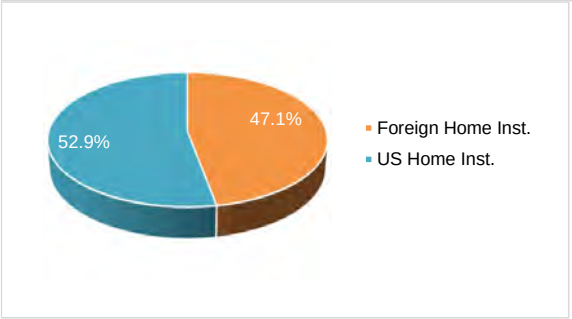
Gender	#	%
# of Distinct Members	51	100.0%
Male	31	60.8%
Female	20	39.2%
Decline to State	0	0.0%



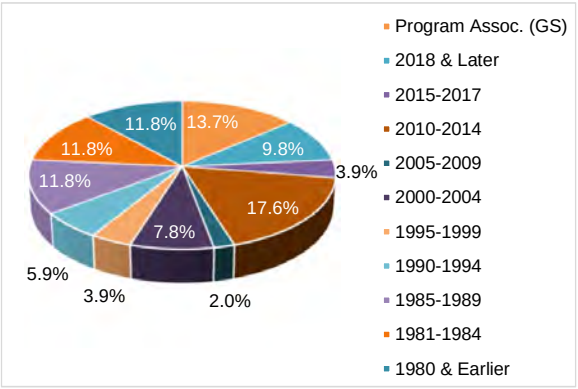
*Race/Ethnicity**	#	%
White	36	70.6%
Asian	6	11.8%
Hispanic/Latino	4	7.8%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	7	13.7%
Unavailable Info.	0	0.0%
Minorities**	1	4.5%



Citizenships	#	%
Foreign Home Inst.	24	47.1%
US Home Inst.	27	52.9%
US Citizens & Perm. Residents	22	43.1%
Foreign Citizens	29	56.9%
US Citizens	22	43.1%
US Permanent Residents	0	0.0%



Year of Ph.D	#	%
Program Assoc. (GS)	7	13.7%
2018 & Later	5	9.8%
2015-2017	2	3.9%
2010-2014	9	17.6%
2005-2009	1	2.0%
2000-2004	4	7.8%
1995-1999	2	3.9%
1990-1994	3	5.9%
1985-1989	6	11.8%
1981-1984	6	11.8%
1980 & Earlier	6	11.8%
Total # of Distinct Members	51	100.0%

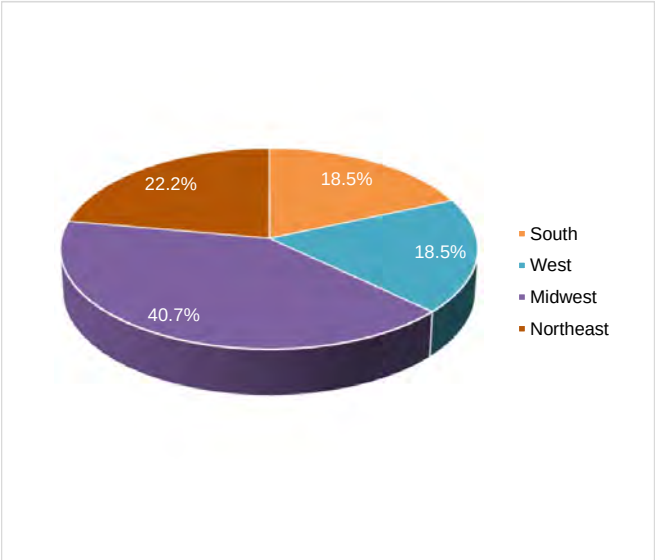


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020–21 DDC Program Members Classified by State

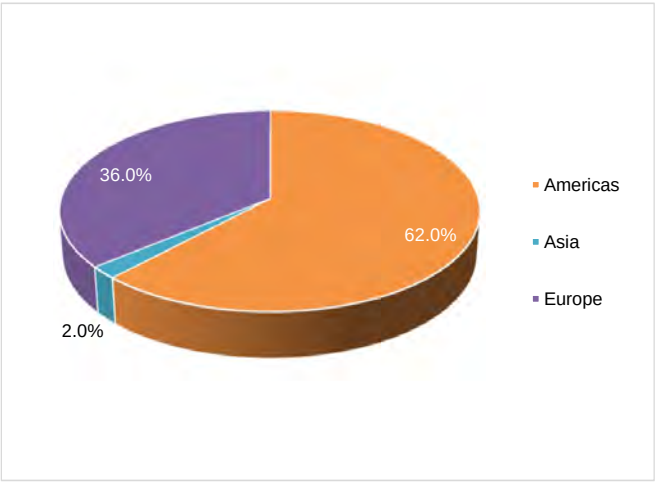
State	#	%	*2020 Census*
South	**5**	**18.5%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	2	7.4%	*0.2%*
FL	1	3.7%	*6.5%*
GA	0	0.0%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	1	3.7%	*1.9%*
MS	0	0.0%	*0.9%*
NC	1	3.7%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	0	0.0%	*8.8%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**5**	**18.5%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.2%*
CA	5	18.5%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**11**	**40.7%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	5	18.5%	*3.9%*
IN	4	14.8%	*2.0%*
KS	0	0.0%	*0.9%*
MI	0	0.0%	*3.0%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	1	3.7%	*3.6%*
SD	0	0.0%	*0.3%*
WI	1	3.7%	*1.8%*
Northeast	**6**	**22.2%**	***17.4%***
CT	0	0.0%	*1.1%*
MA	2	7.4%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	2	7.4%	*6.1%*
PA	2	7.4%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**27**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020–21 DDC Program Members Classified by Countries

Africa			**1**
	Western Africa	Senegal	1
Americas			**31**
	North America	Canada	2
		United States	27
	South America	Chile	2
Asia			**1**
	Western Asia	Israel	1
Europe			**18**
	Eastern Europe	Russian Federatic	1
	Northern Europe	United Kingdom	1
	Southern Europe	Greece	1
		Italy	4
	Western Europe	Belgium	1
		France	4
		Germany	5
		Switzerland	1
Oceania			**0**
Grand Total			**51**



**Regions based on United Nations classification*

Decidability, Definability and Computability in Number Theory: Part 1 - Virtual Semester
August 17, 2020 - December 18, 2020

Total Program Members:	51
Total Survey Respondants:	42
Response Rate:	82%

Note: Questions marked with asterisks (*) were not included on this year's survey due to the virtual nature of the programs.

While at MSRI my research program was advanced in the following ways:

Q1. I learned new ideas/techniques which are applicable to my problems

Yes	29	69%
No	13	31%
Total Responses	42	

Q2. I had opportunities to present my work to new audiences

Yes	33	79%
No	9	21%
Total Responses	42	

Q3. I initiated research with new collaborators

Yes	12	29%
No	30	71%
Total Responses	42	

Q4. I initiated research in new areas

Yes	13	31%
No	29	69%
Total Responses	42	

Q5. My research was advanced in these other ways:

Link to Qualitative Responses

Q6. If your answer to any of the above set of questions was no, what opportunities should MSRI provide to mitigate this?

N/A - This question was not included in the survey for 2020-21.

Q7. MSRI aims to provide a supportive environment for all program participants. How satisfied were you with this aspect of your experience?

1 - Least Satisfying	0	0%
2	2	6%
3	2	6%
4	9	25%
5 - Most Satisfying	23	64%
Total Responses (Exclusive of N/A)	36	100%

Q8. What suggestions would you have for MSRI to provide a more supportive environment?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - For Postdoctoral Fellows: Please rate your level of satisfaction with...

Q9. Your assigned mentor:

1 - Least Satisfying	0	0%
2	0	0%
3	1	17%
4	0	0%
5 - Most Satisfying	5	83%
Total Responses (Exclusive of N/A)	6	100%

Q10. Your overall mentoring experience:

1 - Least Satisfying	0	0%
2	0	0%
3	1	17%
4	1	17%
5 - Most Satisfying	4	67%
Total Responses (Exclusive of N/A)	6	100%

Q11. The lunch meeting with the directorate:

1 - Least Satisfying	0	0%
2	0	0%
3	0	0%
4	1	17%
5 - Most Satisfying	5	83%
Total Responses (Exclusive of N/A)	6	100%

Q12. What suggestions do you have to improve the mentoring experience at MSRI?

Link to Qualitative Responses

MSRI Experience - For Graduate Students

Q13. How much did the Graduate Student Seminar increase your ability to benefit from MSRI's other scientific activities?

1 - Least Satisfying	0	0%
2	0	0%
3	1	50%
4	1	50%
5 - Most Satisfying	0	0%
Total Responses (Exclusive of N/A)	2	100%

MSRI Experience - Program Seminar: Please rate your level of satisfaction with...

Q14. Learning new ideas and techniques:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q15. Forming new acquaintances and collaborations:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q16. The opportunity to present your own work:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

MSRI Experience - General Information

Q17. My office accomodations were

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q18. Professionally, my overall satisfation with MSRI was

1 - Least Satisfying	1	3%
2	4	11%
3	7	18%
4	11	29%
5 - Most Satisfying	15	39%
Total Responses (Exclusive of N/A)	38	100%

MSRI Experience - Feedback

Q19. Did you participate in any of the activities associated with the other MSRI programs or workshops? If so, which ones? Did you find them valuable?

N/A - This question was not included in the survey for 2020-21.

Q20. What aspects of the program, environment, facilities, and relationships with colleagues were most beneficial to you?

Link to Qualitative Responses

Q21. What suggestions would you have for improvements at MSRI?

N/A - This question was not included in the survey for 2020-21.

Q22. What suggestions would you have for future MSRI programs or workshops?

Link to Qualitative Responses

MSRI Experience - Computing Services and Facilities

Q23. How would you rate the computing staff for the support you received while at MSRI

1 - Least Satisfying	0	0%
2	0	0%
3	2	6%
4	4	13%
5 - Most Satisfying	25	81%
Total Responses (Exclusive of N/A)	31	100%

Q24. How would you rate the computing equipment you used at MSRI:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q25. How could we improve our computing services?

N/A - This question was not included in the survey for 2020-21.

Q26. How could we improve our computing equipment and software environment?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - Relocation Advisory Services: How would you rate the following services you received from MSRI?

Q27. Housing Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q28. School and Childcare Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q29. Visa Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q30. How could we improve our relocation advisory services?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - Administrative Support Services

Q31. How would you rate the administrative support you received while at MSRI

1 - Least Satisfying	0	0%
2	0	0%
3	1	3%
4	9	26%
5 - Most Satisfying	25	71%
Total Responses (Exclusive of N/A)	35	100%

Q32. How could we improve our administrative services?

N/A - This question was not included in the survey for 2020-21.

Q33. Your comments about MSRI:

N/A - This question was not included in the survey for 2020-21.

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Random and Arithmetic Structures in Topology

August 17, 2020 to December 18, 2020
MSRI, Berkeley, CA
USA

Organizers:

Martin Bridgeman (Boston College)
Richard Canary (University of Michigan)

FINAL REPORT: RANDOM AND ARITHMETIC STRUCTURES IN TOPOLOGY MSRI RESEARCH PROGRAM, FALL 2020

1. Introduction

The Random and Arithmetic Structures in Topology program aimed to bring together experts and junior faculty to deepen and develop further the connections between randomness, number theory, group actions, geometry and topology. Regrettably, the precautions necessitated by the pandemic forced the program to be altered, and therefore have fundamentally changed the nature and expectations of the program. The primary activities of the program moved on-line. This movement had the unfortunate effect of making the informal interactions which are the fundamental heartbeat of a MSRI program more difficult, although much of this informal activity continued in a less visible manner. The one upside of the program being entirely on-line is that it increased the availability of the program to the entire mathematical community. We estimate that between 150 and 200 mathematicians participated semi-regularly in the program and many more participated occasionally. Overall, we felt that the program was a tremendous success given the constraints it operated under.

2. Research directions

We highlight three of the areas that were prominent themes in the program.

Arithmetic manifolds: Arithmetic hyperbolic manifolds provide the perhaps best studied family of examples whose investigation combines tools from number theory and geometry. In dimension three, non-arithmetic examples can easily be constructed as well, and the solution to the virtual fibered conjecture yields a classification of closed hyperbolic 3-manifolds, at least up to passing to finite quotients. Random hyperbolic 3-manifolds are used to analyze the expected geometric and topological properties and uncover the asymptotic behavior of invariants in towers of covers. This approach aims at understanding the large-scale geometric and topological invariants of such manifolds and the relation to arithmetic properties using tools from random walks on groups, group sieving, geometric representation theory, L^2-invariants, homology with twisted coefficients, and global analysis.

Date: January 29, 2021.

Invariant Random Subgroups: The powerful notion of invariant random subgroup (IRS) provides a framework to study invariants of all hyperbolic manifolds, and, more generally, of all locally symmetric manifolds of non-compact type. Indeed, IRSs can be regarded as generalizations, both of normal subgroups and lattices, which makes this notion particularly rich.

Closely related to IRSs is the so-called Benjamini–Schramm space which is defined to be the space of all Borel probability measures on the space of isometry classes of pointed proper metric spaces equipped with the Gromov–Hausdorff topology. The recently emerged interest in the investigation of this space in the form of Benjamini–Schramm convergent sequences of manifolds and the behavior of their geometric and topological invariants gives a strong connection to (metric) geometry.

Measure theory arises more directly in the concept of measure equivalence relation and cost. Entropy for group actions provides a numerical invariant which in turn sometimes has an interpretation in terms of topological invariants constructed from the group von Neumann algebra over the group ring. The more recent concept of sofic entropy can be studied for a large class of groups, the so-called sofic groups, which comprises all residually finite and all amenable groups.

Ergodic Theory: Methods from ergodic theory have been an important tool in the past thirty years to study questions in number theory, geometry, topology and other fields. Recently, new perspectives opened with the study of randomly constructed manifolds, the powerful notion of invariant random subgroup, and dynamical invariants of groups. Random walks on groups are currently a subject of intense interest.

3. Organizational Structure

Due to the pandemic, the program was held online. We describe how we adapted the program to these new circumstances. There were 6 members of the program who attended in person in Berkeley; Research Professors Martin Bridgeman and Richard Canary, Research Members Michelle Chu and Kasia Jankiewicz and Postdoctoral Members Nicholas Miller and Soumya Sankar. In order to make our program as accessible as possible to worldwide participants, almost all activities took place between 9am and noon Pacific time. The majority of the talks were also recorded and made available on the web so that they could be viewed by mathematicians who were not available during these times.

The organizers of the program were Nicholas Bergeron (ENS-Paris), Jeffrey Brock (Yale), Alexander Furman (Illinois-Chicago), Tsachik Gelander (Weizmann Institute), Ursula Hamenstädt (Bonn), Fanny Kassel (IHES), and Alan Reid (Rice). However, the majority of the program's activities this semester were organized by the participants.

After a long period of uncertainty, planning for the semester began in July. In consultation with early career mathematicians in the program,

it became clear that they would find an introductory workshop especially valuable. The organizing committee for this workshop consisted of Martin Bridgeman, Richard Canary, Michelle Chu, Tommaso Cremaschi, James Farre and David Fisher. Two other mini-courses were given during the semester. We discuss the introductory workshop and other mini-coursees more fully in the next section.

Weekly Seminars and Meetings: The weekly seminars and meetings were

- *Research Seminar:* The research seminar was held on Monday and typically featured two 45 minute talks (usually by members of the program). It was organized by Alessandra Iozzi and and Nicholas Miller.
- *Program Associates Seminar:* This seminar was held on Tuesday. Talks were largely by graduate students who were program associates. It was organized by Michelle Chu, Tommaso Cremaschi and James Farre.
- *Postdoc Research Seminar:* This seminar was generally held on Thursday and consisted largely of talks given by early career mathematicians. It was organized by Tommaso Cremaschi, Soumya Sankar, and Yvon Verberne.
- *"This week I'm thinking about..." Seminar:* This seminar was a weekly 1-2 hour online meeting where each participant is given 10 minutes to discuss a question they are pondering, a difficulty they have encountered, or a discover they have recently made. The other participants then comment on and make suggestions concerning the problem discussed. It was organized by Martin Bridgeman, Soumya Sankar, and Yvon Verberne.
- *Career Development Panel:* The Career Development Panel was a held most weeks and was aimed at addressing Career Issues of early career mathematicians. It was organized by Tommaso Cremaschi and Wesley Calvert (from the Decidability, Definability and Computability Program).
- *Series on Open Questions in Arithmetic, Geometry And Topology (SOQUAGAT)*: This seminar ran weekly during the second half of the semester. The lectures were organized around the theme of open questions in the field with a view to promoting interest in new research directions for the participants. It was organized by Soumya Sankar and Nick Miller.

Mentoring Program and Reading Groups: The MSRI mentoring program, an integral part of the program that offers early career mathematicians regular meetings with assigned senior researchers, was also moved online with each postdoc assigned two mentors whom they met virtually each week.

The organizers also facilitated the creation of a number of online reading groups on subjects. Here is a sample of the topics coverred

- *Topics in Anosov representations* organized by Martin Bobb and Dick Canary
- *Benjamini-Schramm convergence and related topics* organized by Tommaso Cremaschi and James Farre,
- *Anosov groups: local mixing, counting and equidistribution* organized by Leon Carvajales, Fanny Kassel and Beatrice Pozzetti.
- *Nearly Fuchsian surface subgroups of finite covolume Kleinian groups and canonical triangulations of once-punctured torus bundles and two-bridge link complements* organized by Michelle Chu, Franco Vargas Palette, James Farre, and Sami Douba.

Recreating informal interactions and teas: The most difficult part of the typical MSRI semester to replace are the informal interactions which happen between talks and at tea. We tried to recreate this atmosphere as much as possible under the circumstances. As is customary with MSRI programs, the program began with a series of five minute talks (over zoom) where members introduced themselves by giving 5 minute presentations about their research interests. We held nearly daily informal on-line teas. After experimenting with several formats, we ended using Gather.town as the forum for the teas. Finally, the senior local members also organized biweekly social activities for all local members, until the lockdown in the Bay Area made this impossible.

4. Introductory worskhop and mini-courses

The organizing committee for the Introductory Workshop consisted of Martin Bridgeman, Richard Canary, Michelle Chu, Tommaso Cremaschi, James Farre and David Fisher.

Introductory Workshop: We decided to have 6 three hour introductory mini-courses, with topics spanning the different foci of the program, each of which was accompanied by a one hour talk by an early career mathematician. Given that the activities were virtual, and the constraints on the timing of the talks, we spread the workshop over three weeks. The mini-courses are listed below.

- *Geometric Structures on Manifolds*, by Ian Biringer
- *Property T and aTmenability from a Geometric Viewpoint* by Indira Chatterji.
- *Rigidity Phenomena via Ergodic Theory*, by Alexander Furman
- *Anosov Representations*, by Fanny Kassel
- *Arithmetic and Spectral Geometry*, by Lola Thompson
- *Random Walks on Weakly Hyperbolic Groups*, by Giulio Tiozzo

One hour talks related to the minicourses were also given by Martin Bobb, Michelle Chu, Kasia Jankiewicz, Nicholas Miller, Soumya Sankar, and Yvon Verberne. Talk attendance varied between 50 and 100 participants.

Other Minicourses: To take advantage of being online, we also scheduled minicourses later in the semester for those speakers who were unable to participate in the Introductory Workshop. Being online allowed us to reach just as big an audience as the Introductory Workshop. The minicourses were

- *Invariant Random Subgroups and Lattices*, by Tsachik Gelander.
- *Higher Rank Teichmüller-Thurston theories*, by Maria Beatrice Pozzetti.

One hour talks related to these two minicourses were also given by Tomasso Cremaschi and James Farre.

5. Postdoctoral Fellows

The postdoctoral fellows and the junior Research Members played a crucial role in the success of the program. In fact, they took the lead in much of the organization which was deeply appreciated by all involved. Junior researchers Michelle Chu, Tommaso Cremaschi, James Farre, Nicholas Miller, Soumya Sankar, and Yvon Verberne deserves especially high praise for their vital contributions to the program.

As well as playing a vital role in the organization of the program, the postdoctoral fellows were well integrated in the program, playing a co-equal role with the other research members. They initiated many of the reading groups, new seminars ideas (*"This week I'm thinking about..."* and *SOQUAGAT: Series on Open Questions in Arithmetic, Geometry And Topology*) and ran many of the seminars with the senior members in a supporting role.

Mentoring Program: The mentoring program was run online with each postdoctoral fellow assigned a senior mentor that they would meet weekly via zoom. From the postdoctoral report, the program was successful for the majority with a number of postdocs reporting that they started new projects with the help and advice of their mentors. Also at least two postdocs report that they began research collaborations with their mentor which have resulted in joint papers.

Success of Program: From the survey of the postdoctoral fellows, they all found the program helpful for their career development but that the impact of the pandemic and being virtual curtailed the benefits usually offered by an MSRI research program. The main affects were that the virtual program lessened their ability to make new connections and networks, and to forge new research directions through informal meetings and discussions. In spite of these challenges, most describe starting multiple new projects during the program often in collaboration with other program members. One of the postdocs found little to no benefit in having the program virtual. This postdoc also reported not having a good experience with his mentor, which we interpret as evidence that the mentoring program may be even more

important in a virtual program. All postdocs expressed a strong desire to return to in person programming as soon as it is possible.

6. Program Associates

Graduate students were a constant presence at our on-line activities. It seemed that the on-line format may have made it more comfortable for graduate students to ask questions during talks, since there was more questions by graduate student than during typical talks. (This also could have been the result of a particularly interactive group of students participating in the program).

All the feedback we received from graduate students about the program was positive. We include comments from two of the students.

Xialong Han wrote "This semester at the virtual RAS program from MSRI is profoundly helpful, inspiring, enriching, engaging and interesting. I reached out to many people, received lots of helpful feedback about my paper and future research directions, and obtained several useful tips about job applications from various panels.

I would like to thank the PA seminar committee, including Tommaso Cremaschi, Michelle Chu and James Farre. The PA seminar provided the young mathematicians to give a talk to peers and the postdoc. This is very important for the career. We got interesting questions and practiced our confidence in explaining some hard math. The committee are also very helpful and passionate in providing feedbacks for our slides. This is not expected. I made an appointment with Tom to go through the slides and received some comments from James. Various mini courses are also very helpful. Videos recorded allow us to review when necessary. Many videos are the only videos resources for some topics.

I also would like to thank MSRI and its committee, which allows PhD students to participate in such intense workshop for a semester and have an opportunity to interact with so many more experienced mathematicians and peers simultaneously. It is difficult to find such an opportunity outside MSRI. It is tremendously enriching and beneficial, despite the fact that this semester is only virtual. I also would like to thank everyone in the program again. They are so generous and nice. As young mathematicians we get so much attention, helps, resources, feedback, tips and research ideas from other people that are much more than anticipated."

Pat Walsh wrote "I am a graduate student who participated in the PA learning seminar and some of the mini-courses and other seminars - I really enjoyed participating in the PA seminar with other graduate students, and I also think I benefited from the mini-courses and research talks, even if I understood less of those! ..... I am grateful that I was given this opportunity!"

7. Inclusivity

The original organizers took care to recruit and fund a diverse selection of participants. Given that the program was held on-line the major focus of our attempts to encourage inclusivity was in our selection of speakers. We also took care to construct a diverse collection of organizers for our activities.

For example, in the Introductory workshop, three of the six mini-course and four of the six associated talks by early career mathematicans were given by female mathematicians. In addition, one of the two mini-courses given during the semester were given by female speakers.

8. Highlights and Breakthroughs

Although the program was virtual, the program still saw a large number of new collaborations and projects which were facilitated by the program. Here are a number of highlights.

(1) *Mikolaj Fraczyk and Tsachik Gelander:* Research Professor Gelander gave a minicourse on *Invariant Random Subgroups and Lattices*. During the minicourse Professor Gelander discussed a conjecture of Margulis on discrete group actions on Lie groups. The conjecture states that if Γ is a discrete infinite covolume subgroup of a Lie group G then the locally symmetric space $\Gamma\backslash G/K$ has injective balls of any radius. Following the minicourse, one if its participants, Research Member Fraczyk, contacted Professor Gelander and initiated an intensive collaboration which resulted in this paper "Infinite Volume and Infinite Injectivity Radius" which proves the conjecture (https://arxiv.org/abs/2101.00640). The authors also establish similar results for higher rank semisimple groups with Kazhdan's property (T).

(2) Yvon Verberne: During the program Postdoctoral Fellow Yvon Verberne completed the paper "Finite image homomorphisms of the braid group and its generalizations" (see arXiv:2012.01378) with Nancy Scherich. In this paper the authors develop new techniques using multiple totally symmetric sets to count elements in non-abelian finite quotients of the braid group. Applications include improving the lower bound (due to Chudnovsky, Kordek, Li, and Partin) on the cardinality of non-abelian finite quotients of the braid group as well as lower bounds for the finite quotients of the virtual and welded braid groups.

(3) *Giulio Tiozzo:* During the semester, Research Professor Giulio Tiozzo wrote two papers, closely related to the theme of the workshop. These were "The fundamental inequality for cocompact Fuchsian groups" (arXiv:2012.07417) with Petr Kosenko and "Sublinearly Morse Boundary II: Proper geodesic spaces" (arXiv:2011.03481) with Yulan Qing and Kasra Rafi. The first paper proves that the hitting

measure is singular with respect to Lebesgue measure for any random walk on a cocompact Fuchsian group generated by translations joining opposite sides of a symmetric hyperbolic polygon. The second paper continues the author's work on the Morse boundary for a geodesic metric space. In this paper, Tiozzo and collaborators build an analogue of the Gromov boundary for any proper geodesic metric space. Specifically, given a proper geodesic metric space M and a sub-linear function f, they show that the Morse boundary $\partial_f M$ is quasi-isometrically invariant and metrizable. As an application they show that Poisson boundary of the mapping class group $\mathcal{M}(S)$ of a finite type surface S can be realized as the Morse boundary of $\mathcal{M}(S)$ with respect to the the word metric associated to any finite generating set.

(4) *Soumya Sankar:* During the program Postdoctoral Fellow Soumya Sankar completed the two papers "Counting elliptic curves with a rational N-isogeny for small N" (see arXiv:2009.05223) with Brandon Boggess and "Derived equivalences of stacky curves" (see arXiv:2012.02137) with Libby Taylor. In the first paper, the authors count the number of rational elliptic curves of bounded naive height that have a rational N-isogeny, for $N \in \{2, 3, 4, 5, 6, 8, 9, 12, 16, 18\}$. In the second, the authors study derived equivalences of certain stacks over genus 1 curves and develop a theory of integral transforms for these algebraic stacks. One applciation is to answer the question of when two stacky genus 1 curves are derived equivalent. Sankar also started a project on "Rationality of conic bundle threefolds."

(5) *Martin Bridgeman and Franco Vargas Palette:* During the program, Postdoctoral Fellow Franco Vargas Palette and his mentor, Research Professor Martin Bridgeman, worked on a problem concerning the convergence of the Weil-Petersson gradient flow on the deformation space of geometrically finite hyperbolic structures $GF(N)$ on a hyperbolizable three-manifold N. In an earlier paper, Bridgeman, Brock and Bromberg had conjectured that the flow gave a contraction of the deformation space to the unique point minimizing convex core volume in the case when N is acylindrical. Bridgeman, Palette and Bromberg were able to prove the analogous conjecture in the setting of a Bers slice. They expect that their techniques of proof will extend to prove the full conjecture.

(6) *Michelle Chu:* Research Member Michelle Chu, in collaboration with Daniel Groves, showed that if F is a finite abelian group and M is a closed irreducible 3-manifold which is not a graph manifold, then there is a finite cover of M whose first homology group contains a subgroup isomorphic to F. This had previously been established by Sun for closed hyperbolic 3-manifolds, but his techniques do not extend to the general irreducible setting. They also establish an analogue for large classes of hyperbolic manifolds of any dimension.

(7) *Xiaolong Han:* During the semester Program Associate Xiaolong Han completed the paper "Harmonic Forms, Minimal Surfaces and Norms on Cohomology of Hyperbolic 3-Manifolds". The paper generalizes work of Brock and Dunfield relating the Thurston norm and the L^2-norm for harmonic forms on closed hyperbolic 3-manifolds to the cusped case. Han also shows that Brock and Dunfield's inequality is never realized. Han informs us that the advice and mentoring they received in the program was important to its completion, in particular the advice of Postdoctoral Fellow Franco Vargas Pallette.

(8) *Yves Benoist and Dominique Hulin:* Research Professor Benoist and Research Member Hulin produced a number of works during the program. The most significant of these is the paper written in collaboration whose title "Harmonic quasi-isometries of pinched Hadamard surfaces are injective" (see arXiv:2012.08307) is also the main theorem. This extends an old result of Schoen and Yau for compact Riemannian surfaces with negative curvature, and a more recent result of Markovic for the hyperbolic plane. The paper opens new research themes for harmonics maps.

(9) *David Fisher, Mahan Mitra and Wouter van Limbeek:* In joint work Research Professors Fisher and Mitra and Research Member van Limbeek proved a conjecture of Guivarch and Keane from the 1970s which asserts that any recurrent locally compact second countable group has subquadratic growth. This conjecture is closely related to the behavior of random walks on such groups.

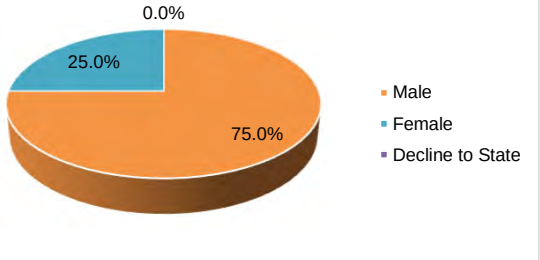
(10) *Dick Canary:* Research Professor Canary initiated a program to study cusped Hitchin representations. The ultimate goal of this project is to develop a theory of the augmented Hitchin component which parallels the theory of the augmented Teichmüller space. The project currently has two pieces. In the first, Canary, Tengren Zhang and Andrew Zimmer develop a theory of cusped Anosov representations of geometrically finite Fuchsian groups which includes the class of cusped Hitchin representations. Key results in this paper are the proof of stability of cusped Anosov representations and that their limit maps, and hence their entropies, vary analytically. In the second part of the project, Harry Bray, Canary, Nyima Kao and Giuseppe Martone develop general counting and equidistribution results for Countable Markov shifts which they then apply to study the dynamical properties of cusped Hitchin representations.

Postdoc Pre/Post-MSRI Institution Group

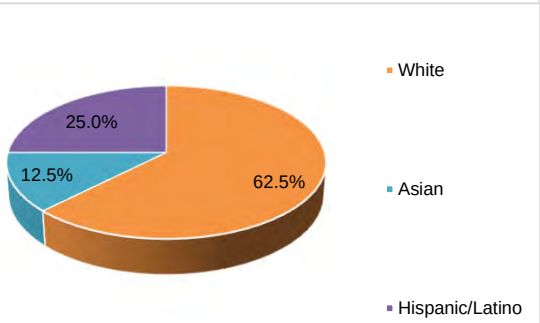
Family Name	First Name	Pre-MSRI Institution Name	Pre-MSRI Institution Group	Post-MSRI Institution Name	Post-MSRI Institution Group
Bobb	Martin	University of Texas	Math Public Large Group	University of Michigan	Math Public Large Group
Carvajales	Leon	Universidad de la República & Sorbonne U.	Foreign	Heidelberg University (Germany)	Foreign
Cremaschi	Tommaso	University of Southern California	Math Private Large Group	University of Southern California	Math Private Large Group
Farre	James	Yale University	Math Private Large Group	Yale University	Math Private Large Group
Miller	Nicholas	University of California, Berkeley	Math Public Large Group	University of California, Berkeley	Math Public Large Group
Sankar	Soumya	University of Wisconsin, Madison	Math Public Large Group	The Ohio State University	Math Public Large Group
Vargas Pallete	Franco	Yale University	Math Private Large Group	Yale University	Math Private Large Group
Verberne	Yvon	University of Toronto	Foreign	Georgia Institute of Technology	Math Public Medium Group

2020-21 RAS Postdoctoral Fellow Demographic Summary

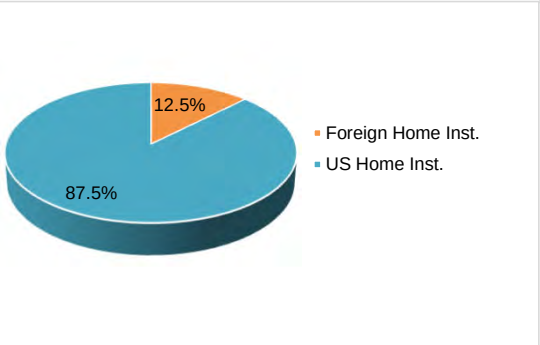
Gender	#	%
# of Distinct Members	8	100.0%
Male	6	75.0%
Female	2	25.0%
Decline to State	0	0.0%



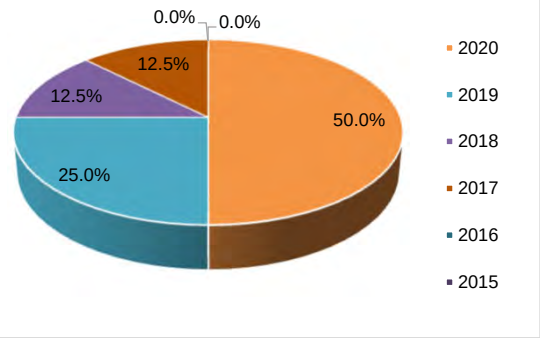
*Race/Ethnicity**	#	%
White	5	62.5%
Asian	1	12.5%
Hispanic/Latino	2	25.0%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	0	0.0%
Unavailable Info.	0	0.0%
Minorities**	1	25.0%



Citizenships	#	%
Foreign Home Inst.	1	12.5%
US Home Inst.	7	87.5%
US Citizen & Perm. Residents	4	50.0%
Foreign Citizens	4	50.0%
US Citizens	3	37.5%
US Permanent Residents	1	12.5%



Year of Ph.D	#	%
2020	4	50.0%
2019	2	25.0%
2018	1	12.5%
2017	1	12.5%
2016	0	0.0%
2015	0	0.0%
Total # of Distinct Postdocs	8	100.0%

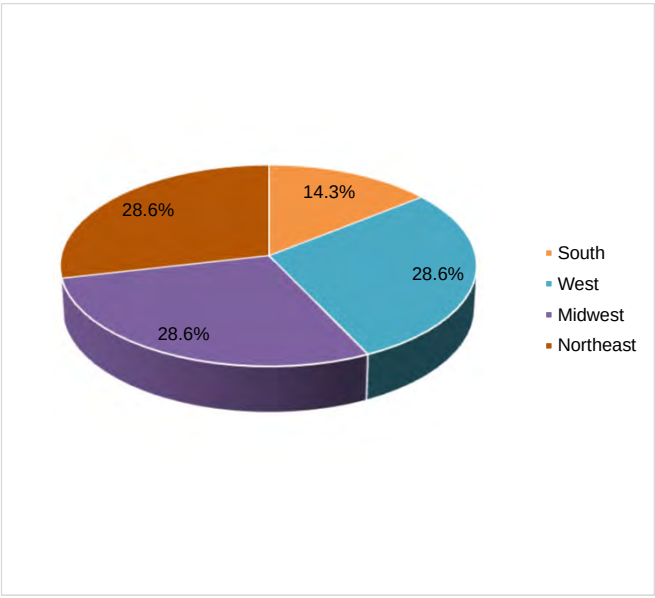


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020-21 RAS Postdoctoral Fellow Classified by States

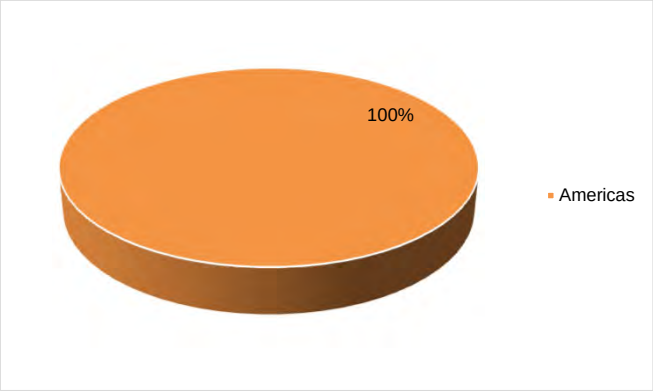
State	#	%	*2020 Census*
South	**1**	**14.3%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.5%*
GA	1	14.3%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	0	0.0%	*1.9%*
MS	0	0.0%	*0.9%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	0	0.0%	*8.8%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**2**	**28.6%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.2%*
CA	2	28.6%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**2**	**28.6%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	0	0.0%	*3.9%*
IN	0	0.0%	*2.0%*
KS	0	0.0%	*0.9%*
MI	1	14.3%	*3.0%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	1	14.3%	*3.6%*
SD	0	0.0%	*0.3%*
WI	0	0.0%	*1.8%*
Northeast	**2**	**28.6%**	***17.4%***
CT	2	28.6%	*1.1%*
MA	0	0.0%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	0	0.0%	*6.1%*
PA	0	0.0%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**7**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020-21 RAS Postdoctoral Fellow Classified by Country

Africa			**0**
Americas			**8**
	North America	United States	7
	South America	Uruguay	1
Asia			**0**
Europe			**0**
Oceania			**0**
Grand Total			**8**



**Regions based on United Nations classification*

Random and Arithmetic Structures in Topology - Virtual Semester

Program Summary

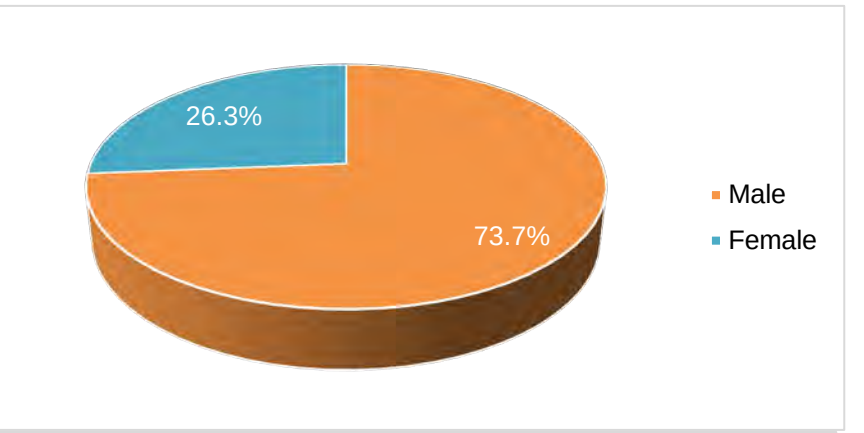
Role	Distinct Members**	%	US Citizens & Perm. Res.	%	Women	%	Minorities*	%
Organizers	6	10.5%	3	50.0%	2	33.3%	0	0.0%
Research Professors	11	19.3%	6	54.5%	2	18.2%	0	0.0%
Postdoctoral Fellows	8	14.0%	4	50.0%	2	25.0%	1	25.0%
Research Members	17	29.8%	5	29.4%	6	35.3%	2	40.0%
Program Associates	15	26.3%	5	33.3%	3	20.0%	2	40.0%
Total # of Distinct Members	**57**	**100.0%**	**23**	***40.4%***	**15**	***26.3%***	**5**	***21.7%***

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.*

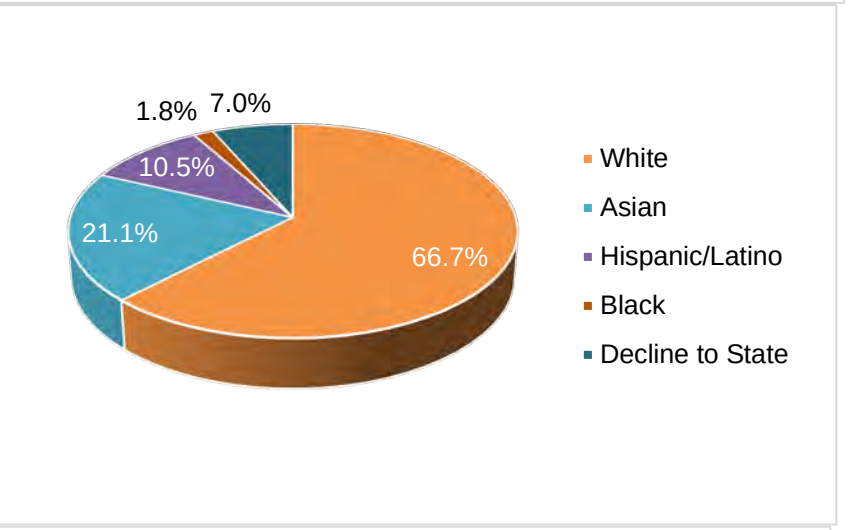
***There were an additional 3 members for whom we cannot confirm virtual participation. They are excluded from these statistics.*

2020–21 RAS Program Members Demographic Summary

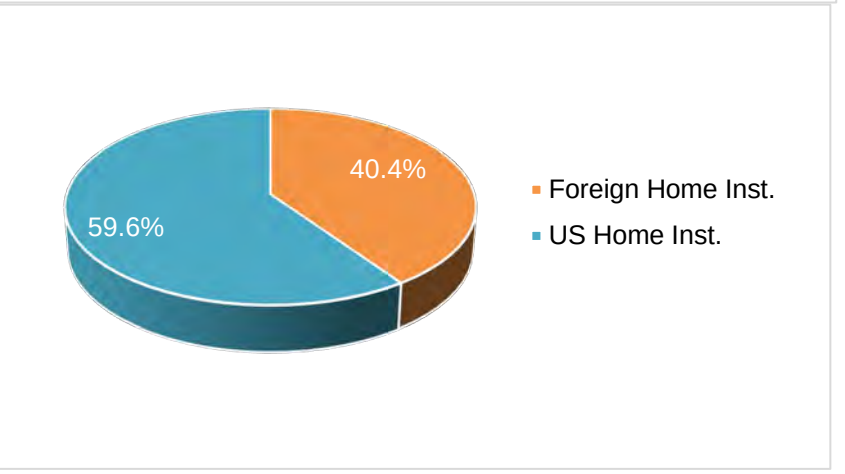
Gender	#	%
# of Distinct Members	57	100.0%
Male	42	73.7%
Female	15	26.3%
Decline to State	0	0.0%



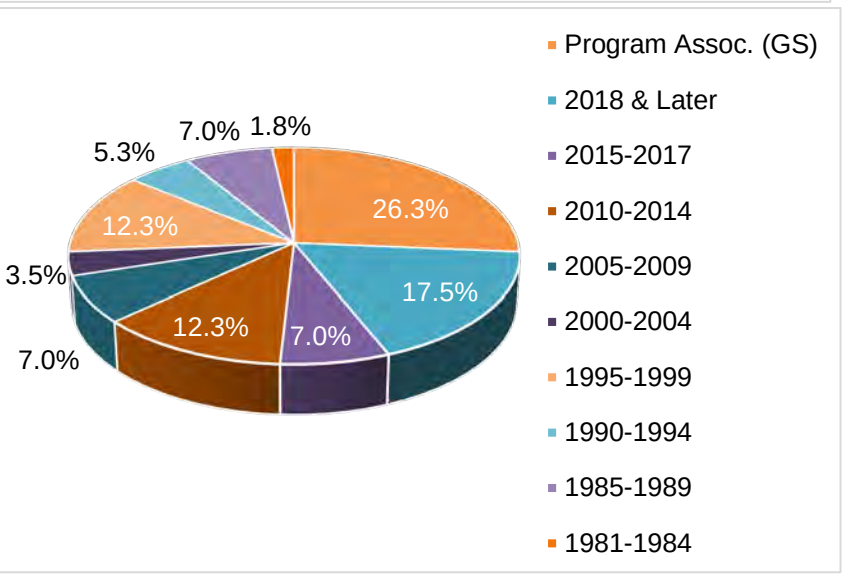
*Race/Ethnicity**	#	%
White	38	66.7%
Asian	12	21.1%
Hispanic/Latino	6	10.5%
Black	1	1.8%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	4	7.0%
Unavailable Info.	0	0.0%
Minorities**	5	21.7%



Citizenships	#	%
Foreign Home Inst.	23	40.4%
US Home Inst.	34	59.6%
US Citizens & Perm. Residents	23	40.4%
Foreign Citizens	34	59.6%
US Citizens	21	36.8%
US Permanent Residents	2	3.5%



Year of Ph.D	#	%
Program Assoc. (GS)	15	26.3%
2018 & Later	10	17.5%
2015-2017	4	7.0%
2010-2014	7	12.3%
2005-2009	4	7.0%
2000-2004	2	3.5%
1995-1999	7	12.3%
1990-1994	3	5.3%
1985-1989	4	7.0%
1981-1984	1	1.8%
1980 & Earlier	0	0.0%
Total # of Distinct Members	57	100.0%

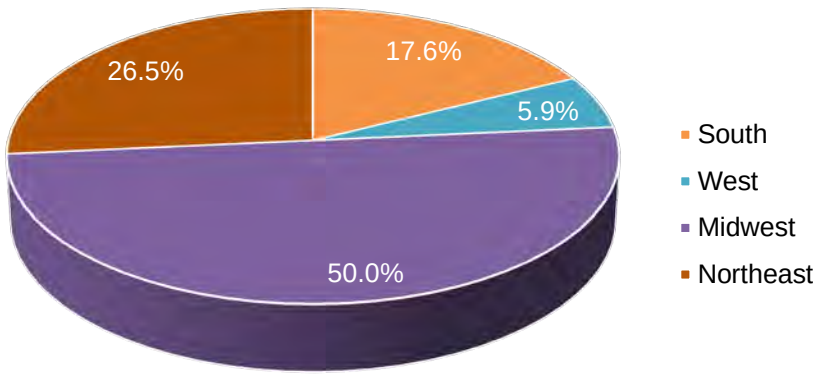


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020–21 RAS Program Members Classified by State

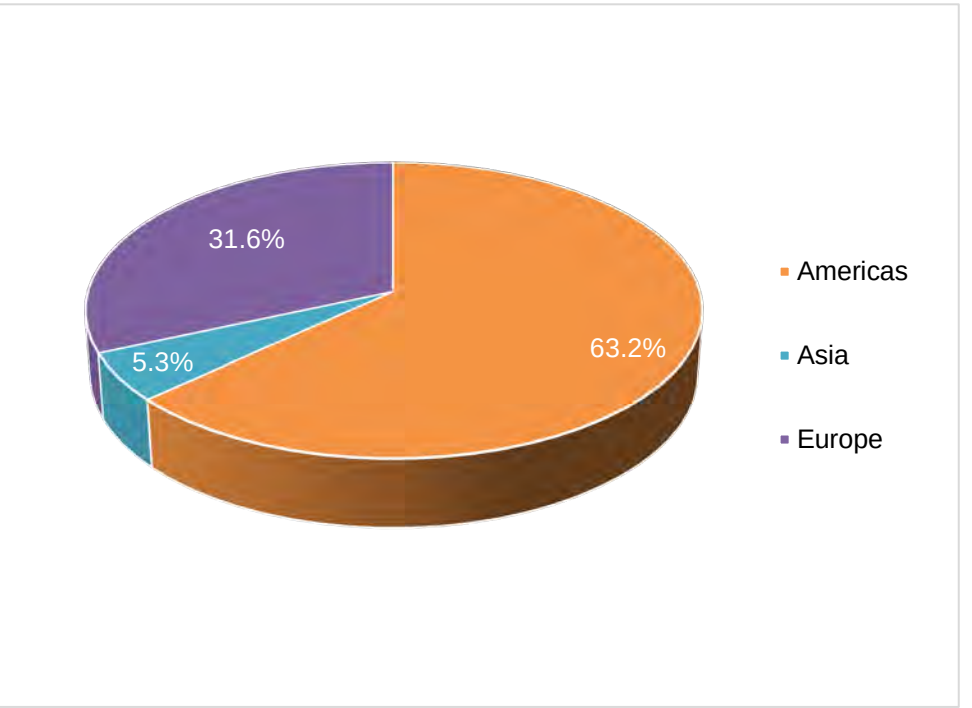
State	#	%	*2010 Census*
South	**6**	**17.6%**	***37.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.1%*
GA	2	5.9%	*3.1%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.5%*
MD	0	0.0%	*1.9%*
MS	0	0.0%	*1.0%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	4	11.8%	*8.1%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.6%*
West	**2**	**5.9%**	***23.3%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.1%*
CA	2	5.9%	*0.4%*
CO	0	0.0%	*0.5%*
HI	0	0.0%	*0.3%*
ID	0	0.0%	*12.1%*
MT	0	0.0%	*1.6%*
NM	0	0.0%	*0.9%*
NV	0	0.0%	*0.7%*
OR	0	0.0%	*1.2%*
UT	0	0.0%	*0.9%*
WA	0	0.0%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**17**	**50.0%**	***21.7%***
IA	0	0.0%	*4.2%*
IL	11	32.4%	*2.1%*
IN	2	5.9%	*1.0%*
KS	0	0.0%	*0.9%*
MI	3	8.8%	*3.2%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	1	2.9%	*3.7%*
SD	0	0.0%	*0.3%*
WI	0	0.0%	*1.8%*
Northeast	**9**	**26.5%**	***17.9%***
CT	3	8.8%	*1.2%*
MA	2	5.9%	*0.4%*
ME	0	0.0%	*2.1%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	1	2.9%	*6.3%*
PA	3	8.8%	*4.1%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**34**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020–21 RAS Program Members Classified by Countries

Africa			**0**
Americas			**36**
	North America	Canada	1
		United States	34
	South America	Uruguay	1
Asia			**3**
	South-central Asia	India	1
	Western Asia	Israel	2
Europe			**18**
	Eastern Europe	Poland	0
		Russian Federatic	0
	Northern Europe	United Kingdom	1
	Western Europe	France	10
		Germany	6
		Switzerland	1
Oceania			**0**
Grand Total			**57**



**Regions based on United Nations classification*

Random and Arithmetic Structures in Topology - Virtual Semester
August 17, 2020 - December 18, 2020

Total Program Members:	57
Total Survey Respondants:	47
Response Rate:	82%

Note: Questions marked with asterisks (*) were not included on this year's survey due to the virtual nature of the programs.

While at MSRI my research program was advanced in the following ways:

Q1. I learned new ideas/techniques which are applicable to my problems

Yes	33	70%
No	14	30%
Total Responses	47	

Q2. I had opportunities to present my work to new audiences

Yes	32	68%
No	15	32%
Total Responses	47	

Q3. I initiated research with new collaborators

Yes	10	21%
No	37	79%
Total Responses	47	

Q4. I initiated research in new areas

Yes	10	21%
No	37	79%
Total Responses	47	

Q5. My research was advanced in these other ways:

Link to Qualitative Responses

Q6. If your answer to any of the above set of questions was no, what opportunities should MSRI provide to mitigate this?

N/A - This question was not included in the survey for 2020-21.

Q7. MSRI aims to provide a supportive environment for all program participants. How satisfied were you with this aspect of your experience?

1 - Least Satisfying	1	3%
2	0	0%
3	2	5%
4	9	23%
5 - Most Satisfying	27	69%
Total Responses (Exclusive of N/A)	39	100%

Q8. What suggestions would you have for MSRI to provide a more supportive environment?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - For Postdoctoral Fellows: Please rate your level of satisfaction with...

Q9. Your assigned mentor:

1 - Least Satisfying	0	0%
2	0	0%
3	1	14%
4	1	14%
5 - Most Satisfying	5	71%
Total Responses (Exclusive of N/A)	7	100%

Q10. Your overall mentoring experience:

1 - Least Satisfying	0	0%
2	0	0%
3	2	29%
4	0	0%
5 - Most Satisfying	5	71%
Total Responses (Exclusive of N/A)	7	100%

Q11. The lunch meeting with the directorate:

1 - Least Satisfying	0	0%
2	1	14%
3	1	14%
4	3	43%
5 - Most Satisfying	2	29%
Total Responses (Exclusive of N/A)	7	100%

Q12. What suggestions do you have to improve the mentoring experience at MSRI?

Link to Qualitative Responses

MSRI Experience - For Graduate Students

Q13. How much did the Graduate Student Seminar increase your ability to benefit from MSRI's other scientific activities?

1 - Least Satisfying	0	0%
2	0	0%
3	2	18%
4	4	36%
5 - Most Satisfying	5	45%
Total Responses (Exclusive of N/A)	11	100%

MSRI Experience - Program Seminar: Please rate your level of satisfaction with...

Q14. Learning new ideas and techniques:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q15. Forming new acquaintances and collaborations:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q16. The opportunity to present your own work:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

MSRI Experience - General Information

Q17. My office accomodations were

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q18. Professionally, my overall satisfation with MSRI was

1 - Least Satisfying	3	7%
2	8	20%
3	5	12%
4	12	29%
5 - Most Satisfying	13	32%
Total Responses (Exclusive of N/A)	41	100%

MSRI Experience - Feedback

Q19. Did you participate in any of the activities associated with the other MSRI programs or workshops? If so, which ones? Did you find them valuable?

N/A - This question was not included in the survey for 2020-21.

Q20. What aspects of the program, environment, facilities, and relationships with colleagues were most beneficial to you?

Link to Qualitative Responses

Q21. What suggestions would you have for improvements at MSRI?

N/A - This question was not included in the survey for 2020-21.

Q22. What suggestions would you have for future MSRI programs or workshops?

Link to Qualitative Responses

MSRI Experience - Computing Services and Facilities

Q23. How would you rate the computing staff for the support you received while at MSRI

1 - Least Satisfying	1	3%
2	1	3%
3	2	6%
4	5	14%
5 - Most Satisfying	27	75%
Total Responses (Exclusive of N/A)	36	100%

Q24. How would you rate the computing equipment you used at MSRI:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q25. How could we improve our computing services?

N/A - This question was not included in the survey for 2020-21.

Q26. How could we improve our computing equipment and software environment?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - Relocation Advisory Services: How would you rate the following services you received from MSRI?

Q27. Housing Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q28. School and Childcare Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q29. Visa Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q30. How could we improve our relocation advisory services?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - Administrative Support Services

Q31. How would you rate the administrative support you received while at MSRI		
1 - Least Satisfying	1	2%
2	0	0%
3	2	5%
4	6	15%
5 - Most Satisfying	32	78%
Total Responses (Exclusive of N/A)	41	100%

Q32. How could we improve our administrative services?

N/A - This question was not included in the survey for 2020-21.

Q33. Your comments about MSRI:

N/A - This question was not included in the survey for 2020-21.

MSRI
Mathematical Sciences Research Institute
17 Gauss Way Berkeley, CA 94720-5070 p: 510.642.0143 f: 510.642.8609 www.msri.org

Mathematical Problems in Fluid Dynamics

January 19, 2021 to May 28, 2021
MSRI, Berkeley, CA
USA

Organizers:

Thomas Alazard (École Normale Supérieure Paris-Saclay; Centre National de la Recherche Scientifique (CNRS))
Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS))
Mihaela Ifrim* (University of Wisconsin-Madison)
Igor Kukavica (University of Southern California)
David Lannes (Intitut de Mathématiques de Bordeaux; Centre National de la Recherche Scientifique (CNRS))
Daniel Tataru* (University of California, Berkeley)

FINAL REPORT ON MSRI PROGRAM "MATHEMATICAL PROBLEMS IN FLUID DYNAMICS"

1. Introduction

The semester-long jumbo research program Mathematical Problems in Fluid Dynamics was proposed and organized by Thomas Alazard, Hajer Bahouri, Mihaela Ifrim, Igor Kukavica, and Daniel Tataru.

The goal of the semester was to bring together a strong selection of both established researchers and more junior members, working on various aspects of fluid dynamics. Unfortunately, the pandemic forced us to move the program almost entirely online, with very few researchers present in person at MSRI, mainly toward the end of the program. This had a mixed impact on the program: on one hand, there was some dampening of the informal interactions between senior participants; but on the other hand, there was some increase in the informal interactions between young and more senior participants. To balance these circumstances, we have striven to enhance the organized aspects of our program.

Some researchers who had planned to be at MSRI for the entire duration of the program ended up participating less due to their duties at their home institutions. On the positive side, some who would not have been able to travel and participate in person were instead able to participate virtually. This led to perhaps greater participation than we might have had if the program were in person. Overall, we believe that, given the circumstances, the program was very successful.

One thing we believe had a significant impact on the level of participation in our program was the extra summer month of program we were promised in the following year(s). This has provided participants with an additional incentive, knowing that there will be an opportunity to discuss the results of their work as an outcome of the program. Our very ambitious postdoctoral fellows were also talking about this opportunity. We truly believe this mix of online and a later month in person month turn out to be a very productive setting.

2. Research directions

We have informally divided the program into four major areas, though with a substantial overlap:

Free boundary problems in fluid dynamics. Free boundary problems in fluid dynamics have attracted much attention in recent years. The most popular equations come from the water wave problem. This is both a very complex physical phenomenon, related to almost every aspect of life on the planet, and a classical subject of mathematical analysis studied since the nineteenth century with the works of Cauchy and Stokes. Water waves pose rich and exciting challenges that have been explored during this program by a large panel of researchers at the highest international level.

Date: July 3, 2021.

Recent advances concerning the study of the Cauchy problem, the asymptotic behavior of solutions for large time or the existence of some special solutions have been discussed during the semester. Many talks reported recent results, combining multiple methods and ideas in a novel way, including questions of microlocal analysis, formation and propagation of singularities, existence of solitary waves and their stability, to name a few problems.

The water wave problem was much discussed during the three workshops, the seminar *Water waves and other interface problems*, as well as the Chancellor Professor's course. The program also addressed many issues related to other free-boundary problems (such as the Muskat equation) or to equations that appear in various asymptotic regimes (in particular with the seminar *Model problems in fluid dynamics*). The program considered both pure and applied questions and many related questions were addressed in the seminar *Applied Fluids*.

Incompressible Euler flows. The Euler equations are a principal model for a motion of an inviscid incompressible fluid. Understanding the behavior of solutions is one of the most important objectives in the analysis of PDEs. There are many outstanding questions regarding the Euler equations. Some of the most well-known open problems are the global existence of solutions, inviscid limit problem, the question of energy conservation, turbulence, the long-time behavior of solutions, and the regularity of solutions of the free boundary problems.

While all the activities during the semester were in some way connected with either the Euler equations or their viscous counterpart the Navier-Stokes equations, we particularly emphasized within the seminar *Mathematical problems in fluid dynamics*, which was held once weekly with two talks every Thursday. The seminar aimed at bringing together diverse group of researchers working on different aspects of the Euler and the Navier-Stokes equations. The principal aim was to allow the program members to present their research, create an opportunity for mathematical discussions and possibilities for new collaborations, and to promote early career mathematicians, who were postdocs at the program. Among the presenters, five were the MSRI postdocs (Novack, Miller, Leslie, Xu, and Wang), and all were given an opportunity to present their research toward the beginning of the semester. Three of the presenters (Hmidi, Kiselev, Shrecker) were outside speakers, while the other speakers were the senior members of the program. The talks addressed the current developments in diverse areas of fluid dynamics, including the regularity questions of the inviscid equations, the connection between kinetic and fluid equations, the Euler equations with the evolving boundary, the mathematical theory of turbulence, convex integration, the primitive equations of the ocean and the atmosphere, compressible and nonhomogeneous models, and the control of fluids.

Incompressible Navier-Stokes. The Navier-Stokes equations, which first appeared in the early 18th century, are still relevant, whether for global regularity or fluid-structure interaction, the vanishing viscosity problem, and many other problems. Although the study of the Navier-Stokes equation is a mature topic, several important questions still remain unanswered. Thus, the program was first an opportunity to provide an overview of these questions (with all points of view) through the different courses (e.g., the two-hour mini-course on boundary layers in the connecting workshop "Mathematical Problems in Fluid Dynamics" and the introductory workshop "Mathematical Problems in Fluid Dynamics") as well as through the presentations in the seminars and the main workshop. Second, there

was also considerable discussion of all the recent advances in research on related equations. Finally, through the discussions after the lectures or on Gathertown, the goal was to foster interactions (and perhaps collaborations) among the participants. The fact that the program took place virtually allowed young participants from many countries, for whom in-person participation would have been challenging, to have contact with researchers from around the world (asking questions, making progress on their thesis, and establishing connections). Each week, an Euler/Navier Stokes seminar was organized, in which all members (and especially all post-docs in the program) working on this topic gave a talk. In the order of their presentations, the speakers were Danchin, Constantin, Gallagher, Novack, Hmidi, Miller, Ibrahim, Leslie, Monniaux, Kiselev, Sverak, Xu, Iftimie, Kelliher, Sueur, Wang, Sammartino, Friedlander, Schrecker, Tuffaha, Gérard-Varet, Jang, Triggiani and Pasqualotto.

Applied fluids. Many international experts of mathematical fluid dynamics were present at this program, most of them theoreticians. We felt that it was an excellent opportunity to present to these researchers some important issues met in real-life problems where fluid dynamics are involved. We, therefore, held an applied seminar where all program members could expose their most applied research, and also invited international experts working in some very active applied research topics.

Thanks to this seminar and to the discussions on Gathertown or Sococo, many fruitful interactions have developed. For instance, many discussions arose on the topics of fluid-structure interactions, where several approaches could be shared and discussed by the participants: bridges between different applied topics (e.g. artery-blood interaction for medical aspects and wave-structure interactions for marine renewable energies), discussion of various general technical approaches (role of augmented systems, the omnipresence of hidden regularity effects, etc.) or in-depth discussion of the properties of stratified flows (convection, dispersion, fluid mixing, etc.), among others.

There was a common sentiment that these interactions have been fruitful both for the applications (because some technical issues could be removed) and for more theoretical aspects since some of the applied problems presented here lead to difficult open mathematical problems.

The following researchers gave a talk at the applied fluid seminar: D. Bresch, R. Bianchini, S. Canic, C. Doering, D. Clamond, J. He, P. Rao, A. Tarfulea, T. Pham, C. Choquet, and C. Rhode. About one third of these people are young researchers; speaking at this seminar gave them the opportunity to interact (on GatherTown and Sococo) with more senior members, as this would have been the case in an in-person event.

3. Workshops

Despite the pandemic, we strongly felt that we should run a full array of workshops during the semester. However, to adapt to the distribution of both speakers and the audience over many time zones, primarily in US and Europe, we have scheduled all the talks in the morning, between 8 am and 12 pm pacific time. The workshops took place on Zoom, with coffee breaks held on GatherTown. All three workshops had a broad audience from the US, Europe, and Asia. We had three workshops in our program:

3.1. **Connections Workshop: Mathematical problems in fluid dynamics.** The workshop, which marked the opening of the semester, featured talks by prominent female mathematicians whose research lies in and interfaces with mathematical fluid mechanics. The talks concerning recent developments in mathematical fluid mechanics from the point of view of the analysis of partial differential equations were geared to a diverse and broad audience from all over the world and was highly successful.

There was a two-hour mini-course by Anne-Laure Dalibard on boundary layers aimed at students and junior researchers, and a series of more advanced talks emphasizing water waves, free boundaries, fluid structures, viscous fluids, and kinetic theory.

The program was as follows:
W: Anne-Laure Dalibard/Helena Nussenzveig-Lopes/Natasa Pavlovic
T: Colette Guillopé/Vera Hur
F: Anne-Laure Dalibard/Inwon Kim/Yao Yao

Organizers:

- Hajer Bahouri (Sorbonne Université)
- Juhi Jang (University of Southern California)
- Anna Mazzucato (Pennsylvania State University)
- Sijue Wu (University of Michigan)

3.2. **Introductory Workshop: Mathematical problems in fluid dynamics.** The workshop addressed the PDE analysis of the fundamental equations of the incompressible fluid dynamics (the Euler equations for inviscid flows, the Navier Stokes equations for viscous flows), interface problems (water waves), and other related equations. Open problems and connections to related branches of mathematics were discussed, including the phenomena of turbulence and the zero viscosity limit. Both theoretical and numerical aspects of these topics were considered. There were some introductory-style lectures as well as shorter research talks. The introductory lectures comprised four series of two or three lectures, given by leaders in their fields, with a goal of providing accessible presentation of a topic from its foundations up to some elements of current research. We have had three talks by Jean-Yves Chemin about incompressible Navier-Stokes equations, three talks by Camillo De Lellis concerning the DiPerna-Lions theory for transport equations and its recent advances, three lectures by Daniel Tataru, devoted to interface problems for gravity/capillary water waves and two lectures by Jon Wilkening related to the numerical study of quasi-periodic water waves. These series of lectures were complemented by talks in related areas, mostly by junior speakers.

To give a better idea about the structure, the workshop's complete schedule was

Monday, January 25		Tuesday, January 26		Wednesday, January 27	Thursday, January 28		Friday, January 29	
8:00-9:00	C. De Lellis	8:30-9:30	J.-Y. Chemin		8:00-9:00	C. De Lellis	8:30-9:30	J.-Y. Chemin
	Tea Break		*Tea Break*			*Tea Break*		*Tea Break*
9:30-10:30	C. De Lellis	10:00-11:00	J.-Y. Chemin		9:30-10:30	V. Vicol	10:00-11:00	V. Banica
	Tea Break					*Tea Break*		
11:00-12:00	J. Bedrossian				11:00-12:00	T. Elgindi		
Chair	D. Tataru		C. de Lellis			J. Bedrossian		S. Wu

Monday, February 1		Tuesday, February 2		Wednesday, February 3	Thursday, February 4		Friday, February 5	
8:00-9:00	D. Tataru	8:30-9:30	J. Wilkening		8:30-9:30	D. Tataru	8:30-9:30	D. Lannes
	Tea Break		*Tea Break*			*Tea Break*		*Tea Break*
9:30-10:30	D. Tataru	10:00-11:00	J. Wilkening		10:00-11:00	T. Hou	10:00-11:00	K. Schratz
	Tea Break							
11:00-12:00	S. Wu							
Chair	V. Banica		T. Hou			K. Schratz		J. Wilkening

Note: The indicated times are Pacific Standard Time. For Central European Time, add 9 hours.

Organizers:

- Nicolas Burq (Université Paris-Saclay)
- Anne-Laure Dalibard (Sorbonne Université)
- Jean Marc Delort (Université Sorbonne Paris Nord)
- Mihaela Ifrim (University of Wisconsin-Madison)
- Irena Lasiecka (University of Memphis)
- Vladimir Sverak (University of Minnesota Twin Cities)

3.3. **Main workshop: Recent Developments in Fluid Dynamics.** This workshop was organized by the six organizers of this semester. One of the main objectives was to gather a strong group of experts in fluid dynamics. The MSRI program "Mathematical Problems in Fluid Dynamics" has chosen the central part of fluid dynamics, namely the study of incompressible fluids. This is still a very broad area, encompassing not only the study of the incompressible Euler and Navier-Stokes equations, but also the study of interface and free boundary problems (water waves), as well as a wide range of related applied topics. Theoretical and numerical aspects of these topics were examined during this workshop, with the main topics interwoven throughout the workshop. There were 35 talks over three weeks, with three talks on Mondays, Tuesdays, Thursdays, and Fridays. In brief, the program was as follows:

M : Jean-Marc Delort / Herbert Koch / Pierre Raphael. Chair : Tataru.
T : Thierry Gallay / Didier Bresch / Frederic Rousset. Chair : Bahouri.
T : Juhi Jang / Albert Ai / Luis Vega. Chair : Kukavica.
F : Peter Constantin / Valeria Banica / Roberto Camassa. Chair : Lannes.
M : Sijue Wu / Eric Wahlen / John Hunter. Chair : Ifrim.
T : Irena Lasiecka / Nicolas Burq / Tristan Buckmaster. Chair : Bresch
T : Anna Mazzucato / Perrin / Benoit Pausader. Chair : Alazard
F : Camillo De Lelis / Mihaela Ignatova / Nader Masmoudi. Chair : Jang.
M : Tarek Elgindi / Jacob Bedrossian / Paul Milewski. Chair : Mazzucato.
T : Vlad Vicol / Frank Sueur. Chair : Lasiecka.
T : Charles Doering / Anne-Laure Dalibard / Emmanuel Dormy. Chair : Koch.
F : Terrence Tao / Pierre Germain / Vladimir Sverak. Chair : Jean-Marc Delort.

4. Organizational Structure

Since the pandemic has inherently dampened the informal part of the program, we have decided to put a greater emphasis on the organized part of the program. To help participants know each other, we have started with a session of five-minute talks, where all were invited to participate. Most of the program members enthusiastically agreed, so this session was spread over two days.

Our many research seminars were organized around the topics described above and were run primarily by the program organizers and a few senior participants. To accommodate multiple time zones, all the seminars were held in the morning.

To allow everyone to follow the seminars, the presentations at the conferences or the courses, almost all of the speakers agreed to have their presentations recorded. MSRI played a crucial role here. The lectures were recorded by Joey Delgadillo. Not only did he record the lectures, but he also did a lot of editing to fit the screen size, to start the recording and end it at the right time, and to put the lectures online in a timely manner. It would have been impossible for the organizers to manage all of this without the help of MSRI. MSRI has also kindly agreed to record the 40 Chancellor Professor lectures. We have had a lot of very positive feedback about this. Also, on the very few occasions when a talk was not posted online right away, we received messages asking if it would be possible to post it, which shows that many people were regularly following the talks in this way, especially in Asia, because of the time difference.

Weekly seminars and meetings. In chronological order, these were as follows:

- *Research seminar: Model problems in Fluid dynamics.* This was held on Monday mornings, and usually featured one 50 minute talk followed by discussion and then Tea Time. It was organized by Herbert Koch.
- *Research seminar: Water waves and other interface problems.* This was held on Tuesday mornings, and usually featured two 50 minute talks followed by discussion and then Tea Time. It was organized by Mihaela Ifrim and Daniel Tataru.
- *Graduate student seminar.* This was held on Wednesday mornings. Talks were given by graduate students who were associated with the program, typically two every day. It was organized by Thomas Alazard and Jean-Marc Delort.
- *Research seminar: Incompressible Euler and Navier-Stokes.* This was held on Thursday mornings, and featured two 50 minute talks followed by discussion and then Tea Time. It was organized by Hajer Bahouri and Igor Kukavica.
- *Research seminar: Applied Fluids.* This was held on Tuesday mornings, and featured one 50 minute talk followed by discussion and then Tea Time. It was organized by Didier Bresch and David Lannes.
- *Career development Panel.* This was held most weeks on Fridays, and was aimed at addressing career issues of early career mathematicians. It was organized by Siddhant Agrawal and Thibault de Poyferre.

Chancellor Professor's course. This online course was held by Thomas Alazard, for three hours a week, for the full 15 weeks duration of the Berkeley academic semester. The course was entitled "Free surface flows in fluid dynamics" and was attended by graduate students from Berkeley or the MSRI program, from several universities in the United States

and other locations. Many colleagues from the program also attended the course, including many of the program postdocs. For most of the course, there were around 45 participants, until the main workshop started. After that, the audience remained steady with about 25 people attending all of the lectures. Lecture notes were posted each week to free up participants from note-taking. The final course notes are available online (300 pages or so, containing over 80 percent of the material covered during the courses and many supplements). Overall, this was a very successful course, which played a major role in strengthening the cohesion of the program.

Mentoring program. For our program this has been organized at two levels, for postdocs and for graduate students.

(1) At the postdoc level, we made a concerted effort to both mentor and fully integrate the postdocs within the program framework. Each postdoc was assigned a mentor by the organizers, usually with weekly meetings. The outcome of some of these pairings is a collaboration between the two. The program organizers, together with MSRI, periodically received feedback from postdocs, and took action to bring things back on track when necessary.
(2) At the graduate student level, the two organizers of the graduate student seminar, Thomas Alazard and Jean-Marc Delort, have supplemented the seminar talks with extensive, aptly named "debriefings", providing the graduate student speakers with valuable feedback and advice. Some of these debriefings were relatively short (10 minutes), and some were longer, when it was useful to make general comments as well as more specific comments, slide by slide. The organizers had also prepared a short text (one-page document) that gives important tips for preparing a presentation. It is indeed difficult to prepare a mathematical presentation, and, in the opinion of the organizers, some guidelines and constraints could help the graduate students to focus on the essentials.

Recreating informal interactions and teas. As we have learned throughout the pandemic, one of the greatest challenges of online set-ups is to recreate the natural informal connections occurring within an on-site program. There were several such venues which we organized:

- Tea times on Sococo, following each research seminar, as well as random Zoom meetings. To reproduce informal discussions that occur at in-person events, we mainly used two tools. The first one is Gathertown, a platform for free discussions in an informal setting. Following each research seminar, all the participants were invited to meet on Gathertown. This was the opportunity to have further discussions with the speaker, but it was also a place where we knew we could meet other members. It was therefore a good place to meet with other members without having to use a formal zoom invitation. The second tool we used was random Zoom meetings. All the participants were divided into several groups of 4-5 persons for 10 minutes. This was an excellent opportunity for young and senior members to interact – a more straightforward one than Gathertown, but very useful nonetheless.

- The postdoc social hour was organized by the postdocs themselves every Wednesday. It was also attended by some of the graduate students, and on occasion by some of the organizers, in order to take the pulse of the group.
- In-person social gatherings. Toward the end of the program, as the pandemic restrictions were slightly relaxed, we were able to have a few group activities for the program participants present in Berkeley. These were organized by Mihaela Ifrim and Daniel Tataru, and had a high tide of 15 participants in the last day of the program.

5. Postdoctoral fellows

The 13 postdoctoral fellows played an essential part in the success of the program, and also were some of the most active and enthusiastic participants, both in seminars and workshops, on GatherTown, as well as in person. They also played a crucial part in organizing some of the program activities.

To facilitate their integration, we have decided not to have a targeted Postdoc Research Seminar, and instead have the postdocs involved in the regular seminars. We believe that this strategy paid off, and we were positively surprised by the level of postdoc interaction during the after-talk discussions.

All postdocs were very involved in the various activities of the programs. They attended all conferences, where there were among the most active in the discussions, participated in most social events, and also organized some social activities. Annalaura Stingo organized the 5-minute presentations, Thibault de Poyferré and Siddhant Agrawal organized the career development seminar.

6. Inclusivity

We share MSRI's dedication to equity, diversity, and inclusiveness. The program organizers carefully selected and recruited a diverse selection of participants, both within the group of program members and the group of postdocs. The selection of speakers for both workshops and the research seminars also reflected similar considerations; indeed, early-career mathematicians and women participants comprised a substantial portion of the speakers. The consequence of this was that SAC has barely changed our lists on postdoc selection and speakers to balance them.

Another critical point is that we have benefited on these issues from the experience of MSRI. In particular, there was an excellent career development seminar on diversity, equity, and inclusion issues held on this issue on May 7, 2021, with the following panelists: Charles Fefferman (Princeton University), Teena Gerhardt (Michigan State University), Edray Goins (Pomona College), Tatiana Toro (University of Washington), and Rodolfo Torres (University of California, Riverside).

A positive side effect of the pandemic was to open the program to all interested participants worldwide. This included a good number of participants from developing countries, some of whom strongly emphasized their gratitude and the positive effects of their participation.

7. Highlights and Breakthroughs

Although the program was virtual, there were still many collaborations fostered by the participation in it:

- Throughout the duration of the program, many collaborations were forged among young mathematicians, as well among more diverse groups, including the postdoc-adviser pairings which we initiated but also beyond that. We have discovered that talking to our postdocs was helpful in determining what their personal worries were and how they affected their participation in the program. A bit of implication from us, the more senior colleagues, went a long way in helping them to fully engage in the program. The overall feeling was that during the program, we managed to be stay focused on helping our young colleagues, and that our effort was well received. Here are three examples from Mihaela Ifrim:

  i) Pooja, one of our female postdoctoral fellows, expressed interest in talking to more experimentalists about job applications in the US, in both academic and non-academic areas. Our colleague, Jon Wilkening, went to great lengths to help Pooja, who, in the end, was very happy with all the info she gathered from John. Talking to her in one of the in-person meetings, which we organized towards the end of the semester, we found out multiple funny stories about her job-application experiences throughout the years, from the times she was a postdoc in Illinois and then in Texas.

  ii) Another example is Evan, one of our postdoctoral fellows. We talked on various online gatherings, and he always explain to me at what stage his research is, including how far he thinks he is from finishing one of his projects. It was so fulfilling to see the excitement in his voice when he was explaining the mathematical issues his encountered in solving his problems.

  iii) Annalaura Stingo, a female postdoctoral fellow in our program, would often share her ideas on specific mathematical papers she was reading. It was nice to see how after some of the talks (probably the ones that resonated the most with her), she would come and talk about potential improvements that the speaker could make on his/her results. She was very engaged in the program as well, and saw that having a senior person to come to and bounce ideas was something that our postdoctoral fellows liked to do.

  The online format made it easier, and somehow less formal, than an in-person interaction as our postdoctoral fellows could easily press on a button and chat with us on Sococo or during the GatherTown meetings. The advantage was that we got to know all of our young colleagues much better, and, in turn not only did they get to know us, but they built some confidence in approaching us and moreover in talking about math with us.
- Our Chancellor Professor, Thomas Alazard, wrote a first version of a book related to his course "Free surface flows in fluid dynamics". Stimulating discussions, questions and comments from postdocs and students were essential to improve these notes. He also wrote two papers on free surface flows. The first, with Quoc-Hung Nguyen, proves that one can solve the Cauchy problem for the 3D Muskat equation in critical space. The second one, with Quoc-Hung Nuyen and Omar Lazar, was directly motivated by a seminar presentation of Professor Alexander Kiselev on a non-local parabolic equation introduced by Stefan Steinerberger to study the roots of polynomials under differentiation. Alexander Kiselev and Changhui Tan proved a global well-posedness result for any positive initial data in the Sobolev space H^s with $s > 3/2$. During this semester, it has been proved that in fact the Cauchy problem

is well posed in the critical space $H^{1/2}$. During the semester, two new collaborations were started, with Siddhant Agrawal (MSRI postdoc) and Herbert Koch (research professor).

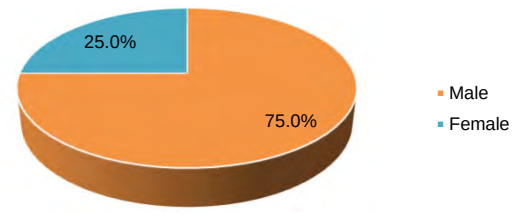
- Two MSRI postdocs obtained positions in France at the end of the semester. Annalaura Stingo obtained a prestigious position at École Polytechnique and Jiao He obtained a long-term postdoc position at the University of Paris-Saclay. They both acknowledge the support of the MSRI program which gave substantial visibility to their results.
- Igor Kukavica and Amjad Tuffaha, both participants in the program, obtained a result on the local well-posedness of the fluid-structure system, modeling the interaction of an elastic body with an incompressible fluid. They obtained the local existence, uniqueness, and continuity with respect to initial data when the initial velocity belongs to the space H^s, where $s > 3/2$ and the initial structure velocity is in $H^{s-1/2}$. The result improved an earlier result of Raymond and Vanninathan, which considered the flat case. The spaces for initial data are expected to be sharp.
- During the program two of the organizers, Mihaela Ifrim and Daniel Tataru, helped by a postdoc, Albert Ai, initiated a small research seminar whose aim was to involve a small group of graduate students in studying water-waves related problems. Three papers came out from this collaborative seminar, all co-authored with them. Even more important are the collaborations this seminar initiated together with the multiple projects that emerged as a natural continuation of the initially assigned problems. Incidentally, one of the problems solved was the last assigned "homework problem" in an MSRI summer school which Ifrim and Tataru ran the previous summer!
- Stimulated in part by discussions following Daniel's series of lectures in the introductory workshop, Mihaela Ifrim and Daniel Tataru are in the process of preparing a set of expository notes on their method of *testing by wave packets*.
- Many of the attendees expressed their gratitude for having a well-designed online organization which allowed a good online participation. In comparison with in-person programs, the new format had the advantage that accommodated more mathematician, broadening not only the mathematical interaction but also the social interactions.

Postdoc Pre/Post-MSRI Institution Group

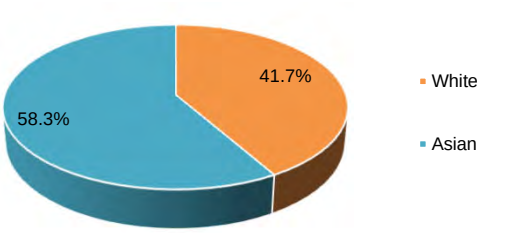
Family Name	First Name	Pre-MSRI Institution Name	Pre-MSRI Institution Group	Post-MSRI Institution Name	Post-MSRI Institution Group
Agrawal	Siddhant	University of Massachusetts Amherst	Math Public Medium Group	ICMAT (Instituto de Ciencias Matemáticas, Spain)	Foreign
Ai	Albert	University of Wisconsin, Madison	Math Public Large Group	University of Wisconsin, Madison	Math Public Large Group
de Poyferré	Thibault	University of California, Berkeley	Math Public Large Group	TBD	n/a
He	Jiao	University of Evry; University Paris-Saclay	Foreign	University of Evry & AMP; University Paris-Saclay	Foreign
Leslie	Trevor	University of Wisconsin, Madison	Math Public Large Group	University of Southern California	Math Private Large Group
Miller	Evan	McMaster University	Foreign	University of British Columbia	Foreign
Novack	Matthew	New York University	Math Private Large Group	Institute for Advanced Study	Non-group
Rao	Pooja	Stony Brook University	Math Public Large Group	TBD - seeking industry positions	n/a
Stingo	Annalaura	University of California, Davis	Math Public Large Group	ICERM (Institute for Computational & Experimental Research in Mathematics)	Non-group
Wang	Weinan	University of Arizona	Math Public Medium Group	University of Arizona	Math Public Medium Group
Zhu	Hui	University of Michigan	Math Public Large Group	University of Michigan	Math Public Large Group

2020-21 FD Postdoctoral Fellow Demographic Summary

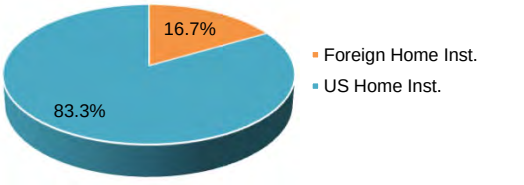
Gender	#	%
# of Distinct Members	12	100.0%
Male	9	75.0%
Female	3	25.0%
Decline to State	0	0.0%



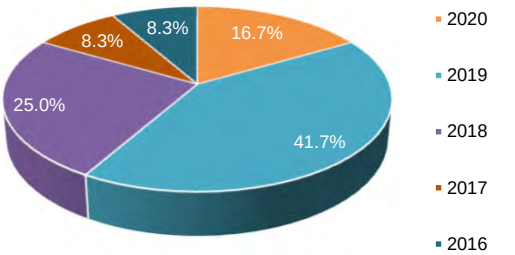
*Race/Ethnicity**	#	%
White	5	41.7%
Asian	7	58.3%
Hispanic/Latino	0	0.0%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	0	0.0%
Unavailable Info.	0	0.0%
Minorities**	0	0.0%



Citizenships	#	%
Foreign Home Inst.	2	16.7%
US Home Inst.	10	83.3%
US Citizen & Perm. Residents	5	41.7%
Foreign Citizens	7	58.3%
US Citizens	4	33.3%
US Permanent Residents	1	8.3%



Year of Ph.D	#	%
2020	2	16.7%
2019	5	41.7%
2018	3	25.0%
2017	1	8.3%
2016	1	8.3%
2015	0	0.0%
Total # of Distinct Postdocs	12	100.0%

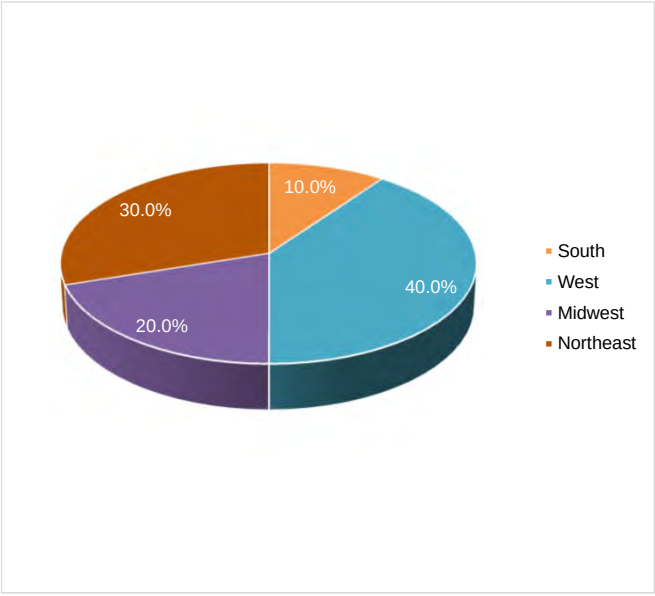


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020-21 FD Postdoctoral Fellow Classified by States

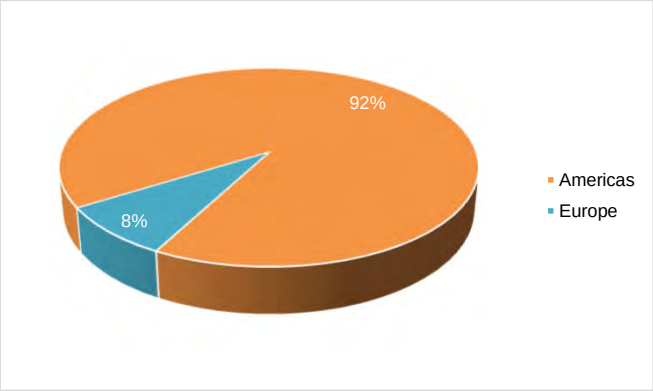
State	#	%	*2020 Census*
South	**1**	**10.0%**	***38.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.5%*
GA	0	0.0%	*3.2%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.4%*
MD	0	0.0%	*1.9%*
MS	0	0.0%	*0.9%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	0	0.0%	*8.8%*
VA	1	10.0%	*2.6%*
WV	0	0.0%	*0.5%*
West	**4**	**40.0%**	***23.7%***
AK	0	0.0%	*0.2%*
AZ	1	10.0%	*2.2%*
CA	3	30.0%	*11.9%*
CO	0	0.0%	*1.7%*
HI	0	0.0%	*0.4%*
ID	0	0.0%	*0.6%*
MT	0	0.0%	*0.3%*
NM	0	0.0%	*0.6%*
NV	0	0.0%	*0.9%*
OR	0	0.0%	*1.3%*
UT	0	0.0%	*1.0%*
WA	0	0.0%	*2.3%*
WY	0	0.0%	*0.2%*
Midwest	**2**	**20.0%**	***20.8%***
IA	0	0.0%	*1.0%*
IL	0	0.0%	*3.9%*
IN	0	0.0%	*2.0%*
KS	0	0.0%	*0.9%*
MI	1	10.0%	*3.0%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.6%*
SD	0	0.0%	*0.3%*
WI	1	10.0%	*1.8%*
Northeast	**3**	**30.0%**	***17.4%***
CT	0	0.0%	*1.1%*
MA	1	10.0%	*2.1%*
ME	0	0.0%	*0.4%*
NH	0	0.0%	*0.4%*
NJ	0	0.0%	*2.8%*
NY	2	20.0%	*6.1%*
PA	0	0.0%	*3.9%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**10**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020-21 FD Postdoctoral Fellow Classified by Country

Africa			**0**
Americas			**11**
	North America	Canada	1
	North America	United States	10
Asia			**0**
Europe			**1**
	Western Europe	France	1
Oceania			**0**
Grand Total			**12**



**Regions based on United Nations classification*

Mathematical problems in fluid dynamics

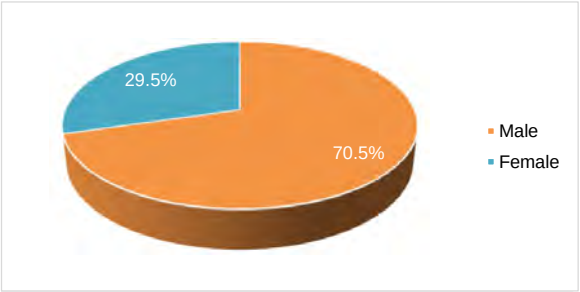
Program Summary

Role	Distinct Members**	%	US Citizens & Perm. Res.	%	Women	%	Minorities*	%
Organizers	6	6.8%	3	50.0%	2	33.3%	0	0.0%
Research Professors	21	23.9%	10	47.6%	7	33.3%	0	0.0%
Postdoctoral Fellows	12	13.6%	5	41.7%	3	25.0%	0	0.0%
Research Members	34	38.6%	10	29.4%	11	32.4%	2	20.0%
Program Associates	15	17.0%	2	13.3%	3	20.0%	0	0.0%
Total # of Distinct Members	**88**	**100.0%**	**30**	***34.1%***	**26**	***29.5%***	**2**	***6.7%***

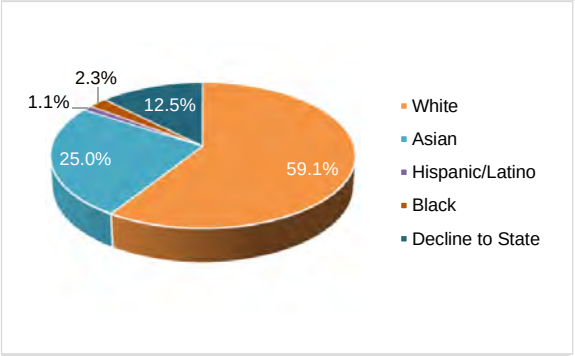
** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.*

2020-21 FD Program Members Demographic Summary

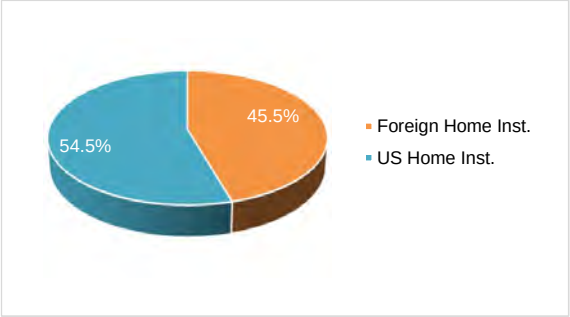
Gender	#	%
# of Distinct Members	88	100.0%
Male	62	70.5%
Female	26	29.5%
Decline to State	0	0.0%



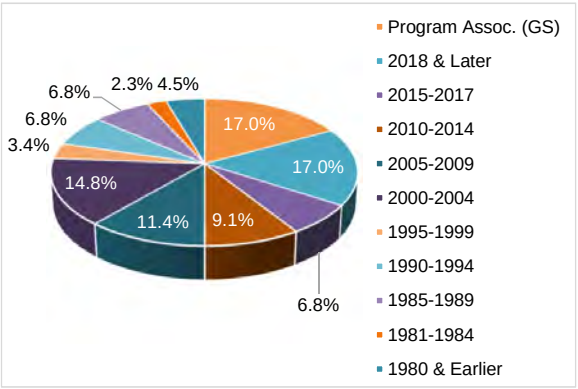
*Race/Ethnicity**	#	%
White	52	59.1%
Asian	22	25.0%
Hispanic/Latino	1	1.1%
Black	2	2.3%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	11	12.5%
Unavailable Info.	0	0.0%
Minorities**	2	6.7%



Citizenships	#	%
Foreign Home Inst.	40	45.5%
US Home Inst.	48	54.5%
US Citizens & Perm. Residents	30	34.1%
Foreign Citizens	58	65.9%
US Citizens	20	22.7%
US Permanent Residents	10	11.4%



Year of Ph.D	#	%
Program Assoc. (GS)	15	17.0%
2018 & Later	15	17.0%
2015-2017	6	6.8%
2010-2014	8	9.1%
2005-2009	10	11.4%
2000-2004	13	14.8%
1995-1999	3	3.4%
1990-1994	6	6.8%
1985-1989	6	6.8%
1981-1984	2	2.3%
1980 & Earlier	4	4.5%
Total # of Distinct Members	88	100.0%

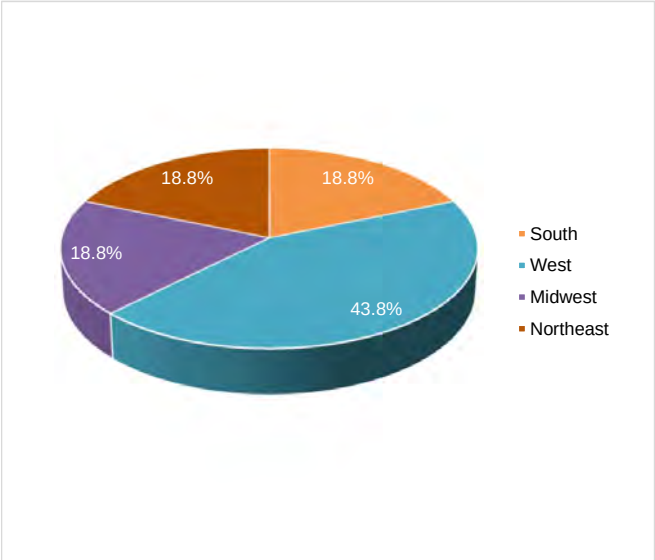


**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2020-21 FD Program Members Classified by State

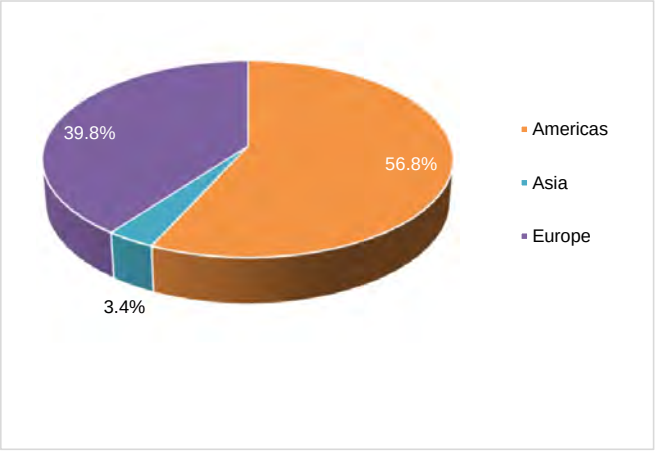
State	#	%	*2010 Census*
South	**9**	**18.8%**	***37.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.1%*
GA	2	4.2%	*3.1%*
KY	0	0.0%	*1.4%*
LA	1	2.1%	*1.5%*
MD	2	4.2%	*1.9%*
MS	0	0.0%	*1.0%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	3	6.3%	*2.1%*
TX	0	0.0%	*8.1%*
VA	1	2.1%	*2.6%*
WV	0	0.0%	*0.6%*
West	**21**	**43.8%**	***23.3%***
AK	0	0.0%	*0.2%*
AZ	1	2.1%	*2.1%*
CA	18	37.5%	*0.4%*
CO	0	0.0%	*0.5%*
HI	0	0.0%	*0.3%*
ID	0	0.0%	*12.1%*
MT	0	0.0%	*1.6%*
NM	0	0.0%	*0.9%*
NV	0	0.0%	*0.7%*
OR	0	0.0%	*1.2%*
UT	1	2.1%	*0.9%*
WA	1	2.1%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**9**	**18.8%**	***21.7%***
IA	0	0.0%	*4.2%*
IL	0	0.0%	*2.1%*
IN	0	0.0%	*1.0%*
KS	0	0.0%	*0.9%*
MI	4	8.3%	*3.2%*
MN	2	4.2%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.7%*
SD	0	0.0%	*0.3%*
WI	3	6.3%	*1.8%*
Northeast	**9**	**18.8%**	***17.9%***
CT	0	0.0%	*1.2%*
MA	1	2.1%	*0.4%*
ME	0	0.0%	*2.1%*
NH	0	0.0%	*0.4%*
NJ	1	2.1%	*2.8%*
NY	4	8.3%	*6.3%*
PA	3	6.3%	*4.1%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	**48**	**100.0%**	***100.0%***



**Regions based on US Census classification*

2020-21 FD Program Members Classified by Countries

Africa			**0**
Americas			**50**
	North America	Canada	2
		United States	48
Asia			**3**
	Eastern Asia	China	2
	Western Asia	United Arab Emira	1
Europe			**35**
	Northern Europe	Norway	1
		Sweden	1
	Southern Europe	Italy	2
		Spain	1
	Western Europe	France	27
		Germany	3
Grand Total			**88**



**Regions based on United Nations classification*

Mathematical Problems in Fluid Dynamics

January 19, 2021 - May 28, 2021

Note: Questions marked with asterisks (*) were not included on this year's survey due to the virtual nature of the programs.

Total Program Members:	88
Total Survey Respondants:	70
Response Rate:	80%

While at MSRI my research program was advanced in the following ways:

Q1. I learned new ideas/techniques which are applicable to my problems

Yes	58	83%
No	12	17%
Total Responses	70	

Q2. I had opportunities to present my work to new audiences

Yes	62	89%
No	8	11%
Total Responses	70	

Q3. I initiated research with new collaborators

Yes	20	29%
No	50	71%
Total Responses	70	

Q4. I initiated research in new areas

Yes	16	23%
No	54	77%
Total Responses	70	

Q5. My research was advanced in these other ways:

Link to Qualitative Responses

Q6. If your answer to any of the above set of questions was no, what opportunities should MSRI provide to mitigate this?

N/A - This question was not included in the survey for 2020-21.

Q7. MSRI aims to provide a supportive environment for all program participants. How satisfied were you with this aspect of your experience?

1 - Least Satisfying	0	0%
2	1	2%
3	4	6%
4	12	19%
5 - Most Satisfying	45	73%
Total Responses (Exclusive of N/A)	62	100%

Q8. What suggestions would you have for MSRI to provide a more supportive environment?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - For Postdoctoral Fellows: Please rate your level of satisfaction with...

Q9. Your assigned mentor:

1 - Least Satisfying	0	0%
2	0	0%
3	1	8%
4	1	8%
5 - Most Satisfying	10	83%
Total Responses (Exclusive of N/A)	12	100%

Q10. Your overall mentoring experience:

1 - Least Satisfying	0	0%
2	0	0%
3	2	17%
4	1	8%
5 - Most Satisfying	9	75%
Total Responses (Exclusive of N/A)	12	100%

Q11. The lunch meeting with the directorate:

1 - Least Satisfying	0	0%
2	0	0%
3	0	0%
4	4	36%
5 - Most Satisfying	7	64%
Total Responses (Exclusive of N/A)	11	100%

Q12. What suggestions do you have to improve the mentoring experience at MSRI?

Link to Qualitative Responses

MSRI Experience - For Graduate Students

Q13. How much did the Graduate Student Seminar increase your ability to benefit from MSRI's other scientific activities?

1 - Least Satisfying	1	8%
2	0	0%
3	2	17%
4	5	42%
5 - Most Satisfying	4	33%
Total Responses (Exclusive of N/A)	12	100%

MSRI Experience - Program Seminar: Please rate your level of satisfaction with… *

Q14. Learning new ideas and techniques:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q15. Forming new acquaintances and collaborations:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q16. The opportunity to present your own work:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

MSRI Experience - General Information

Q17. My office accomodations were

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q18. Professionally, my overall satisfation with MSRI was

1 - Least Satisfying	1	2%
2	4	6%
3	6	9%
4	12	19%
5 - Most Satisfying	41	64%
Total Responses (Exclusive of N/A)	64	100%

MSRI Experience - Feedback

Q19. Did you participate in any of the activities associated with the other MSRI programs or workshops? If so, which ones? Did you find them valuable?

N/A - This question was not included in the survey for 2020-21.

Q20. What aspects of the program, environment, facilities, and relationships with colleagues were most beneficial to you?

Link to Qualitative Responses

Q21. What suggestions would you have for improvements at MSRI?

N/A - This question was not included in the survey for 2020-21.

Q22. What suggestions would you have for future MSRI programs or workshops?

Link to Qualitative Responses

MSRI Experience - Computing Services and Facilities

Q23. How would you rate the computing staff for the support you received while at MSRI

1 - Least Satisfying	0	0%
2	0	0%
3	3	5%
4	6	10%
5 - Most Satisfying	50	85%
Total Responses (Exclusive of N/A)	59	100%

Q24. How would you rate the computing equipment you used at MSRI:

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q25. How could we improve our computing services?

N/A - This question was not included in the survey for 2020-21.

Q26. How could we improve our computing equipment and software environment?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - Relocation Advisory Services: How would you rate the following services you received from MSRI?

Q27. Housing Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q28. School and Childcare Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q29. Visa Assistance

1 - Least Satisfying	*	*
2	*	*
3	*	*
4	*	*
5 - Most Satisfying	*	*
Total Responses (Exclusive of N/A)	*	*

Q30. How could we improve our relocation advisory services?

N/A - This question was not included in the survey for 2020-21.

MSRI Experience - Administrative Support Services

Q31. How would you rate the administrative support you received while at MSRI

1 - Least Satisfying	0	0%
2	0	0%
3	2	3%
4	7	11%
5 - Most Satisfying	54	86%
Total Responses (Exclusive of N/A)	63	100%

Q32. How could we improve our administrative services?

N/A - This question was not included in the survey for 2020-21.

Q33. Your comments about MSRI:

N/A - This question was not included in the survey for 2020-21.

Complementary Program 2020-21

August 17, 2020 to July 30, 2021

MSRI

Berkeley, CA

USA

Complementary Program (2020-21)

August 17, 2020 to July 30, 2021

The Complementary Program has a limited number of memberships that are open to both mathematicians whose interests align with those of the Director or Deputy Director, and mathematicians who are partners of invited members of a core program.

During the 2020-21 year, one postdoctoral fellow participated in MSRI's small Complementary Program. Two additional Complementary Program members visited MSRI to spend a few days collaborating with MSRI's Director, David Eisenbud.

Workshop Reports

Please note, because of the virtual nature of the 2020-21 workshops, no participant costs were incurred; therefore participant financials are not included in these reports. However, MSRI has incurred significant costs for these workshops related to software licenses and additional IT staff, including a dedicated remote event support engineer.

Hot Topics Workshop: Topological Insights in Neuroscience

May 4, 2021 – May 11, 2021

Virtual Workshop

Organizers:

Carina Curto (University of Pennsylvania)

Chad Giusti (University of Delaware)

Kathryn Hess (École Polytechnique Fédérale de Lausanne (EPFL))

Ran Levi (University of Aberdeen)

REPORT ON THE MSRI WORKSHOP
"Hot Topics: Topological Insights in Neuroscience (Virtual Workshop)"
May 4 – 11, 2021

Organizers

- Carina Curto (Pennsylvania State University)
- Chad Giusti (University of Delaware)
- Kathryn Hess (École Polytechnique Fédérale de Lausanne (EPFL))
- Ran Levi (University of Aberdeen)

Scientific Description

The workshop presented a wide array of current applications of topology in neuroscience, including classification and synthesis of neuron morphologies, analysis of synaptic plasticity, algebraic analysis of the neural code, topological analysis of neural networks and their dynamics, topological decoding of neural activity, diagnosis of traumatic brain injuries, and topological biomarkers for psychiatric disease. Some of the talks were devoted to promising new directions in algebraic topology that have been inspired by neuroscience.

Highlights of the Workshop

Among the speakers at this workshop were several neuroscientists who have successfully employed topological techniques in their analysis of neuroscientific data. *Lida Kanari* explained how a simple topological signature for trees embedded in 3-space enables biologically meaningful classification of neurons by morphological type. *Tim Gentner* described topological tools for decoding stimulus-specific invariant structure in the spiking coactivity of large neural populations in birdsong, which he illustrated with an application to encoding and decoding natural vocalizations. *Manish Saggar* showed that applying Mapper, a tool of topological data analysis, to fMRI data revealed a rich topographic landscape in which the transition of brain activity from one canonical brain network to the next involved a large, shared attractor-like basin. *Zaq Pitkow* presented a theory-driven mathematical framework based on Graph Neural Networks for inferring implicit canonical computations in the brain from large-scale neural measurements. *Tatyana Sharpee* described both theoretical reasons and experimental evidence that natural odor stimuli and human perception thereof can be represented on a low-dimensional surface equipped with a hyperbolic metric. *Ben Dunn* talked about his recent work with the Nobel-prize-winning Moser lab, in which they discovered toroidal structure in the population activity of grid cells.

Mathematicians who have applied topology in innovative ways to neuroscience were also among the invited lecturers at the workshop. *Matilde Marcolli* described the promising new theoretical framework for analyzing network function that she has developed with Yuri Manin, integrating information theory, homotopy theory, and categorical probability theory. *Daniela Egas* talked about analyzing dynamics in combinatorial threshold-linear networks, by taking the nerve of

well-chosen covers of the underlying directed graph. *Konstantin Mischaikov* presented a theory of dynamics based on combinatorics and algebraic topology with sample applications to the analysis of dynamics of networks. *Vladimir Itskov* presented two methods, based on computational topology and differential geometry, to infer the dimension of neural representations from receptive field properties, providing a concrete application to inferring the dimension of olfactory space.

There were also several mathematicians using topological data analysis (TDA) to answer questions about neuroscience data. *Anne Blevins* gave an overview of applications of persistent homology computations to network analysis, in particular for the connectome. *Bei Wang* presented her work on topological analysis of fMRI data, which showed that persistence barcodes are significantly correlated to cognitive and personality differences. *Alice Patania* also talked about using topological network analysis on resting state fMRI to probe brain anatomy and function. *Martina Scolamiero* talked about stable ranks as a tool for TDA, with applications to analysis of neuron morphologies.

Pure TDA, particularly with potential applications to neuroscience, also formed a major part of the conference. *Jose Perea* presented a talk about quasiperiodic recurrence in time series data and discussed techniques to study the persistent homology emerging from such data, along with several applications. *Katharine Turner* discussed the stability of persistence diagrams between different functions on the same finite simplicial with practical applications to image analysis as well as theoretical applications to persistence homology transforms and Vietoris-Rips complexes. *Ezra Miller* presented an overview of persistent homology in one or more discrete or continuous parameters, including past and potential applications to brain structure and function, followed by a discussion of challenges and recent developments in multiparameter methods, concerning mathematics, statistics, and computation.

Most of the shorter, contributed talks during the week were given by younger mathematicians, who exhibited great enthusiasm for applications of topology and remarkable creativity in elaborating new theoretical foundation, developing new topological tools, and exploring new applications.

Organizers

First Name	Last Name	Institution
Carina	Curto	Pennsylvania State University
Chad	Giusti	University of Delaware
Kathryn	Hess	École Polytechnique Fédérale de Lausanne (EPFL)
Ran	Levi	University of Aberdeen

Speakers

First Name	Last Name	Institution
Ann	Blevins	University of Pennsylvania
Benjamin	Dunn	Norwegian University of Science and Technology (NTNU)
Daniela	Egas Santander	École Polytechnique Fédérale de Lausanne
Steven	Ellis	Columbia University
Tim	Gentner	University of California, San Diego
Vladimir	Itskov	Pennsylvania State University
Lida	Kanari	École Polytechnique Fédérale de Lausanne (EPFL)
Woojin	Kim	Duke University
Hengrui	Luo	Lawrence Berkeley National Laboratory
Matilde	Marcolli	California Institute of Technology
Ezra	Miller	Duke University
Konstantin	Mischaikow	Rutgers University
Alice	Patania	Indiana University
Jose	Perea	Michigan State University
Xaq	Pitkow	Baylor College of Medicine
Henri	Riihimäki	University of Aberdeen
Manish	Saggar	Stanford University School of Medicine
Martina	Scolamiero	Royal Institute of Technology (KTH)
Tatyana	Sharpee	The Salk Institute for Biological Studies
Dane	Taylor	University at Buffalo, SUNY
Katharine	Turner	Australian National University
Bei	Wang	University of Utah
Yusu	Wang	University of California, San Diego
Iris	Yoon	University of Delaware

Mathematical Sciences Research Institute

Hot Topics: Topological Insights in Neuroscience

May 4 to May 11, 2021

Tuesday, May 4, 2021		
07:50 AM - 8:00 AM		Welcome
08:00 AM - 08:45 AM	Lida Kanari	Topological insights on neuronal morphologies
09:00 AM - 09:45 AM	Tim Gentner	A topological approach for understanding the neural representation of natural auditory signals
09:45 AM - 10:15 AM		Break
10:15 AM - 10:45 AM	Woojin Kim	The Persistent Topology of Dynamic Data
11:00 AM - 11:45 AM	Manish Saggar	Using Mapper to reveal a unique hub-like brain state at rest in highly sampled individuals

Wednesday, May 5, 2021		
08:00 AM - 08:45 AM	Xaq Pitkow	Discovering implicit computation graphs in nonlinear brain dynamics
09:00 AM - 09:45 AM	Tatyana Sharpee	Hyperbolic geometry in biological networks
09:45 AM - 10:15 AM		Break
10:15 AM - 10:45 AM	Dane Taylor	Geometrical and topological data analyses reveal that higher-order structures provide flow channels for neuronal avalanches
11:00 AM - 11:45 AM	Jose Perea	Topological analysis of quasiperiodic signals

Thursday, May 6, 2021		
08:00 AM - 08:45 AM	Bei Wang	Topological Data Analysis of Functional Brain Connectivity in Time and Space Domains
09:00 AM - 09:45 AM	Matilde Marcolli	Homotopy Theoretic and Categorical Models of Neural Information Networks
09:45 AM - 10:15 AM		Break
10:15 AM - 10:45 AM	Hengrui Luo	Combining Geometric and Topological Information for Boundary Estimation
11:00 AM - 11:45 AM	Konstantin Mischaikow	Identifying dynamics of networks

Friday, May 7, 2021		
08:00 AM - 08:45 AM	Daniela Egas Santander	Nerve theorems for fixed points of neural networks
09:00 AM - 09:45 AM	Martina Scolamiero	Extracting topological features from multiple measurements
09:45 AM - 10:15 AM		Break
10:15 AM - 10:45 AM	Iris Yoon	Identifying analogous topological features across multiple systems
11:00 AM - 11:45 AM	Benjamin Dunn	A grid cell torus

Monday, May 10, 2021		
08:00 AM - 08:45 AM	Vladimir Itskov	Decoding geometry and topology of neural representations
09:00 AM - 09:45 AM	Alice Patania	Topological Characterization for Multi-Variate Pattern Analysis
09:45 AM - 10:15 AM		Break
10:15 AM - 10:45 AM	Henri Riihimäki	Simplicial connectivities of directed networks and higher paths
11:00 AM - 11:45 AM	Katharine Turner	Wasserstein stability for persistence diagrams

Tuesday, May 11, 2021		
08:00 AM - 08:45 AM	Yusu Wang	Discrete Morse based Graph Skeletonization and Applications in Computational Neuroscience
09:00 AM - 09:45 AM	Ezra Miller	Persistent homology in one or more parameters
09:45 AM - 10:15 AM		Break
10:15 AM - 10:45 AM	Steven Ellis	Using "Concurrence Topology" to Detect Statistical (In)dependence Among Items of the Hamilton Depression Rating Scale
11:00 AM - 11:45 AM	Ann Blevins	Topological cavities in the human connectome

Identifiable Participants		
First Name	**Last Name**	**Institution**
Maheswari	A	Government Arts College Coimbatore Tamilnadu India
Katharine	Adamyk	University of Western Ontario
Tahmineh	Azizi	Kansas State University
Nils	Baas	Norwegian University of Science and Technology (NTNU)
Matteo	Barucco	University of Warwick
Katherine	Benjamin	University of Oxford
Yakov	Berchenko-Kogan	University of Hawaii at Manoa
Ranita	Biswas	Institute of Science and Technology Austria
Pavle	Blagojevic	Freie Universität Berlin
Ann	Blevins	University of Pennsylvania
Julian	Brüggemann	Max-Planck-Institut für Mathematik
Michael	Briden	University of California, Santa Cruz
Felicia	Burtscher	University of Luxembourg
Jacob	Canel	McGill University
Luigi	Caputi	University of Aberdeen
Wojciech	Chacholski	Royal Institute of Technology
Apratim	Chakraborty	TCG Centres for Research and Education in Science and Technology (TCG CREST)
Thomas	Chaplin	University of Oxford
Mauricio	Che Moguel	University of Durham
Man Chuen	Cheng	Chinese University of Hong Kong
Samir	Chowdhury	Stanford University School of Medicine
Maria-Veronica	Ciocanel	Duke University
Robert	Claar	University of Florida
Pedro	Conceicao	University of Aberdeen
René	Corbet	Royal Institute of Technology
Sebastiano	Cultrera di Montesano	Institute of Science and Technology Austria
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David	Damiano	College of the Holy Cross
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Chad	Giusti	University of Delaware
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Vinicio	Gomez-Gutierrez	Universidad Nacional Autonoma de Mexico (UNAM)
Martin	Gonzalez	Institut de Mathématiques de Jussieu
Ray	Gonzalez	University of Iowa
Rocio	Gonzalez-Diaz	University of Sevilla
Gabrielle	Gorostiza	California State University, East Bay
Andrea	Guidolin	Royal Institute of Technology
Araceli	Guzmán	Center of Investigations in Mathematics (CIMAT)
Alex	Hanna	Thompson Rivers University

Identifiable Participants		
First Name	**Last Name**	**Institution**
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Mason	Hargrave	The Rockefeller University
Amber	Harris Bozer	Tarleton State University
Leon	Hendrian	Westfälische Wilhelms-Universität Münster
Giseon	Heo	University of Alberta
Erik	Hermansen	Norwegian University of Science and Technology (NTNU)
Kathryn	Hess	École Polytechnique Fédérale de Lausanne (EPFL)
Carter	Hinsley	University of North Georgia
Rezwaneh	Hoseinzadeh	Ferdowsi University of Mashhad
Linda	Hu	Universität Regensburg
Jici	Huang	DeSales University
Michael	Hutchings	University of California, Berkeley
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Oleg	Kachan	Skolkovo Institute of Science and Technology
Shabnam	Kadir	University of Hertfordshire
Sameer	Kailasa	University of Michigan
Sadok	Kallel	American University of Sharjah
Lida	Kanari	École Polytechnique Fédérale de Lausanne (EPFL)
Dilan	Karagüler	Middle East Technical University (ODTU)
Sheldon	Katz	University of Illinois at Urbana-Champaign
Aayush	Khare	Penn State University
Woojin	Kim	Duke University
Jisu	Kim	Institut National de Recherche en Informatique Automatique (INRIA)
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Johan	Konter	Stockholm University
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William	Kronholm	Whittier College
Alexander	Kunin	Baylor College of Medicine
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Jānis	Lazovskis	University of Latvia
Vadim	Lebovici	Université Paris-Saclay
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Ran	Levi	University of Aberdeen
Zelong	Li	Pennsylvania State University
Caitlin	Lienkaemper	Pennsylvania State University
Vasiliki	Liontou	University of Toronto
Yining	Liu	Columbia University
Juliana	Londono Alvarez	Pennsylvania State University
Hengrui	Luo	Lawrence Berkeley National Laboratory
Chitaranjan	Mahapatra	University of California, San Francisco
Ayush	Mandwal	University of Calgary
Matilde	Marcolli	California Institute of Technology
Gordana	Matic	University of Georgia
Azita	Mayeli	City University of New York (CUNY)
John	McCarthy	Washington University
Stephen	McKean	Duke University
José	Mijangos	Tecnológico Nacional de México
Nikola	Milicevic	University of Florida
Ezra	Miller	Duke University
Konstantin	Mischaikow	Rutgers University
Atish	Mitra	Montana Tech

Identifiable Participants		
First Name	**Last Name**	**Institution**
Lucia	Mocz	University of Chicago
Katie	Morrison	University of Northern Colorado
Arsenii	Onuchin	Moscow State University
Vikram	Oruganti	University at Buffalo
Joshua	Paik	Pennsylvania State University
Semra	Pamuk	Middle East Technical University (ODTU)
Caitlyn	Parmelee	Keene State College
Alice	Patania	Indiana University
Kristine	Pelatt	St. Catherine University
Jose	Perea	Michigan State University
Camilo	Perez	Universidad de los Andes
Tuan	Pham	University of Chicago
Azélie	Picot	École Normale Supérieure
Xaq	Pitkow	Baylor College of Medicine
Syama	R	PSG College of Technology
Emanuel	Reinecke	Institute for Advanced Study
Antonio	Rieser	Cimat
Henri	Riihimäki	University of Aberdeen
Jerome	Roehm	University of Delaware
Ilaria	Rossinelli	Università di Pavia
Hyunnam	Ryu	University of Georgia
Manish	Saggar	Stanford University School of Medicine
Sule	Sahin	Hitit University
Emilio	Salazar	Carnegie Mellon University
Nicholas	Sale	Swansea University
Shion	Samadder Chaudhury	TCG Centres for Research and Education in Science and Technology (TCG CREST)
Nicole	Sanderson	Pennsylvania State University
Hannah	Santa Cruz	Pennsylvania State University
Aman	Sawhney	University of Delaware
Radmila	Sazdanovic	North Carolina State University
Martina	Scolamiero	Royal Institute of Technology (KTH)
Daniel	Scott	Brown University
Hossein	Sh	University of Isfahan
Vahid	Shamsaddini	Sharif University of Technology
Tatyana	Sharpee	The Salk Institute for Biological Studies
Enrico	Sintoni	Università di Padova
Jason	Smith	Nottingham Trent University
Alexander	Smith	University of Wisconsin - Madison
Konstantinos	Spiliotis	Mathematical Institute
Manuel	Staiger	Freie Universität Berlin
Ari	Stern	Washington University
Tom	Stone	Brown University
Pablo	Suarez-Serrato	Universidad Nacional Autonoma de Mexico (UNAM)
Dane	Taylor	University at Buffalo, SUNY
Frank	Tejera	Rockefeller University
Brad	Theilman	University of California, San Diego
Tom	Thorne	University of Surrey
Francesca	Tombari	Royal Institute of Technology
Toan	Tran	Florida State University
Doris	Tsao	California Institute of Technology
Junyi	Tu	Salisbury University
Renata	Turkes	Universiteit Antwerp
Katharine	Turner	Australian National University
Florian	Unger	TU Graz
Jasna	Urbancic	School of Mathematical Sciences, Queen Mary, University of London
Melvin	Vaupel	Norwegian University of Science and Technology (NTNU)
Mikael	Vejdemo-Johansson	College of Staten Island, CUNY
Elizabeth	Vidaurre	Molloy College
Juan Pablo	Vigneaux	Max Planck Institute for Mathematics in the Sciences
He	Wang	Northeastern University

Identifiable Participants		
First Name	**Last Name**	**Institution**
Bei	Wang	University of Utah
Yusu	Wang	University of California, San Diego
Miguel	Xicotencatl	Centro de Investigacion y de Estudios Avanzados del IPN
Xiaoqi	Xu	Isae Supaero
Iris	Yoon	University of Delaware
Nora	Youngs	Colby College
Valentina	Zapata Castro	University of Virginia
Mengsen	Zhang	University of North Carolina at Chapel Hill

Participants Information

Participants		188
Gender		**188**
Male	60.64%	114
Female	35.11%	66
Other	0.00%	0
Declined to state	4.26%	8

Ethnicity*		200
White	48.00%	96
Asian	21.00%	42
Hispanic	9.50%	19
Pacific Islander	0.00%	0
Black	0.50%	1
Native American	0.50%	1
Mixed	3.00%	6
Declined to state	17.50%	35

* ethnicity specifications are not exclusive

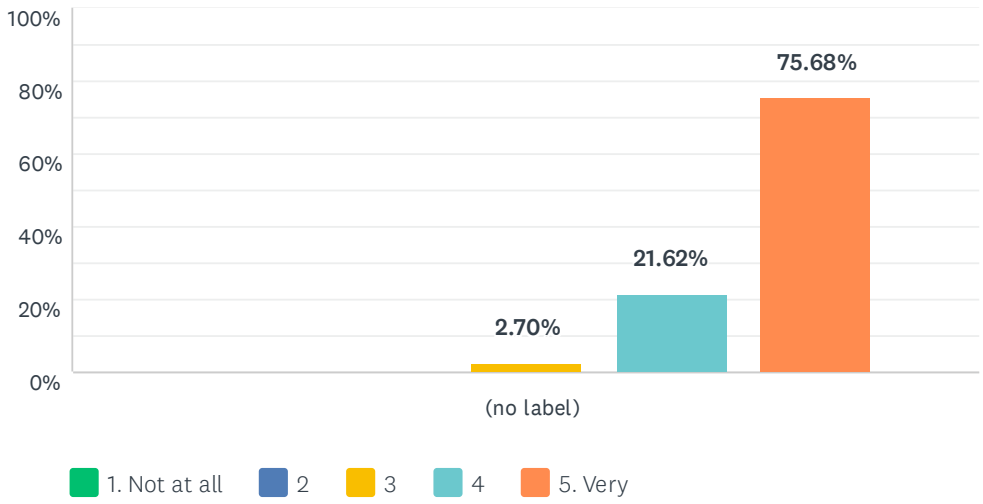
There were 20 additional virtual participants who were not identifiable

940 Hot Topics: Topological Insights in Neuroscience: Participant Survey

74 responses out of 188 identifiable participants = 39% response rate

Q1 The workshop was intellectually stimulating

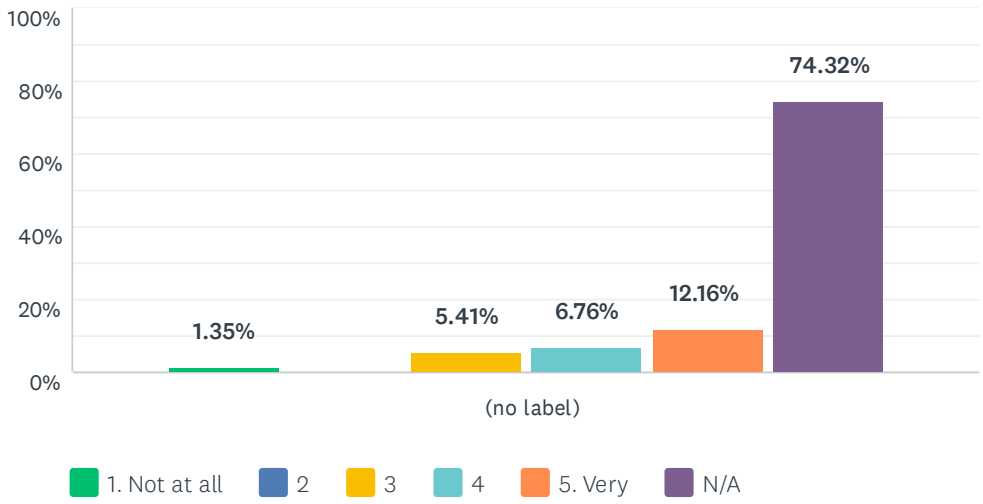
Answered: 74 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	2.70% 2	21.62% 16	75.68% 56	74	4.73

Q2 The virtual teas were useful

Answered: 74 Skipped: 0

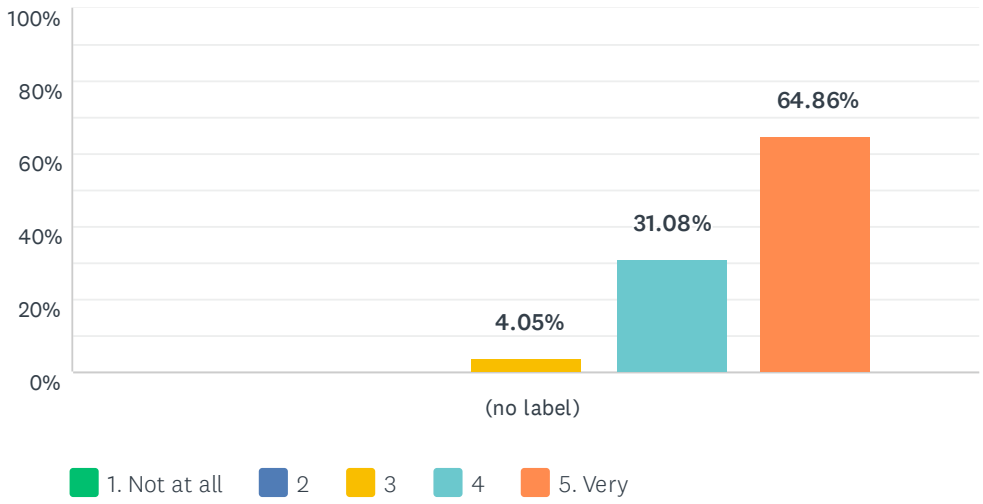


	1. NOT AT ALL	2	3	4	5. VERY	N/A	TOTAL	WEIGHTED AVERAGE
(no label)	1.35% 1	0.00% 0	5.41% 4	6.76% 5	12.16% 9	74.32% 55	74	4.11

#	COMMENTS ON THE VIRTUAL TEAS	DATE
1	I	6/24/2021 7:56 AM
2	I was not able to join the virtual teas	6/23/2021 6:05 PM
3	I didn't attend any	5/15/2021 12:11 PM
4	Didn't hear about.	5/14/2021 12:28 AM
5	As a beginner of this topic; I feel the description of used computational tools and techniques are helpful. Expecting in future workshops.	5/13/2021 1:20 AM
6	I did not attend them because I do not enjoy online social events like this	5/12/2021 10:35 PM
7	I did not attend	5/12/2021 1:01 PM
8	Probably use more the breakout rooms	5/12/2021 11:08 AM
9	Good	5/12/2021 10:43 AM
10	What are virtual teas	5/12/2021 10:16 AM

Q3 The overall experience of the workshop was worthwhile

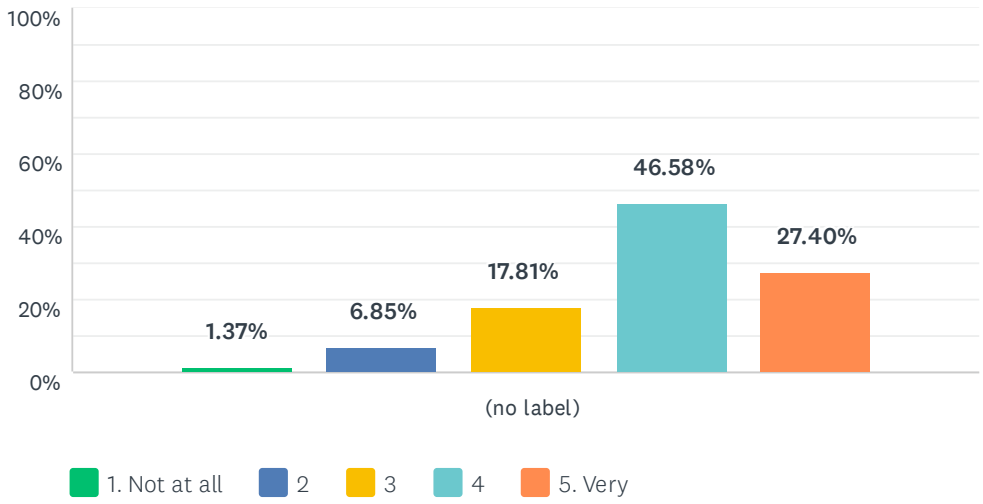
Answered: 74 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	4.05% 3	31.08% 23	64.86% 48	74	4.61

Q4 I was well prepared to benefit from the lectures

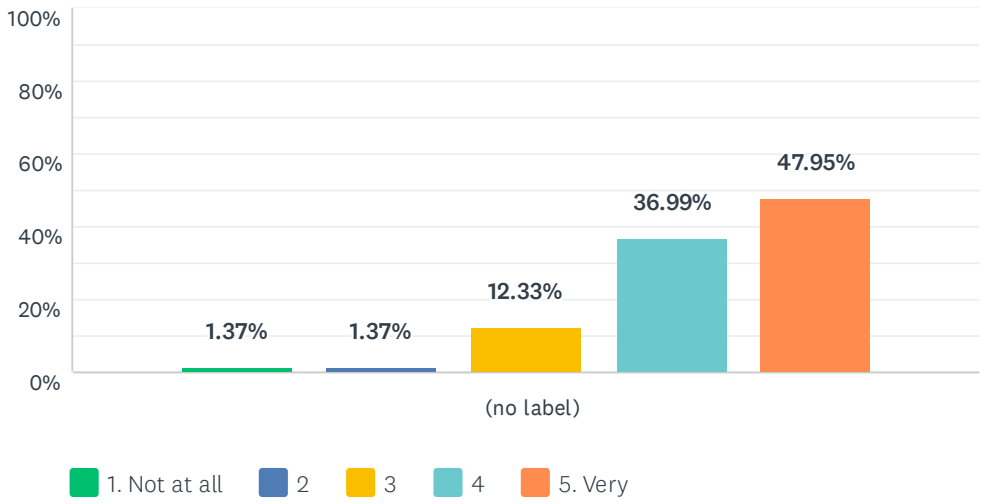
Answered: 73 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	1.37% 1	6.85% 5	17.81% 13	46.58% 34	27.40% 20	73	3.92

Q5 My interest in the subject matter was increased by the workshop

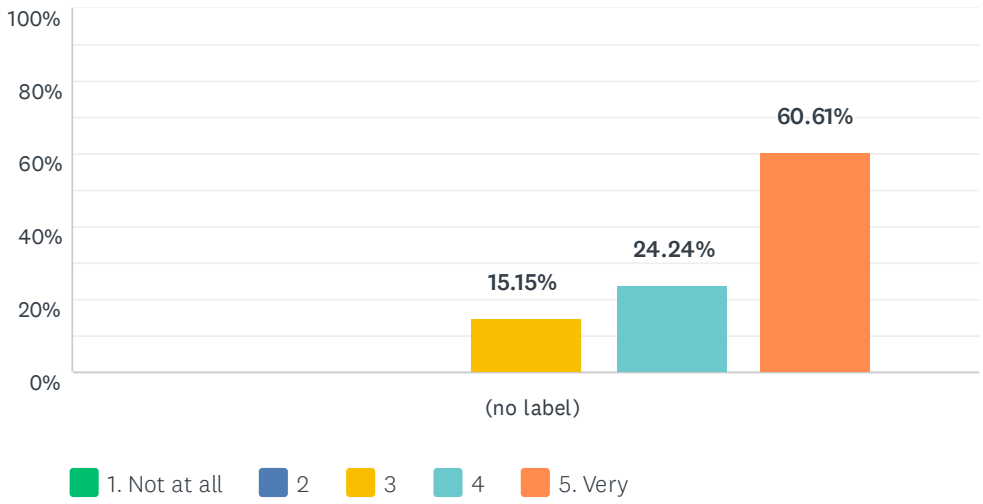
Answered: 73 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	1.37% 1	1.37% 1	12.33% 9	36.99% 27	47.95% 35	73	4.29

Q6 I found the MSRI staff helpful

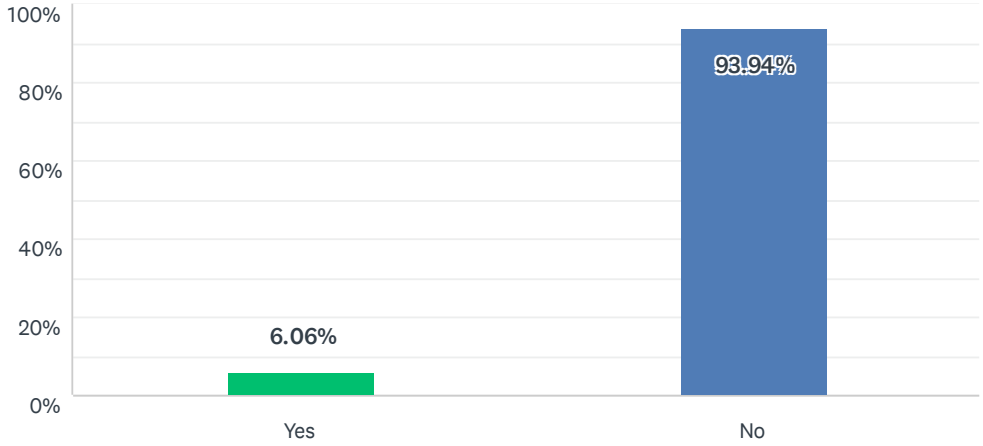
Answered: 66 Skipped: 8



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	15.15% 10	24.24% 16	60.61% 40	66	4.45

Q7 Did you experience any technical difficulties accessing the online workshop?

Answered: 66 Skipped: 8



ANSWER CHOICES	RESPONSES	
Yes	6.06%	4
No	93.94%	62
TOTAL		66

#	IF YES, PLEASE EXPLAIN	DATE
1	My mic didn't work in tea times.	6/24/2021 8:00 AM
2	Unstable internet connection from my end.	6/23/2021 6:08 PM
3	Due to my network speed I felt difficulty(not from MSRI)	5/13/2021 1:34 AM
4	A lot of registration needed from the MSRI webpage	5/12/2021 6:55 PM

Q8 How did having the workshop held online impact your participation? For instance: did personal circumstances due to the pandemic hamper your participation in any way or was there a barrier to participation due to time zone differences?

Answered: 66 Skipped: 8

#	RESPONSES	DATE
1	no issues	7/1/2021 11:02 AM
2	It makes it generally harder to engage, but there's nothing really that can be done about that.	6/27/2021 7:39 PM
3	Online workshop is okay for me.	6/25/2021 5:09 AM
4	None	6/24/2021 1:56 PM
5	If it didn't hold online I could not participate at all.	6/24/2021 8:00 AM
6	It would have been great if all the speakers would have used external microphone with good sensitivity. This would improve audibility.	6/24/2021 5:00 AM
7	My participation was not impacted at all	6/24/2021 12:55 AM
8	Since I am joining from the Philippines, the time difference was a major consideration.	6/23/2021 6:08 PM
9	It was convenient to have it online since I could not have easily traveled to the workshop	6/23/2021 5:21 PM
10	it was better to follow it online because it allowed a greater participation of people	6/23/2021 3:06 PM
11	No	6/23/2021 2:22 PM
12	no	6/23/2021 2:01 PM
13	The online format makes it easier to participate.	6/23/2021 1:59 PM
14	yes	6/23/2021 1:58 PM
15	My regular schedule made it difficult to attend some talks.	6/23/2021 1:55 PM
16	It is convenient for me to participate in the workshop without traveling.	6/23/2021 1:55 PM
17	made participation easier	6/23/2021 1:52 PM
18	Certainly personal circumstances due to the pandemic did hamper your participation a bit. Nothing serious but just because I'm phisically at home, not at the conference venue. I wish I had been in Berkeley in order to fully focus on the workshop, but I overall enjoyed the virtual workshop enough.	5/23/2021 3:29 PM
19	Holding online workshops has wider reach. It was a good opportunity for me as someone from the Philippines.	5/20/2021 8:35 AM
20	I would not have been able to participate in person (even without the pandemic) so this was a great opportunity for me.	5/18/2021 1:53 PM
21	If the event had not been online, I would not be able to participate.	5/17/2021 12:45 PM
22	I was busy with work so could only attend a few sessions. This is less of a problem with in person conferences.	5/15/2021 12:12 PM
23	I don't think I could have managed to attend the workshop if it was not online	5/15/2021 12:48 AM
24	I was less engaged with the workshop material than I would have been if I were present in person. It is difficult to maintain attention on online talks when one can be checking email on another monitor to avoid falling behind and needs to ignore environmental distractions. I think	5/14/2021 4:23 AM

	the lack of time for in-person conversation after the talks also likely led to a lot of missed opportunities.	
25	Time zone was an issue.	5/14/2021 12:29 AM
26	Much less stimulating.	5/13/2021 3:44 PM
27	made it possible.	5/13/2021 3:26 PM
28	My participation, in terms of asking questions and attending lectures was unchanged. My participation in terms of interacting with other conference attendees was severely negatively impacted, because I did not socialize with them at all.	5/13/2021 8:45 AM
29	I think it had a positive impact: I live in Europe and I've been able to attend several conferences based in the USA in the past year. Normally I would have not been able to travel so much.	5/13/2021 2:00 AM
30	Yes, workshop sessions completed at midnight in india	5/13/2021 1:34 AM
31	--	5/12/2021 11:51 PM
32	I probably would not have attended if it would have been in person, since I live so far away (Eastern Europe)	5/12/2021 10:38 PM
33	I had to miss the morning talks due to being in Hawaii, and I'm not sure if they were recorded.	5/12/2021 8:14 PM
34	Yes, this is a time difference. So the records are really help	5/12/2021 8:10 PM
35	Time zone difference was definitely an issue. At the Philippines, the conference time was around 11 pm to 3 am, which caused me to miss some of the lectures.	5/12/2021 6:55 PM
36	No, It is ok for an online conference.	5/12/2021 5:01 PM
37	Can attend from everywhere	5/12/2021 4:13 PM
38	Because on time zone differences, it was not easy to follow all talks (during dinner for instance). Moreover it is much harder to concentrate during zoom talks than during "real" talks. I personnally cannot be concentrated and listen to 4 zoom conferences per day.	5/12/2021 2:29 PM
39	Having the workshop held online allowed me to attend to these wonderful presentations, because otherwise I wouldn't have been able to attend, due to funding limitations.	5/12/2021 2:22 PM
40	Time zone difference made the attendance to be quite late for me.	5/12/2021 1:15 PM
41	I would not have participated if it were not online. I am in Central Timezone, so the times worked very well for me. I did have a child get sick during the workshop, so I missed the talks for the last few days.	5/12/2021 1:03 PM
42	Probably would not have attended at all if not online; in-person workshops require more travel planning, scheduling, etc.	5/12/2021 12:30 PM
43	Not at all	5/12/2021 12:28 PM
44	As a worker student it was perfect. I wouldn't be able to participate if it wasn't held online.	5/12/2021 12:17 PM
45	I could not attend some of the talks due to time zone differences.	5/12/2021 12:10 PM
46	The online version enabled me to attend the lectures.	5/12/2021 11:50 AM
47	It allowed me to "attend" the talks. Flying from coast to coast would have been difficult.	5/12/2021 11:31 AM
48	I did not experience major difficulties. In any case, it is alwaus better to have person to person interaction	5/12/2021 11:23 AM
49	For an interdisciplinary conference like this the inability to have informal discussions after the talks was severely missed. I have no idea how to replace this online.	5/12/2021 11:15 AM
50	Having the workshop online meant that I didn't need to travel all the way to California from Europe, which made it easier to participate.	5/12/2021 11:13 AM
51	Naturally in-person would be superior, but I think that the workshop was done well despite the challenge of online delivery.	5/12/2021 11:11 AM

52	Could not have attended if it was in person.	5/12/2021 11:08 AM
53	I feel quite anxious asking questions in an online format.	5/12/2021 11:01 AM
54	It was actually nice to be able to access the talks without travel and fit it into my schedule	5/12/2021 10:51 AM
55	No	5/12/2021 10:47 AM
56	None	5/12/2021 10:46 AM
57	Having it online made it possible for me to attend.	5/12/2021 10:40 AM
58	No problem	5/12/2021 10:29 AM
59	no adverse impact	5/12/2021 10:28 AM
60	NO	5/12/2021 10:26 AM
61	As a student in Germany I would not have been able to participate otherwise	5/12/2021 10:26 AM
62	Confining the sessions to a five hour time block PST made it easier to follow three time zones away.	5/12/2021 10:23 AM
63	Not impacted at all.	5/12/2021 10:21 AM
64	I was an organiser. So participated fully. But with 8 hours time difference it was a bit challenging.	5/12/2021 10:20 AM
65	Due to the conference factually being "after work" in CET I kinda felt the obligation to both work a full day an then spend time at the conference. That was quite exhausting. I would have preferred to spend some time with other participants in small groups to spend some time with and discuss ideas.	5/12/2021 10:17 AM
66	Living in the Philippines, there is an apparent time zone difference but I pushed through because there's not a lot of online webinars or workshops about the topic. Holding it online helped me attend and learn more about the topic.	5/12/2021 10:16 AM

Q9 One important aspect that was missing due to the online format was interaction between participants. Do you have any suggestions on how we can provide this interaction if we hold future workshops online?

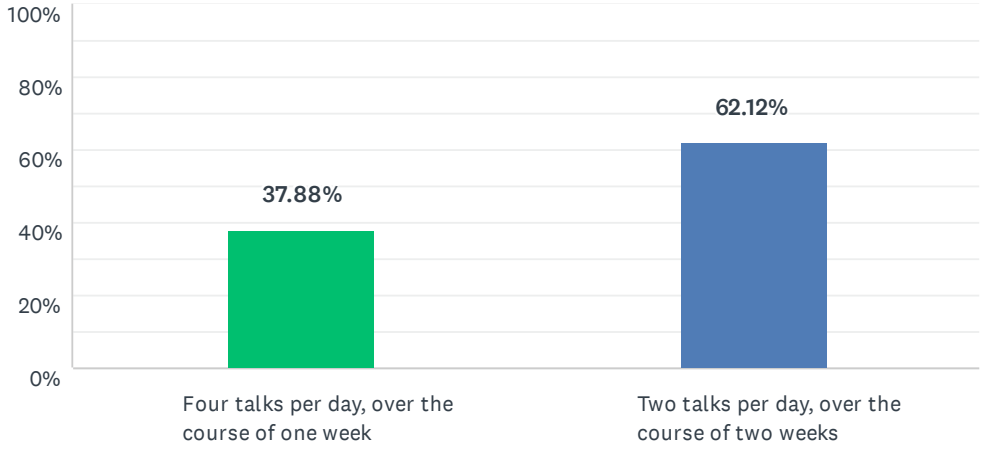
Answered: 25 Skipped: 49

#	RESPONSES	DATE
1	None	6/24/2021 1:56 PM
2	-	6/23/2021 2:22 PM
3	Scheduled virtual happy hours and random shuffles among the participants.	6/23/2021 1:59 PM
4	breakout rooms	6/23/2021 1:52 PM
5	I have seen some success with gather.town at ICERM workshops, but I think this is problem technology is (at least currently) not going to solve.	5/14/2021 4:23 AM
6	The is a "speed-networking" app called Glimpse that's amazing. Every 5 minutes you're paired with a different person, allowing for intros, networking, and putting names to faces.	5/13/2021 2:00 AM
7	Better to have every sessions/topic include both theoritical and technical explanations (how the data enhanced through the packages..)	5/13/2021 1:34 AM
8	--	5/12/2021 11:51 PM
9	No. I think it is very difficult to replicate, but I encourage you to keep looking for a solution.	5/12/2021 10:38 PM
10	I think holding a separate session just for participant interaction is enough.	5/12/2021 6:55 PM
11	I think everything is ok so far. Thanks so much for MSRI.	5/12/2021 5:01 PM
12	It could be useful to have some "know each other" sessions to allow informal discussions between participants, for example in random subgroup gatherings.	5/12/2021 2:22 PM
13	Gather town is a good discussion format	5/12/2021 11:50 AM
14	Organizing previously working groups or groups of collaborators	5/12/2021 11:23 AM
15	It might be a good idea to have a online space in which to hang out, e.g., GatherTown or something similar.	5/12/2021 11:13 AM
16	Breakout rooms managed by the speaker, so that people could talk about it and the speaker could pop in to each one.	5/12/2021 11:01 AM
17	Maybe a time for discussion in break out rooms each with a subtopic?	5/12/2021 10:51 AM
18	Good	5/12/2021 10:47 AM
19	It seemed like there was plenty of interaction during Q&A	5/12/2021 10:40 AM
20	Sorry, no idea	5/12/2021 10:26 AM
21	It might be helpful to hold informal discussion sessions around a topic common to several presentations. The presenters could lead by making short statements about open questions or problems they have encountered. Other individuals might pose deeper or more extended questions than is possible in the standard speaker question format. If a particular topic was thought to be fruitful there could be two or three such sessions staged to focus on different aspects of the common area of interest.	5/12/2021 10:23 AM
22	Platforms like Gathertown are excellent!	5/12/2021 10:21 AM
23	There is no replacement in that sense to physical participation. Not with current technology by my experience anyway.	5/12/2021 10:20 AM

24	gather.town works ok. Otherwise: Breakout rooms so that e.g. the younger participants can freely chat with each other.	5/12/2021 10:17 AM
25	Probably workshops on smaller groups on different topics.	5/12/2021 10:16 AM

Q10 In the event that we must hold future workshops online, which of the following would be preferable?

Answered: 66 Skipped: 8



ANSWER CHOICES	RESPONSES	
Four talks per day, over the course of one week	37.88%	25
Two talks per day, over the course of two weeks	62.12%	41
TOTAL		66

#	OTHER (PLEASE SPECIFY)	DATE
1	The format we had was pretty much ideal, I think.	5/12/2021 11:13 AM
2	I liked the 4 talks split over 2 weeks	5/12/2021 10:51 AM
3	We had four per day over a week and half. It was suitable	5/12/2021 10:20 AM

Q11 We welcome any additional comments or suggestions you may have to improve the overall online experience for future participants.

Answered: 12 Skipped: 62

#	RESPONSES	DATE
1	The talks should be more general rather than specialised.	6/24/2021 5:00 AM
2	Would you be able to provide me a certificate of participation in the event? As an institution from a developing country, we are expected to report productive activities we participate in. Sorry for the trouble. You can send it via email to ppignacio@up.edu.ph. Thank you!	6/23/2021 6:08 PM
3	post the videos and materials, please.	5/13/2021 3:26 PM
4	Consider time zone difference if possible. Thank you for the chance given to me for the participation of this workshop.	5/13/2021 1:34 AM
5	Thanks for organizing this!	5/12/2021 10:38 PM
6	The question about the MSRI staff needs to have N/A option. I didn't interact with the staff, so I just picked the middle option.	5/12/2021 8:14 PM
7	It was a very interesting workshop!	5/12/2021 12:28 PM
8	Thank you for this insightful workshop.	5/12/2021 11:50 AM
9	I would like to thank the organizers of the workshop, as well as the stsff of the MSRI, for putting together such a nice group of experts in applications of topology to neuroscience. This interaction has a great future.	5/12/2021 11:23 AM
10	Really fantastic organization and it went really smoothly - and thank you for posting videos so quickly, that was really helpfuk	5/12/2021 10:51 AM
11	Consider the Timing	5/12/2021 10:47 AM
12	Having attended a half-dozen workshops or conference virtually this year with large numbers of attendees, it appears there is demand for workshops that exceeds the ability of people to travel to on-site workshops or conferences. This is especially the case for conferences scheduled during the typical Northern Hemisphere academic year September to May. It is expensive and time-consuming to travel large distances to a half dozen workshops a year. I would like to see research institutes like MSRI find ways to host productive hybrid workshops in the future.	5/12/2021 10:23 AM

Connections Workshop: Mathematical Problems in Fluid Dynamics

January 20, 2021 - January 22, 2021

Virtual Workshop

Organizers:

Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS))

Juhi Jang (University of Southern California)

Anna Mazzucato (Pennsylvania State University)

Sijue Wu (University of Michigan)

REPORT ON THE MSRI WORKSHOP
"Connections Workshop: Mathematical problems in fluid dynamics (Virtual Workshop)"
January 20 – 22, 2021

Organizers

- Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS))
- Juhi Jang (University of Southern California)
- Anna Mazzucato (Pennsylvania State University)
- Sijue Wu (University of Michigan)

Scientific Description

The focus of the workshop was recent developments in mathematical fluid mechanics from the point of view of the analysis of partial differential equations. This is a mature field, where however several important open questions remain unanswered, such as uniqueness and regularity of solutions to the fluid equations, or the vanishing viscosity limit and rigorous analysis of boundary layers, to name a few, with important applications, for example to understanding and modeling turbulence.

The workshop featured talks by prominent female mathematicians whose research lies in and interfaces with mathematical fluid mechanics, emphasizing water waves, free boundaries, fluid structures, viscous fluids, and kinetic theory. The talks were geared to a diverse and broad audience, with a two-hour minicourse on boundary layers aimed at students and junior researchers and several more advanced talks aimed at presenting the state-of-the-art in the field.

Highlights of the Workshop

Originally designed as an in-person workshop, it was moved to an all-virtual format due to the COVID-19 pandemic. Open to all mathematicians, the workshop was attended remotely by 150 participants from Africa, the Americas, Asia, and Europe. The workshop online talks were complemented by virtual teas, using the online platform Gather.town.

The virtual platform presented challenges and opportunities. It allowed participants from under-privileged areas and Third World countries, for whom participation in person would have otherwise posed challenges. It widened participation of students and junior researchers, who likely benefited the most from the workshop. It widened speaker participation as well. We had 100% acceptance rate from speakers, due in part to the more flexible virtual format. Speakers did not experience any major technical issue and delivered their presentation using a variety of tools, from prepared slides to a mix of prepared slides annotated in real time.

At the same time, this format posed challenges in terms of connecting and effectively engaging participants. Although the chat and other features of the online meeting platform Zoom allowed

for a robust number of questions, especially from junior participants, who were perhaps less timid in a more impersonal setting, it made offline discussion after the talks less spontaneous.

The survey responses collected after the workshop were generally very positive, and reflected these challenges and opportunities. Almost 70% of the attendees found the workshop intellectually stimulating and over 60% deemed worthwhile attending it. The perception of the level of the lectures was more mixed, in part likely due to the broad and diverse audience. Over half the attendees stated that their interest for the subject matter of the workshop was increased by participating in it. Almost 70% found the MSRI staff supportive, and this was also the experience of the organizers. One very positive aspect of the survey is that over 95% of the participants did not report any issue connecting to the online platform.

Responses regarding the impact of the virtual format, especially with respect to the interactions among participants, were mixed. Several respondents were intrigued by the Gather.town platform, which allows simultaneous conversations among different self-assembled groups. Others, however, found the platform awkward to navigate and would have preferred more traditional assigned breakout rooms. Participation to teas was somewhat low.

Overall, the workshop was successful and achieved its goals.

Organizers		
First Name	**Last Name**	**Institution**
Hajer	Bahouri	Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)
Juhi	Jang	University of Southern California
Anna	Mazzucato	Pennsylvania State University
Sijue	Wu	University of Michigan
Speakers		
First Name	**Last Name**	**Institution**
Anne-Laure	Dalibard	Université de Paris VI (Pierre et Marie Curie)
Colette	Guillopé	Université Paris-Est Créteil Val-de-Marne
Vera Mikyoung	Hur	University of Illinois at Urbana-Champaign
Inwon	Kim	University of California, Los Angeles
Helena	Nussenzveig Lopes	Federal University of Rio de Janeiro
Natasa	Pavlovic	University of Texas, Austin
Yao	Yao	Georgia Institute of Technology

Mathematical Sciences Research Institute

Connections for Women: Mathematical problems in fluid dynamics (Virtual Workshop)

January 20 to January 22, 2021

Wednesday, January 20, 2021		
8:00AM - 9:00AM	Anne-Laure Dalibard	Boundary layer methods in semilinear fluid equations
9:00AM - 9:30AM		Tea Break Using Virtual Platform
9:30AM - 10:30AM	Vera Mikyoung Hur	Unstable water waves: periodic Evans function approach
10:30AM - 11:00AM		Tea Break Using Virtual Platform
11:00AM - 12:00PM	Natasa Pavlovic	Beyond binary interactions of particles

Thursday, January 21, 2021		
8:30AM - 9:30AM	Colette Guillopé	About a higher-order water wave model: further theory
9:30AM - 11:00AM		Tea Break Using Virtual Platform
11:00AM - 12:00PM	Helena Nussenzveig Lopes	Vanishing viscosity and conserved quantities for 2D incompressible flow

Friday, January 22, 2021		
8:00AM - 9:00AM	Anne-Laure Dalibard	Boundary layer methods in semilinear fluid equations
9:00AM - 9:30AM		Tea Break Using Virtual Platform
9:30AM - 10:30AM	Inwon Kim	A variational scheme for Naiver-Stokes Equations
10:30AM - 11:00AM		Tea Break Using Virtual Platform
11:00AM - 12:00PM	Yao Yao	Radial symmetry of stationary and uniformly-rotating solutions in 2D incompressible fluid equations

Participants		
First name	**Last name**	**Institution name**
Sara	Abu Diab	American University of Beirut
Terrence	Adams	TimeTested, LLC
Siddhant	Agrawal	University of Massachusetts Amherst
Albert	Ai	University of Wisconsin-Madison
Thomas	Alazard	Ecole Normale Supérieure Paris-Saclay
Maurice	Alexander	San Jose State University
Diego	Alonso-Oran	University of Bonn
Vinay	Arora	Panjab University, UIET (PUSSGRC, Hoshiarpur)
Hajer	Bahouri	Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)
Jeaheang	Bang	Rutgers University
Valeria	Banica	Sorbonne University, Laboratoire Jacques-Louis Lions
Roberta	Bianchini	Consiglio Nazionale delle Ricerche (CNR)
Edoardo	Bocchi	University of Sevilla
Didier	Bresch	Université de Savoie (Chambéry)
Adriana Valentina	Busuioc	Université Jean Monnet
Fei	Cao	Arizona State University
Eonho	Chang	University of Arizona
Gong	Chen	Fields Institute for Research in Mathematical Sciences
Jingchun	Chen	University of Toledo
Didier	Clamond	Universite de Nice Sophia Antipolis
Dragoianu	Constantina-Cristina	Universitatea din Craiova
Carlos M.	Corona	Universidad Politécnica de Madrid
Joaquim	Correia	University of Évora
Jackson	Criswell	Central Michigan University
Anne-Laure	Dalibard	Université de Paris VI (Pierre et Marie Curie)
Thibault	de Poyferré de Cère	MSRI - Mathematical Sciences Research Institute
Latifa	Debbi	Universite M'hammed Bouguerra de Boumerdes
Briceyda	Delgado López	Universidad Autónoma de Aguascalientes
Jean Marc	Delort	Université de Paris XIII (Paris-Nord)
Marcelo	Disconzi	Vanderbilt University
Shanna	Dobson	California State University, Los Angeles
Martin	Donati	Institut Camille Jordan
Hongjie	Dong	Brown University
Hengrong	Du	Purdue University
Daniel	Erickson	Oregon State University
Lucas	Ertzbischoff	École Polytechnique
Wen	Feng	Niagara University
Padi	Fuster Aguilera	Tulane University
Eduardo	Garcia-Juarez	Universitat de Barcelona
Dan	Geba	University of Rochester
Jose Eduardo	Cazares Tapia	Universidad Nacional Autónoma de México
Colette	Guillopé	Université Paris-Est Créteil Val-de-Marne
Srujan	Gupta	none
Siming	He	Duke University

Participants		
First name	**Last name**	**Institution name**
Jiao	He	MSRI - Mathematical Sciences Research Institute
Cong	He	University of Wisconsin-Milwaukee
Gerardo	Hernandez-Duenas	UNAM - Universidad Nacional Autonoma de Mexico
Stephen	Hobbs	Naval Information Warfare Center
Ting-Yang	Hsiao	University of Illinois at Urbana-Champaign
Yiran	Hu	University of Texas, Austin
Weiwei	Hu	University of Georgia
Vera Mikyoung	Hur	University of Illinois at Urbana-Champaign
Hussain	Ibdah	Texas A & M University
Slim	Ibrahim	University of Victoria
Mihaela	Ifrim	University of Wisconsin-Madison
Dragos	Iftimie	Université Claude-Bernard (Lyon I)
Michael	Iyoko	Federal University of Agriculture Abeokuta
Juhi	Jang	University of Southern California
Gray	Jennings	American Mathematical Society
Tulin	Kaman	University of Arkansas
Muhammad	Kamran	COMSATS University Islamabad, Wah Campus
Tanay	Karmakar	Indian Institute of Technology
Matthew	Kehoe	University of Illinois at Chicago
Jim	Kelliher	University of California, Riverside
Inwon	Kim	University of California, Los Angeles
Herbert	Koch	Rheinische Friedrich-Wilhelms-Universitãt Bonn
Ryan	Konno	Simon Fraser University
Igor	Kukavica	University of Southern California
Anuj	Kumar	University of California, Santa Cruz
Dohyun	Kwon	University of Wisconsin-Madison
Joonhyun	La	Stanford University
David	Lannes	Institut de Mathématiques de Bordeaux
Fizay-Noah	Lee	Princeton University
Trevor	Leslie	University of Southern California
Linfeng	Li	University of Southern California
En-Bing	Lin	Central Michigan University
Hans	Lindblad	Johns Hopkins University
Xiao	Liu	Georgia Institute of Technology
Shizhe	Liu	University of California, Berkeley
Jiaqi	Liu	University of Southern California
Brandon Alejandro	Llaca Sanchez	Universidad Autónoma de Querétaro (UAQ)
Wenjie	Lu	University of Minnesota, Twin Cities
Michelle	Luckas	Gesamthochschule (GHS) Kassel
Yuchen	Mao	University of California, Berkeley
Jeffrey	Marino	Johns Hopkins University
Michael	Maroun	Independent Researcher
Vincent	Martinez	Hunter College, CUNY
Hussein	Mastaneh	Iran Meteorology Organization
Anna	Mazzucato	Pennsylvania State University

Participants		
First name	**Last name**	**Institution name**
Halima	Meddour	University Batna 2
Evan	Miller	McMaster University
Joseph	Miller	University of Texas, Austin
Sylvie	Monniaux	Aix-Marseille Université
Ryan Chris	Moreno-Vasquez	University of California, Davis
Matthew	Novack	New York University, Courant Institute
Helena	Nussenzveig Lopes	Federal University of Rio de Janeiro
Ignacio	Otero	Centro de Investigacion y Estudios Avanzados
Jaemin	Park	Georgia Institute of Technology
Federico	Pasqualotto	University of California, Berkeley
Natasa	Pavlovic	University of Texas, Austin
José Juan	Peña Leal	Universidad Nacional Autónoma de México
Tuan	Pham	Brigham Young University
Patrick	Phelps	University of Arkansas
Ben	Pineau	University of California, Berkeley
Pooja	Rao	State University of New York, Stony Brook
Brandy	Rapatski	Stockton University
Calum	Rickard	University of Southern California
Jorge	Robinson Arrieta	Universidad del Norte
Cesar Alberto	Rosales-Alcantar	Universidad Nacional Autónoma de México (UNAM)
James	Rowan	University of California, Berkeley
Fatemeh	saghafifar	Simon Fraser University
Marco	Sammartino	UniversitÃ di Palermo
Riuji	Sato	Worcester Polytechnic Institute
Bhupesh	Sharma	VIT-AP University
Jingyang	Shu	Temple University
Annalaura	Stingo	University of California, Davis
Robert	Strain	University of Pennsylvania
Qingtang	Su	University of Southern California
Vladimir	Sverak	University of Minnesota Twin Cities
Reena	Tandon	Lovely Professional University
Andrei	Tarfulea	Louisiana State University
Daniel	Tataru	University of California, Berkeley
Mitchell	Taylor	University of California, Berkeley
Duoc	Trinh	University of Science, Vietnam National University
Amjad	Tuffaha	American University of Sharjah
Jack	Urombo	Harare institute of Technonology
Gaston	Vergara-Hermosilla	Institut de Mathématiques de Bordeaux
Lizhe	Wan	University of Wisconsin-Madison
Weinan	Wang	University of Arizona
Jörg	Weber	Lund University
Bobby	Wilson	University of Washington
Sijue	Wu	University of Michigan
Xuming	Xie	Morgan State University
Xiangjin	Xu	Binghamton University (SUNY)

Participants		
First name	**Last name**	**Institution name**
Fanhui	Xu	Carnegie Mellon University
Liaosha	Xu	University of Virginia
Jiaqi	Yang	Georgia Institute of Technology
Jincheng	Yang	University of Texas, Austin
Ruoxuan	Yang	Massachusetts Institute of Technology
Zhao	Yang	University of Illinois at Urbana-Champaign
Yao	Yao	Georgia Institute of Technology
Gael	Yomgne	Rheinische Friedrich-Wilhelms-Universitãt Bonn
Giorgio	Young	Rice University
Lei	Yu	Tongji University
Chongchun	Zeng	Georgia Institute of Technology
Jhih-Jyun	Zeng	Oregon State University
Mohamed	Zerguine	Batna 2 University
Yuming	Zhang	University of California, San Diego
Zirui	Zhou	University of California, Berkeley
Hui	Zhu	University of Michigan

Identifiable Participants Information

Identifiable Participants		150

Gender		150
Male	68.67%	103
Female	28.00%	42
Other	0.67%	1
Declined to state	2.67%	4

Ethnicity*		153
White	37.91%	58
Asian	43.14%	66
Hispanic	7.19%	11
Pacific Islander	1.31%	2
Black	2.61%	4
Native American	0.65%	1
Declined to state	7.19%	11

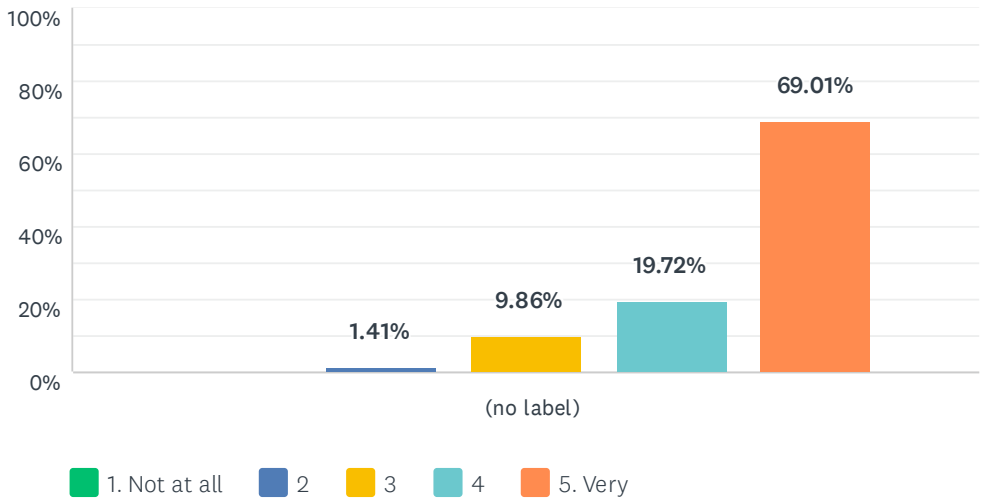
* ethnicity specifications are not exclusive

There were 9 additional virtual participants who were not identifiable

71 responses out of 150 participants = 47% response rate

Q1 The workshop was intellectually stimulating

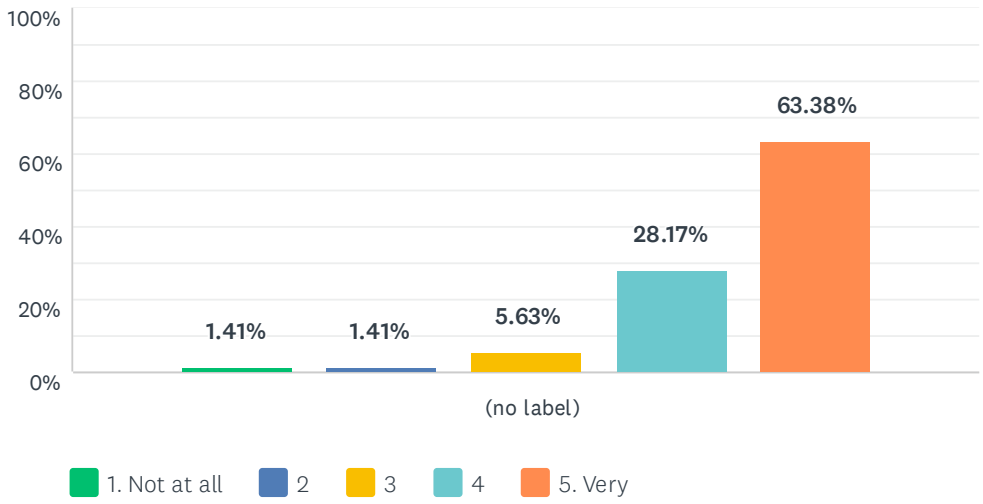
Answered: 71 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	1.41% 1	9.86% 7	19.72% 14	69.01% 49	71	4.56

Q2 The overall experience of the workshop was worthwhile

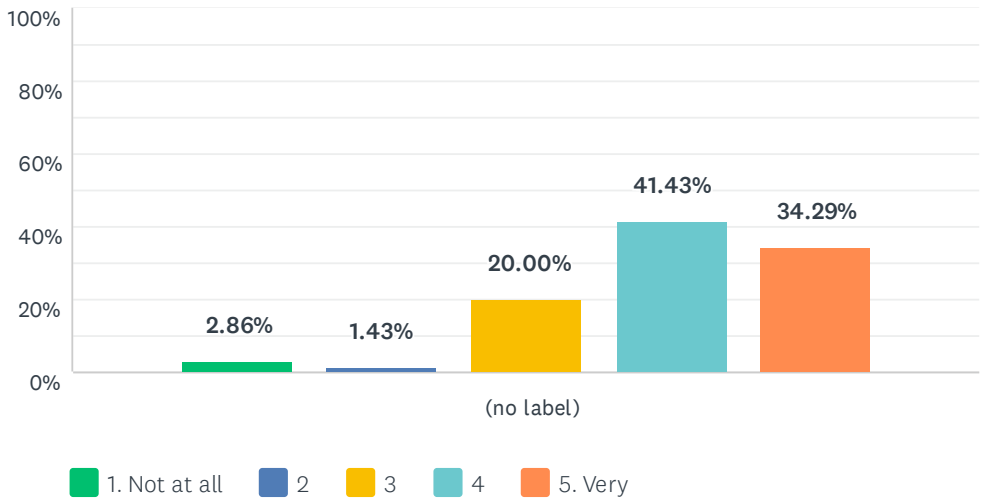
Answered: 71 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	1.41% 1	1.41% 1	5.63% 4	28.17% 20	63.38% 45	71	4.51

Q3 I was well prepared to benefit from the lectures

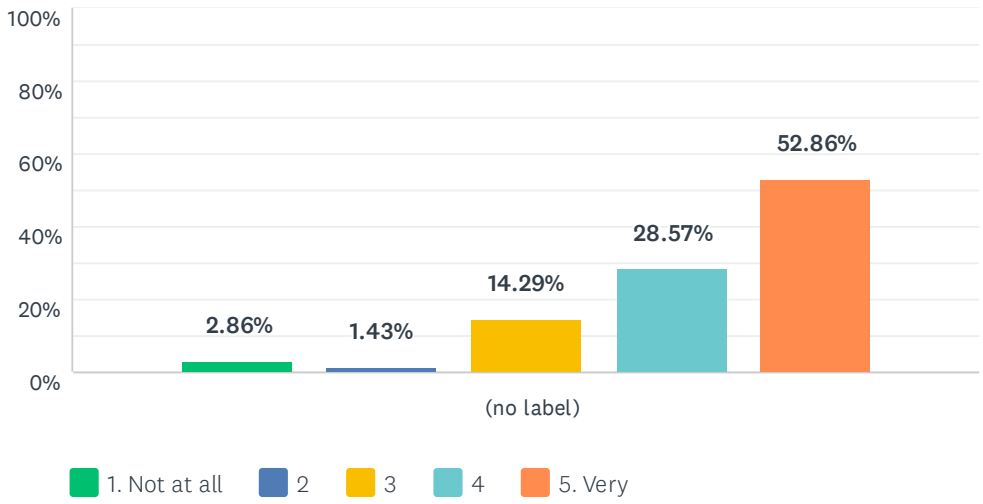
Answered: 70 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	2.86% 2	1.43% 1	20.00% 14	41.43% 29	34.29% 24	70	4.03

Q4 My interest in the subject matter was increased by the workshop

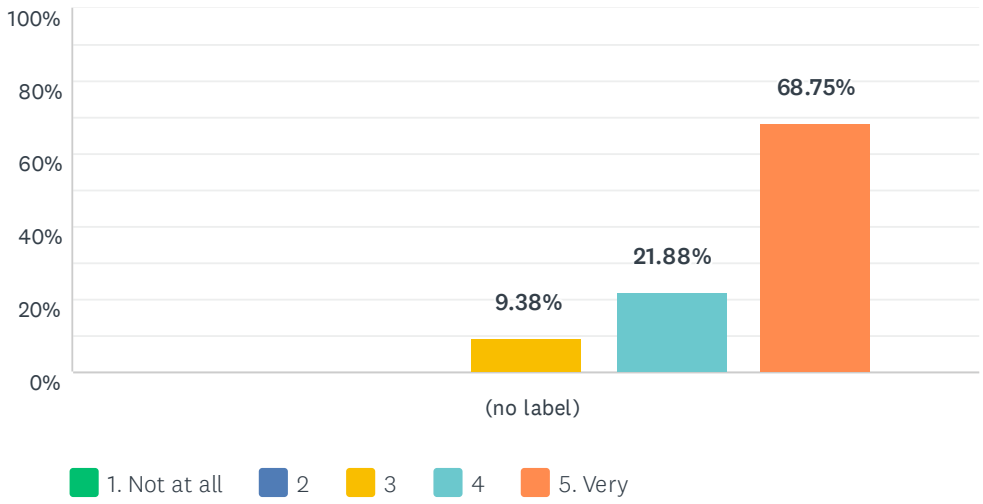
Answered: 70 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	2.86% 2	1.43% 1	14.29% 10	28.57% 20	52.86% 37	70	4.27

Q5 I found the MSRI staff helpful

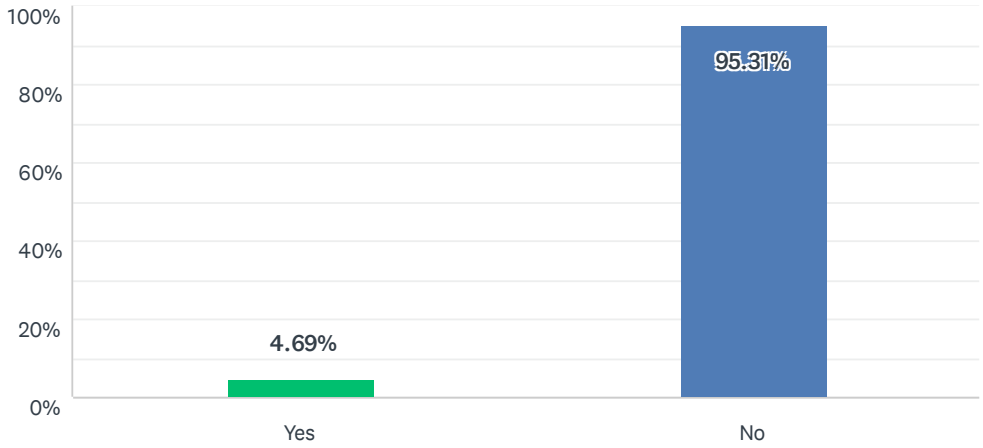
Answered: 64 Skipped: 7



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	9.38% 6	21.88% 14	68.75% 44	64	4.59

Q6 Did you experience any technical difficulties accessing the online workshop?

Answered: 64 Skipped: 7



ANSWER CHOICES	RESPONSES	
Yes	4.69%	3
No	95.31%	61
TOTAL		64

#	IF YES, PLEASE EXPLAIN	DATE
1	Network was bad	2/3/2021 1:07 PM
2	I could not join tea time meeting because of audio and video problems	1/23/2021 4:03 AM
3	MSRI's IT support was great!	1/22/2021 12:17 PM

Q7 How did having the workshop held online impact your participation?

Answered: 64 Skipped: 7

#	RESPONSES	DATE
1	This aspect didn't impact my participation in any way.	2/19/2021 10:00 AM
2	The online workshop was for me not too enjoyable because of poor network in my country.	2/6/2021 7:13 AM
3	Good	2/3/2021 6:52 PM
4	no need to travel; i can multi-task while speaker is presenting --- for example, a quick google on the speaker, or the mathematical concepts, etc helped me understand things a little bit better	2/3/2021 1:07 PM
5	It completely made my participation possible	2/3/2021 1:07 PM
6	The adaptation of the workshop to an online format is really well made, the only missing thing is the small social interactions/questions that one could have with his colleagues usually siting next to him in a conference/workshop but this doesn’t seem solvable in an online format.	2/3/2021 12:20 PM
7	It's actually convenient for me to attend	2/3/2021 11:48 AM
8	Not possible if not online.	2/3/2021 11:36 AM
9	I have no opinion on that. Everything was fine.	2/3/2021 11:26 AM
10	I would not be able to attend this workshop if it had been held in person.	2/3/2021 10:58 AM
11	It allowed me to attend this workshop, which would have been impossible presentially due to the COVID-19 pandemic.	2/3/2021 10:57 AM
12	I could follow some registered lectures and that was very useful.	2/3/2021 10:43 AM
13	As a graduate student, it is more difficult to socialize with the speakers online.	2/3/2021 10:42 AM
14	Well, just in the interaction between participants.	2/3/2021 10:41 AM
15	The issue for me was being in a completely different time zone (GTM+1), but I am grateful I was able to follow the workshop online.	2/3/2021 10:28 AM
16	Yes, I likely would not have been able to participate if the workshop was online.	2/3/2021 10:14 AM
17	In Vietnam, the time difference is quite large.	1/26/2021 1:40 AM
18	Not at all	1/25/2021 1:20 PM
19	yes	1/25/2021 7:30 AM
20	It was not easy to start a conversation but the tea room idea was interesting.	1/23/2021 11:03 AM
21	Increased my participation due to the flexibility	1/23/2021 8:45 AM
22	I could participate because it held online; otherwise I could not participate at all.	1/23/2021 4:03 AM
23	Yes, it is more difficult to feel personnaly involved, especially given that due to the time zone difference, I had to attend the workshop after my full day of work..	1/23/2021 3:42 AM
24	Oh my God, it was nice to participate, because moving to MSRI for a workshop or a conference etc. is not very easy especially in terms of financial impact incurred. People from low-income countries really can get benefit from this type of webinars. I really hope to see more webinars in the future.	1/23/2021 3:22 AM
25	It was a very informative session, I learned new things	1/23/2021 12:47 AM
26	I think it’s more convenient to have it online.	1/23/2021 12:08 AM
27	For me, the online workshop requires the speakers to explain more their works for participants and gives detailed answers for the questions posed. This is nice!	1/22/2021 11:53 PM
28	Time difference	1/22/2021 10:17 PM
29	a little bit.	1/22/2021 8:31 PM
30	It benefited me in the sense I did not need to travel to Berkeley for the workshop. However I do believe one gets more out of in person events overall.	1/22/2021 8:28 PM

31	It certainly had a positive impact on my participation by enabling me to work on my own and simultaneously interact with the participants.	1/22/2021 7:33 PM
32	Online meetings are not as effective as in person meetings, but such are the boundary conditions imposed by the pandemic.	1/22/2021 6:28 PM
33	I wouldn't be able to go if this was at MSRI, but I could not make the full talk most of the time so I didn't learn much.	1/22/2021 4:23 PM
34	I think that it is even easier for me to participate the workshop than before.	1/22/2021 4:10 PM
35	Good	1/22/2021 2:38 PM
36	It was difficult	1/22/2021 2:08 PM
37	I loved it. It is difficult for me to travel these days with family duties. Having the lectures online really made me feel welcome. It enabled me to listen in while working :) so that I did not miss out on anything.	1/22/2021 1:36 PM
38	Not at all	1/22/2021 1:30 PM
39	It is a perfect experience to participate the workshop	1/22/2021 1:22 PM
40	it's helpful to have the workshop held online	1/22/2021 1:19 PM
41	couldn't participate if it wasn't online	1/22/2021 1:13 PM
42	Clearly a "real life meeting" is always better than a workshop on line, but due to the present situation, this was the best (and only) option.	1/22/2021 12:59 PM
43	Not much.	1/22/2021 12:57 PM
44	It made it easier- especially the fact that such was open to all mathematicians.	1/22/2021 12:45 PM
45	I didn't have any issues with participation in the talks. I would guess that the only difference would be that I could not interact with other members that easily during tea time.	1/22/2021 12:44 PM
46	It offers the convenience of being at home, but having more than two talks a day is too much zoom time.	1/22/2021 12:34 PM
47	There was not much impact; I was able to participate in most parts of the workshop.	1/22/2021 12:32 PM
48	Due to the time lag, the lectures were given during the evening for me which is not the best time.	1/22/2021 12:28 PM
49	Quite a bit.	1/22/2021 12:26 PM
50	I think the Tea breaks did not work as well as in person, but on the positive side it was easier for participants to join even from Third World countries	1/22/2021 12:26 PM
51	I was able to participate to the whole workshop (without having to travel from Europe)	1/22/2021 12:24 PM
52	The influence is positive	1/22/2021 12:23 PM
53	I couldn't meet people in person.	1/22/2021 12:19 PM
54	Not so much... Great Experience. But I miss personal & physical meeting with all the Speaker's & Participants.	1/22/2021 12:19 PM
55	It was great to see participants from all over the world. Personally I was not sure how things will work out in the beginning, but I can see that there's an advantage of online workshop. Thank MSRI!	1/22/2021 12:17 PM
56	No.	1/22/2021 12:15 PM
57	The online version allows to have interesting scientific exchanges.	1/22/2021 12:11 PM
58	It made it super easy! It also stimulated collaboration with active research outside of the workshop as the energy gave me ideas about my own work I was able to do work and listen to talks simultaneously. This is not possible in a in-person format!	1/22/2021 12:10 PM
59	Not having to travel is great as I otherwise would be unable to attend, but it does mean I have to fit in the talks between my typical work schedule (teaching duties, etc.).	1/22/2021 12:09 PM

60	Less social activity	1/22/2021 12:08 PM
61	The difference of time zone is a bit challenge.	1/22/2021 12:08 PM
62	It made it possible, or at least financially feasible.	1/22/2021 12:08 PM
63	I would have attended more talks and been more engaged in person. I also would not have left talks early in person	1/22/2021 12:07 PM
64	It would have been very difficult to attend otherwise.	1/22/2021 12:07 PM

Q8 One important aspect that may have been missing due to the online format was interaction between participants. If you have any suggestions on how this can be improved in the future, please explain.

Answered: 15 Skipped: 56

#	RESPONSES	DATE
1	Participants should indicate their particular research interest in terms of type of fluid.	2/3/2021 1:07 PM
2	I have no suggestions.	2/3/2021 10:42 AM
3	participant interaction is overrated	1/25/2021 7:30 AM
4	No, It was very well planned.	1/23/2021 12:47 AM
5	I think that the speakers should put their talks on the screen at least 15 minutes before starting to give more time to participants to better understand the subject.	1/22/2021 11:53 PM
6	NO	1/22/2021 8:31 PM
7	I liked the idea of the gather.town app, but it needs to be improved -- so that nearby conversations are muted or muffled -- and, most importantly, it needs a tutorial when first logging in. I only discovered how to move my avatar on the last day of the workshop, for instance.	1/22/2021 6:28 PM
8	I think gather town is a great interaction tool, but I will keep my eye out for others.	1/22/2021 1:36 PM
9	n/a	1/22/2021 1:19 PM
10	No idea. I think gathertown during tea time was quite good but I think in person interaction is better.	1/22/2021 12:44 PM
11	Randomly select a group of participants in a zoom breakout room, so they can introduce themselves and talk about work.	1/22/2021 12:34 PM
12	I did not find the gather platform very conducive to interaction. Few people went there and it was not easy to navigate at the beginning. Zoom breakout rooms might be a good alternative.	1/22/2021 12:26 PM
13	I coud not use the coffee room (no idea how to make it work). Real interactions between participants is very much valuable.	1/22/2021 12:24 PM
14	There is no big interaction between participants. I think to enlarge the time of discussion and create a mini workshop between participants	1/22/2021 12:23 PM
15	By Sharing their Contact details...	1/22/2021 12:19 PM

Q9 We welcome any additional comments or suggestions you may have to improve the overall online experience for future participants.

Answered: 12 Skipped: 59

#	RESPONSES	DATE
1	Kindly remind speakers to not say things like "I am sure you know this..."	2/3/2021 1:07 PM
2	Thank you so much for holding this workshop online. It will be worthy if after pandemic the workshops hold online too; or it can be combined.	1/23/2021 4:03 AM
3	MSRI did a tremendous job by successfully arranging this webinar when there was a frightening atmosphere everywhere due to COVID. I really appreciate the efforts. I almost attended all the sessions from all three days. It was really a rewarding time investment. I learned a lot from the speakers with diverse work in FD. I really hope to see more webinars in the future.	1/23/2021 3:22 AM
4	I really want to be the part of the coming workshops.	1/23/2021 12:47 AM
5	Broaden the time for discussion	1/22/2021 11:53 PM
6	If possible please provide the soft copy of material related to this workshop.	1/22/2021 8:31 PM
7	Please host more online events. They are very helpful and respectful to those of us who cannot easily travel.	1/22/2021 1:36 PM
8	n/a	1/22/2021 1:19 PM
9	Not have more than two talks a day and have more interactions between the participants. And not have the course at the same time as some talk.	1/22/2021 12:34 PM
10	What about having a list of participants with institutions and emails? What about making a picture of everyone: it is possible to ask a picture to each participants (the ones who accept) and to put them together on a page and put it on the website of the workshop.	1/22/2021 12:24 PM
11	It will be very thankful , if we receive certificate of participation....	1/22/2021 12:19 PM
12	Question (5) should have an option to mark as "NA" because I did not interact with the MSRI staff so I am not qualified to answer the question.	1/22/2021 12:08 PM

Introductory Workshop: Mathematical problems in fluid dynamics

January 25, 2021 - February 05, 2021

Virtual Workshop

Organizers:

Nicolas Burq (Université de Paris XI)

Anne-Laure Dalibard (Université de Paris VI (Pierre et Marie Curie))

Jean Marc Delort (Université de Paris XIII (Paris-Nord))

Mihaela Ifrim (University of Wisconsin-Madison)

Irena Lasiecka (University of Memphis)

Vladimir Sverak (University of Minnesota Twin Cities)

REPORT ON THE MSRI WORKSHOP
"Introductory Workshop: Mathematical problems in fluid dynamics (Virtual Workshop)"
January 25 – February 05, 2021

Organizers

- Nicolas Burq (Université de Paris XI)
- Anne-Laure Dalibard (Université de Paris VI (Pierre et Marie Curie))
- Jean Marc Delort (Université de Paris XIII (Paris-Nord))
- Mihaela Ifrim (University of Wisconsin-Madison)
- Irena Lasiecka (University of Memphis)
- Vladimir Sverak (University of Minnesota Twin Cities)

Scientific Description

Fluid dynamics is one of the classical areas of partial differential equations, and has been the subject of extensive research over hundreds of years. It is perhaps one of the most challenging and exciting fields of scientific pursuit simply because of the complexity of the subject and the endless breadth of applications.

The workshop addressed topics in the PDE analysis of the basic equations of the incompressible fluid dynamics (the Euler equations for inviscid flows, the Navier Stokes equations for viscous flows), interface problems (water waves), and other related equations. Open problems and connections to related branches of mathematics were discussed, including the phenomena of turbulence and the zero viscosity limit. Both theoretical and numerical aspects of these topics were considered. There were some introductory style lectures as well as shorter research talks. More precisely, we planned four series of two or three lectures, given by leaders in their fields, aimed at giving an accessible presentation of a topic from its foundations up to some elements of current research. We have had thus three talks by Jean-Yves Chemin about incompressible Navier-Stokes equations, three talks by Camillo DeLellis concerning the DiPerna-Lions theory for transport equations and its recent advances, three lectures by Daniel Tataru, devoted to interface problems for gravity/capillary water waves and two lectures by Jon Wilkening related to the numerical study of quasi-periodic water waves.

The introductory lectures -3 hours long- have provided a panoramic overview of specific areas of current interest to the FD community. Starting with the basics and good physical motivation for the problems studied, the lectures culminated with most recent advances and an array of open problems of current interest. Excellent presentations and stimulating content have provided great opportunity for the beginners wishing to enter the field and the experts working actively in the area. Discussions and questions asked during the workshop, provide an ample evidence of a very healthy interaction between the participants. Choice of the topics was well balanced in providing different approaches to mathematical theory of fluid Dynamics. The material presented will be made available to the entire community by re positing pdf files with the talks.

Introductory lectures were complemented by one hour talks on related subjects. The workshop was open to all.

During the one hour talks, several speakers reported exciting new developments concerning mathematical analysis of PDEs of fluid mechanics. These included for example the latest on the singularity formation for Euler equation from compactly supported $C^{1,\alpha}$ initial conditions (T. Elgindi), computational efforts to capture potentail singularities starting from smooth axi-symmetric data (T. Hou), and new connections between intermittency exponents in phenomenological turbulence and regularity classes achievable in constructions based on convex integration (V. Vicol).

Highlights of the Workshop

For us the organizers, the MSRI input and guidance in organizing the Introductory Workshop in a virtual fashion was the key to a successful outcome. What we set out to do was to provide the participants with a full day immersion into the program, guided by several main ideas that came together to provide a positive experience for the participants:

- MSRI provided an array of tools, all of which have played key roles. This included Zoom, Sococo, Gather Town Jamboard, Slack, Overleaf. This all came on top of a main program page that served as the participant's entry point toward all other platforms. All participants benefited from the almost real experience that all of this software provided: including the Tea Time, which was a real hit! We used Gathertown for the meetings and even though in the beginning there was a slow response from the participants, we all quickly adapted. As an example, within a few days some groups were constantly meeting on Gathertown, even when Tea Time was not scheduled. This software, together with Sococo and Zoom made the whole experience very pleasant and as close to a "face-to-face" experience as possible.

- The MSRI IT team was always attentive and resolved all unavoidable hiccups related to speaker's issues on sharing their screen before their talks. All was done in a timely manner, and no talk cancellation due to technical issues occurred during the duration of the workshop. There were a couple of issues related to some of the participants (few of them) not being able to use their cameras and microphones during the Gathertown meetings but exclusively all of them were related to the quality of their own devices. Some of them addressed the problem quickly by either updating their software (and in doing so they were helped by the IT team) or, in some case, by buying a new device.

- The scientific component was also well received by the audience. All the speakers delivered their talks clearly and efficiently. Discussions at the end of the talks were lively and sometimes lengthily (which we believe shows interest in the subject!). In some cases, some discussions were carried out for longer time, including during the Tea Time meetings. The Tea meetings took place in Gathertown. We believe the participants were comfortable in asking questions, especially the postdoctoral fellows which throughout the workshop connected and interacted with senior fellows.

- One main feature of the Workshop, as far as the organization was concerned, was the idea of arranging the talks in a way that (i) allowed participants located on different time zones to participate, (ii) had the “the right number” of talks scheduled on a day so that a burnout feeling was avoided, (iii) efficiently and as much as possible integrated the Chancellor's Professor lectures so participants will have access to both. The other nice feature of the workshop was that most of the speakers agreed to have their lectures (videos and pdf) posted on the workshop's webpage, which most of us greatly appreciate.

- It is worth mentioning that some participants, especially from developing countries, expressed their gratitude about the fact that the online conference was opened to all, as they would not have had, in normal times, the financial possibility to attend an onsite meeting so far away from their institutional home.

- We believe the workshop delivered a very positive experience for both the speakers and the organizers, and this conclusion is a result of the nice comments some of the organizers received from the speakers, and participants. The overall feeling was that the workshop was a success and a much needed experience during these unprecedented times!

Organizers

First Name	Last Name	Institution
Nicolas	Burq	Université de Paris XI
Anne-Laure	Dalibard	Université de Paris VI (Pierre et Marie Curie)
Jean Marc	Delort	Université de Paris XIII (Paris-Nord)
Mihaela	Ifrim	University of Wisconsin-Madison
Irena	Lasiecka	University of Memphis
Vladimir	Sverak	University of Minnesota Twin Cities

Speakers

First Name	Last Name	Institution
Valeria	Banica	Sorbonne University, Laboratoire Jacques-Louis Lions
Jacob	Bedrossian	University of Maryland
Jean-Yves	Chemin	Sorbonne Université
Camillo	De Lellis	Institute for Advanced Study
Tarek	Elgindi	Duke University
Thomas	Hou	California Institute of Technology
David	Lannes	Institut de Mathématiques de Bordeaux
Katharina	Schratz	Sorbonne University
Daniel	Tataru	University of California, Berkeley
Vlad	Vicol	New York University, Courant Institute
Jon	Wilkening	University of California, Berkeley
Sijue	Wu	University of Michigan

Mathematical Sciences Research Institute

Introductory Workshop: Mathematical Problems In Fluid Dynamics (Virtual Workshop)

January 25, 2021 to February 05, 2021

Monday, January 25, 2021		
8:00AM - 9:00AM	Camillo De Lellis	Transport equations and ODEs with nonsmooth coefficients (Part 1)
9:00AM - 9:30AM		Tea Break Using Virtual Platform
9:30AM - 10:30AM	Camillo De Lellis	Transport equations and ODEs with nonsmooth coefficients (Part 2)
10:30AM - 11:00AM		Tea Break Using Virtual Platform
11:00AM - 12:00PM	Jacob Bedrossian	Lagrangian chaos, almost sure exponential mixing, and passive scalar turbulence

Tuesday, January 26, 2021		
8:30AM - 9:30AM	Jean-Yves Chemin	Regularity of the solutions of the Navier-Stokes equations (Part 1)
9:30AM - 10:00AM		Tea Break Using Virtual Platform
10:00AM - 11:00AM	Jean-Yves Chemin	Regularity of the solutions of the Navier-Stokes equations (Part 2)

Thursday, January 28, 2021		
8:00AM - 9:00AM	Camillo De Lellis	Transport equations and ODEs with nonsmooth coefficients (Part 3)
9:00AM - 9:30AM		Tea Break Using Virtual Platform
9:30AM - 10:30AM	Vlad Vicol	Non-conservative $H^{1/2-}$ weak solutions of the incompressible 3D Euler equations
10:30AM - 11:00AM		Tea Break Using Virtual Platform
11:00AM - 12:00PM	Tarek Elgindi	Non-conservative $H^{1/2-}$ weak solutions of the incompressible 3D Euler equations

Friday, January 29, 2021		
8:30AM - 9:30AM	Jean-Yves Chemin	Regularity of the solutions of the Navier-Stokes equations (Part 3)
9:30AM - 10:00AM		Tea Break Using Virtual Platform
10:00AM - 11:00AM	Valeria Banica	Vortex filament dynamics

Monday, February 01, 2021		
8:00AM - 9:00AM	Daniel Tataru	An introduction to water waves (Part 1)
9:00AM - 9:30AM		Tea Break Using Virtual Platform
9:30AM - 10:30AM	Daniel Tataru	An introduction to water waves (Part 2)
10:30AM - 11:00AM		Tea Break Using Virtual Platform
11:00AM - 12:00PM	Sijue Wu	On the free boundary hard phase fluid in Minkowski spacetime

Tuesday, February 02, 2021		
8:30AM - 9:30AM	Jon Wilkening	A Numerical Study of Quasi-Periodic Water Waves (Part 1)
9:30AM - 10:00AM		Tea Break Using Virtual Platform
10:00AM - 11:00AM	Jon Wilkening	A Numerical Study of Quasi-Periodic Water Waves (Part 2)

Thursday, February 04, 2021		
8:30AM - 9:30AM	Daniel Tataru	An introduction to water waves (Part 3)
9:30AM - 10:00AM		Tea Break Using Virtual Platform
10:00AM - 11:00AM	Thomas Hou	Potential Singularity Formation of the 3D Euler Equations and Related Models

Friday, February 05, 2021		
8:30AM - 9:30AM	David Lannes	Wave-Structure interactions
9:30AM - 10:00AM		Tea Break Using Virtual Platform
10:00AM - 11:00AM	Katharina Schratz	Introduction to numerics for nonlinear Schrödinger

Identifiable Participants		
First Name	**Last Name**	**Institution**
Terrence	Adams	TimeTested, LLC
Siddhant	Agrawal	University of Massachusetts Amherst
Albert	Ai	University of Wisconsin-Madison
Thomas	Alazard	Ecole Normale Supérieure Paris-Saclay
Maurice	Alexander	San Jose State University
Diego	Alonso-Oran	University of Bonn
Ovidiu-Neculai	Avadanei	University of California, Berkeley
Hajer	Bahouri	Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)
Valeria	Banica	Sorbonne University, Laboratoire Jacques-Louis Lions
J. Thomas	Beale	Duke University
Jacob	Bedrossian	University of Maryland
Abdelmajid	Ben Hadj Salem	ST2I, Tunisia
Roberta	Bianchini	Consiglio Nazionale delle Ricerche (CNR)
Edoardo	Bocchi	University of Sevilla
Vitor	Borges	Institute of Mathematics and Statistics (IME)
Didier	Bresch	Université de Savoie (Chambéry)
Maila	Brucal-Hallare	Norfolk State University
Thomas	Brunner	University of Oregon
Nicolas	Burq	Université de Paris XI
Adriana Valentina	Busuioc	Université Jean Monnet
Suncica	Canic	University of California, Berkeley
Eonho	Chang	University of Arizona
Jean-Yves	Chemin	Sorbonne Université
Anthony	Chen	University of California, Berkeley
Gong	Chen	Fields Institute for Research in Mathematical Sciences
Jingchun	Chen	University of Toledo
Kyle	Chickering	University of California, Davis
Didier	Clamond	Universite de Nice Sophia Antipolis
Charles	Collot	Centre National de la Recherche Scientifique (CNRS)
Dragoianu	Constantina-Cristina	Universitatea din Craiova
Joaquim	Correia	University of Évora
Jackson	Criswell	Central Michigan University
Anne-Laure	Dalibard	Université de Paris VI (Pierre et Marie Curie)
Raphaël	Danchin	Université Paris-Est Créteil Val-de-Marne
Camillo	De Lellis	Institute for Advanced Study
Thibault	de Poyferré de Cère	MSRI - Mathematical Sciences Research Institute
Luigi	De Rosa	École Polytechnique Fédérale de Lausanne (EPFL)
Latifa	Debbi	Universite M'hammed Bouguerra de Boumerdes (UMBB)
Jean Marc	Delort	Université de Paris XIII (Paris-Nord)
Marcelo	Disconzi	Vanderbilt University
Martin	Donati	Institut Camille Jordan
Hongjie	Dong	Brown University
Hengrong	Du	Purdue University
Tarek	Elgindi	Duke University
Daniel	Erickson	Oregon State University
Wen	Feng	Niagara University
Susan	Friedlander	University of Southern California
Thierry	Gallay	Université Grenoble Alpes (Université de Grenoble I - Joseph Fourier)

Identifiable Participants		
First Name	**Last Name**	**Institution**
Claudia	Garcia	University of Granada
Eduardo	Garcia-Juarez	Universitat de Barcelona
Dan	Geba	University of Rochester
Yeva	Gevorgyan	Institute of Mathematics and Statistics (IME)
Tom	Gilat	Bar-Ilan University
Elena	Giorgi	Princeton University
Javier	Gomez-Serrano	Brown University
Mark	Groves	Universitàt des Saarlandes
Andre	Guerra	University of Oxford
Colette	Guillopé	Université Paris-Est Créteil Val-de-Marne
Srujan	Gupta	none
Mason	Haberle	University of California, Berkeley
Cong	He	University of Wisconsin-Milwaukee
Jiao	He	MSRI - Mathematical Sciences Research Institute
Siming	He	Duke University
Gerardo	Hernandez-Duenas	UNAM - Universidad Nacional Autonoma de Mexico
Thomas	Hou	California Institute of Technology
Haroune	Houamed	NYUAD
Ting-Yang	Hsiao	University of Illinois at Urbana-Champaign
Weiwei	Hu	University of Georgia
Xiaoyu	Huang	University of California, Berkeley
John	Hunter	University of California, Davis
Vera Mikyoung	Hur	University of Illinois at Urbana-Champaign
Mario	Hurtado Herrera	Universite du Quebec
Farzana	Hussain	Huston-Tillotson College
Manh Khang	Huynh	University of California, Los Angeles
Hussain	Ibdah	Texas A & M University
Slim	Ibrahim	University of Victoria
Mihaela	Ifrim	University of Wisconsin-Madison
Dragos	Iftimie	Université Claude-Bernard (Lyon I)
Michael	Iyoko	Federal University of Agriculture Abeokuta
Juhi	Jang	University of Southern California
Gray	Jennings	American Mathematical Society
Min Jun	Jo	University of British Columbia
Adilbek	Kairzhan	University of Toronto
Tulin	Kaman	University of Arkansas
Muhammad	Kamran	COMSATS University Islamabad, Wah Campus
Tanay	Karmakar	Indian Institute of Technology
Ori	Katz	Weizmann Institute of Science
Matthew	Kehoe	University of Illinois at Chicago
Jim	Kelliher	University of California, Riverside
Boris	Khesin	University of Toronto
Friedrich	Klaus	Karlsruhe Institute of Technology
Herbert	Koch	Rheinische Friedrich-Wilhelms-Universitàt Bonn
Collin	Kofroth	University of North Carolina
Jeffrey	Kuan	University of California, Berkeley
Jeffrey	Kuan	University of California, Berkeley
Igor	Kukavica	University of Southern California
Anuj	Kumar	University of California, Santa Cruz
Hyunju	Kwon	Institute for Advanced Study
David	Lannes	Institut de Mathématiques de Bordeaux

Identifiable Participants		
First Name	**Last Name**	**Institution**
Irena	Lasiecka	University of Memphis
Fizay-Noah	Lee	Princeton University
James	Leng	University of California, Los Angeles
Trevor	Leslie	University of Southern California
Linfeng	Li	University of Southern California
En-Bing	Lin	Central Michigan University
Quyuan	Lin	Texas A & M University
Jiaqi	Liu	University of Southern California
Shizhe	Liu	University of California, Berkeley
Xiao	Liu	Georgia Institute of Technology
Catharine	Lo	University of Lisbon
Maria Carmela	Lombardo	Università di Palermo
Wenjie	Lu	University of Minnesota, Twin Cities
Michelle	Luckas	Gesamthochschule (GHS) Kassel
Debayan	Maity	Tata Institute of Fundamental Research
Yuchen	Mao	University of California, Berkeley
Jeffrey	Marino	Johns Hopkins University
Michael	Maroun	Independent Researcher
Vincent	Martinez	Hunter College, CUNY
Jeremy	Marzuola	University of North Carolina
Hussein	Mastaneh	Iran Meteorology Organization
Anna	Mazzucato	Pennsylvania State University
John	McCleary	Vassar College
Halima	Meddour	University Batna 2
Chebbab	Mesbah	University of Science and Technology Houari Boumedienne (USTHB)
Evan	Miller	McMaster University
Sylvie	Monniaux	Aix-Marseille Université
Ryan Chris	Moreno-Vasquez	University of California, Davis
Boris	Muha	Faculty of Science, University of Zagreb
Wordsobe Byeong-Ju	Mun	University of Alberta
Camil	Muscalu	Cornell University
savitha	muthanna	University of Washington
Fagueye	Ndiaye	FASTEF
Quoc-Hung	Nguyen	Institute of Mathematical Sciences
Matthew	Novack	New York University, Courant Institute
Helena	Nussenzveig Lopes	Federal University of Rio de Janeiro
Sung-Jin	Oh	University of California, Berkeley
Anupam	Pandey	Indian Institute Of Technology (BHU) Varanasi
Jaemin	Park	Georgia Institute of Technology
Federico	Pasqualotto	University of California, Berkeley
Clara	Patriarca	Politecnico di Milano
Galina	Perelman	University Paris Est Creteil
Charlotte	Perrin	Centre National de la Recherche Scientifique (CNRS)
Tuan	Pham	Brigham Young University
Patrick	Phelps	University of Arkansas
Ben	Pineau	University of California, Berkeley
Pooja	Rao	State University of New York, Stony Brook
Calum	Rickard	University of Southern California
Ayman	Rimah Said	École Normale Supérieure de Cachan

Identifiable Participants		
First Name	**Last Name**	**Institution**
Emmanuel	Roque	Centro de Investigacion y de Estudios Avanzados del IPN
Cesar Alberto	Rosales-Alcantar	Universidad Nacional Autónoma de México (UNAM)
James	Rowan	University of California, Berkeley
Antonio	Sa Barreto	Purdue University
Afshan	Sadiq	Government College
Marco	Sammartino	Università di Palermo
Riuji	Sato	Worcester Polytechnic Institute
Katharina	Schratz	Sorbonne University
Chengyang	Shao	Massachusetts Institute of Technology
Bhupesh	Sharma	VIT-AP University
Jingyang	Shu	Temple University
Hira	Siddiqui	University of Hai'l
Mike	Singer	Stenomics, LLC
Vikendra	Singh	SAU
Bhavesh	Sirvi	Modern College of Arts , Science and Commerce
Max	Souza	Universidade Federal Fluminense
Annalaura	Stingo	University of California, Davis
Robert	Strain	University of Pennsylvania
Pei	Su	Institut de Mathématiques de Bordeaux
Qingtang	Su	University of Southern California
Vladimir	Sverak	University of Minnesota Twin Cities
Chakir	TAJANI	University of Tétouan (Abdelmalek Essaadi)
Andrei	Tarfulea	Louisiana State University
Daniel	Tataru	University of California, Berkeley
Krutika	Tawri	Indiana University
Mitchell	Taylor	University of California, Berkeley
Jingzhi	Tie	University of Georgia
Roberto	Triggiani	University of Memphis
Duoc	Trinh	University of Science, Vietnam National University, Hanoi
Tien	Truong	Lund University
Amjad	Tuffaha	American University of Sharjah
Jack	Urombo	Harare institute of Technonology
Jeroen	van der Meer	University of Copenhagen
Rosa	Vargas	University of Edinburgh
Joonas	Vättö	ETH Zurich
Luis	Vega	Universidad del Paà-s Vasco/Euskal Herriko Unibertsitatea
Gaston	Vergara-Hermosilla	Institut de Mathématiques de Bordeaux
Vlad	Vicol	New York University, Courant Institute
Collin	Victor	University of Nebraska
Dan-Virgil	Voiculescu	University of California, Berkeley
Lizhe	Wan	University of Wisconsin-Madison
Weinan	Wang	University of Arizona
Yuxin	Wang	University of Michigan
Jörg	Weber	Lund University
Jon	Wilkening	University of California, Berkeley
Bobby	Wilson	University of Washington
Sijue	Wu	University of Michigan
Xuming	Xie	Morgan State University

Identifiable Participants		
First Name	**Last Name**	**Institution**
Fanhui	Xu	Carnegie Mellon University
Liaosha	Xu	University of Virginia
Xiang	Xu	Old Dominion University
Xiangjin	Xu	Binghamton University (SUNY)
Cheng	Yang	University of Toronto
Jiaqi	Yang	Georgia Institute of Technology
Ruoxuan	Yang	Massachusetts Institute of Technology
Gael	Yomgne	Rheinische Friedrich-Wilhelms-Universitàt Bonn
Dongxiao	Yu	University of California, Berkeley
Lei	Yu	Tongji University
Xu	Yuan	Centre de Mathématiques Laurent Schwartz, École Polytechnique
Jhih-Jyun	Zeng	Oregon State University
Mohamed	Zerguine	Batna 2 University
Qingtian	Zhang	West Virginia University
Yabin	Zhang	University of Michigan
Zirui	Zhou	University of California, Berkeley
Hui	Zhu	University of Michigan
Christian	Zillinger	Karlsruhe Institute of Technology

Identifiable Participants Information

Identifiable Participants		214

Gender		214
Male	70.56%	151
Female	26.64%	57
Other	0.47%	1
Declined to state	2.34%	5

Ethnicity*		218
White	42.66%	93
Asian	38.99%	85
Hispanic	5.50%	12
Pacific Islander	0.92%	2
Black	2.29%	5
Native American	0.92%	2
Declined to state	8.72%	19

* ethnicity specifications are not exclusive

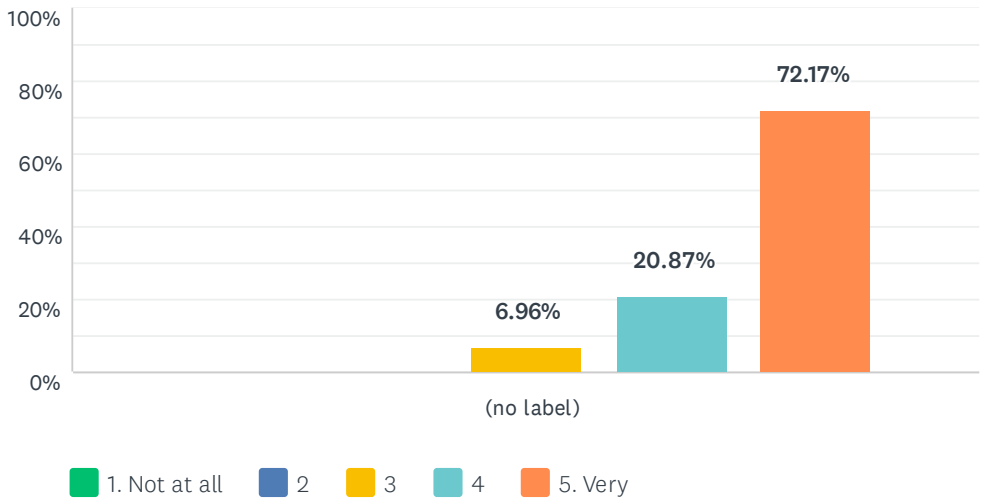
There were 23 additional virtual participants who were not identifiable

945 Introductory Workshop: Mathematical problems in fluid dynamics: Participant Survey

115 responses out of 214 participants = 54% response rate

Q1 The workshop was intellectually stimulating

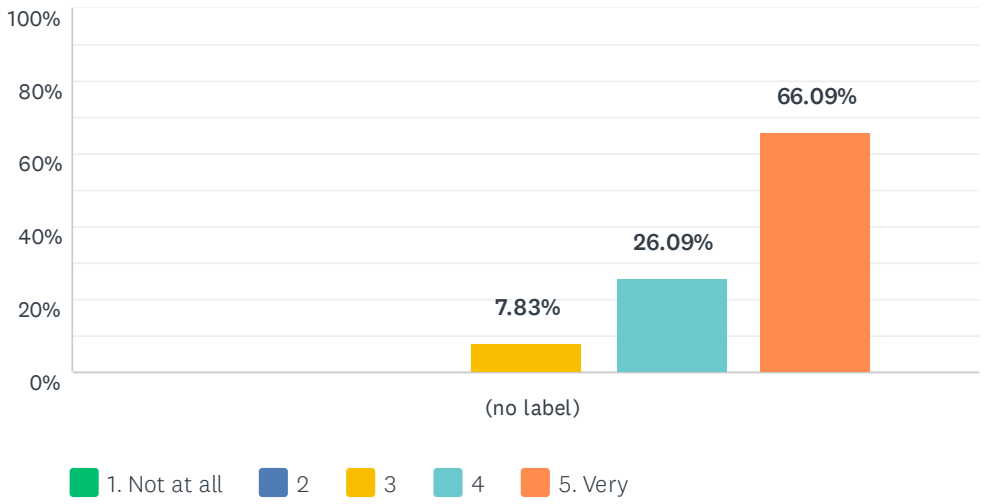
Answered: 115 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	6.96% 8	20.87% 24	72.17% 83	115	4.65

Q2 The overall experience of the workshop was worthwhile

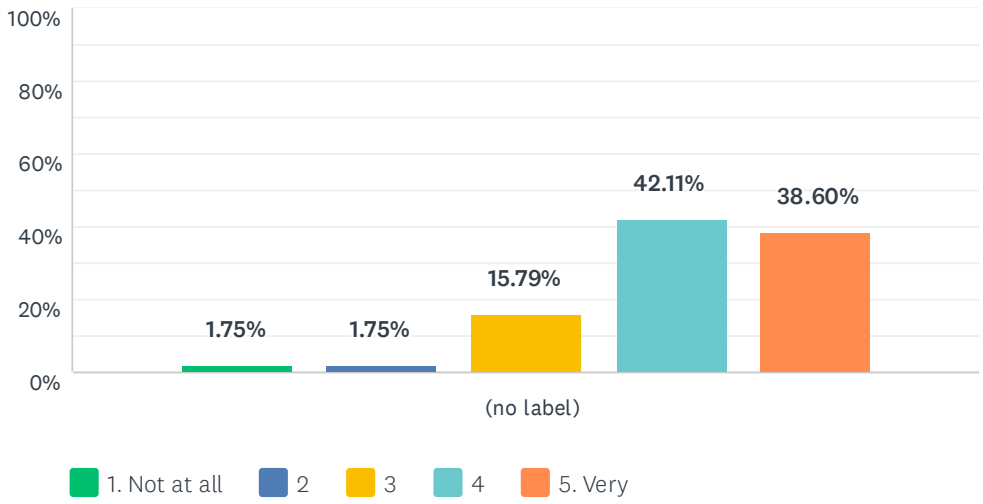
Answered: 115 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	7.83% 9	26.09% 30	66.09% 76	115	4.58

Q3 I was well prepared to benefit from the lectures

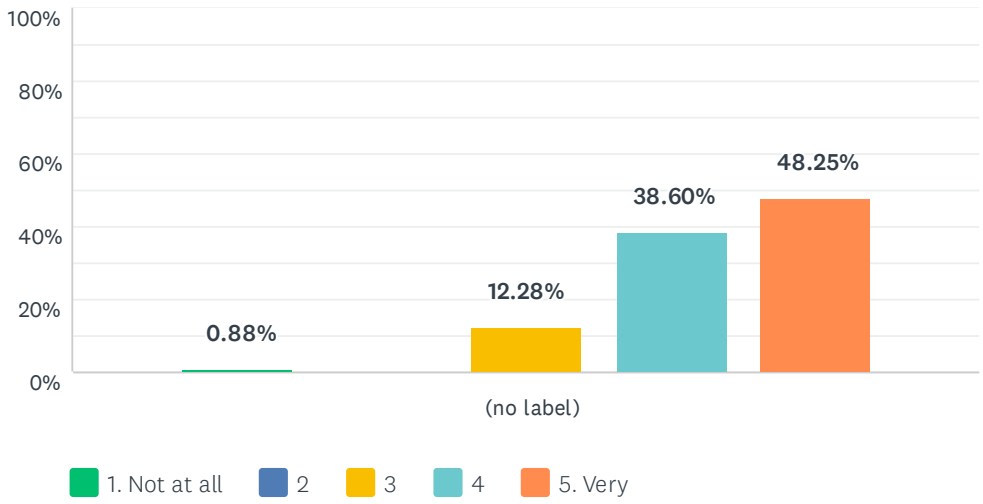
Answered: 114 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	1.75% 2	1.75% 2	15.79% 18	42.11% 48	38.60% 44	114	4.14

Q4 My interest in the subject matter was increased by the workshop

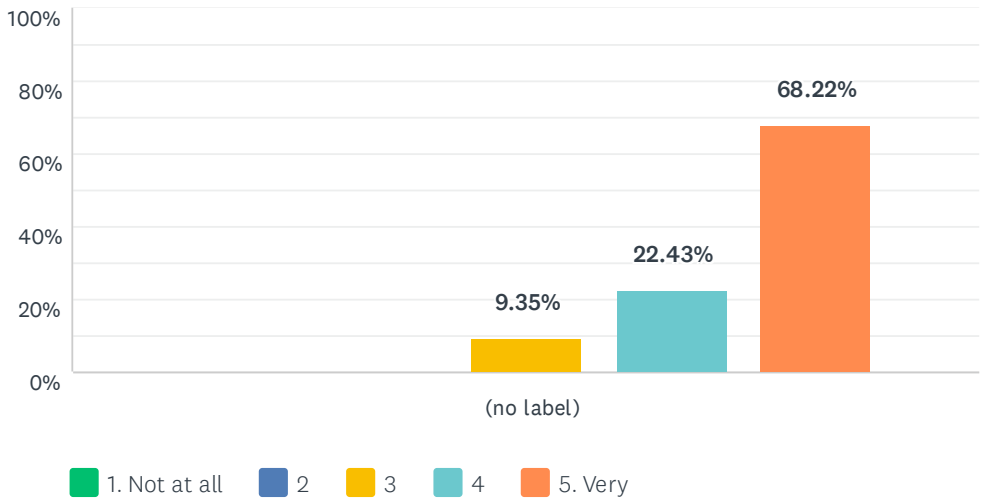
Answered: 114 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.88% 1	0.00% 0	12.28% 14	38.60% 44	48.25% 55	114	4.33

Q5 I found the MSRI staff helpful

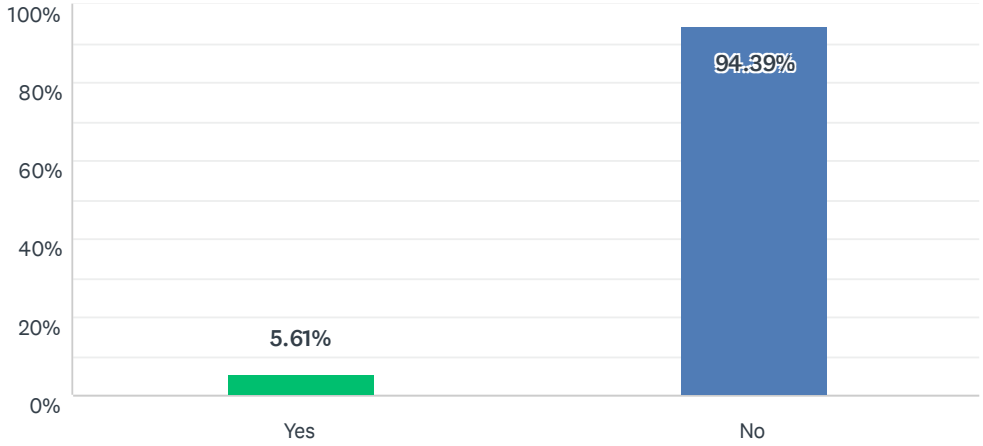
Answered: 107 Skipped: 8



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	9.35% 10	22.43% 24	68.22% 73	107	4.59

Q6 Did you experience any technical difficulties accessing the online workshop?

Answered: 107 Skipped: 8



ANSWER CHOICES	RESPONSES	
Yes	5.61%	6
No	94.39%	101
TOTAL		107

#	IF YES, PLEASE EXPLAIN	DATE
1	Small problems of connection	2/23/2021 1:14 PM
2	Accessing video recordings of presentations	2/15/2021 3:41 AM
3	My webcam and microphone did not work during tea times.	2/7/2021 3:55 AM
4	yes i have some difficulties to access site	2/7/2021 12:52 AM
5	Bad network	2/6/2021 12:00 AM
6	I wasnt able to hear and see in gathertown during tea break	2/5/2021 3:21 PM

Q7 How did having the workshop held online impact your participation?

Answered: 107 Skipped: 8

#	RESPONSES	DATE
1	It did not have a negative impact on my participation.	2/27/2021 10:06 PM
2	It was very fruitful for me as a researcher from developing country.	2/23/2021 1:14 PM
3	Having the workshop held online impacted me in a much prompter way. Since, the time-zones didn't quite match between the ist and est, I ha difficulty attending all the lectures and discussions. Besides, I think that having things online impacts the stretch of collaborations as well. It's okay till the discussions sessions go on but it's very difficult to collaborate online with the other fellow graduate students and professors because being a graduate student myself, I can say that collaborating on internet is far difficult, while on-site collaborations can give you the pleasure in doing blackboard interactions and more spontaneous discussions that might seed a collaboration, which is very difficult to pursue while during online sessions. So, I think this should be definitely be looked at so as to bring students from different backgrounds and helping them to collaborate on-site which also gives much more pleasure and fosters good collaborations I believe.	2/20/2021 6:29 AM
4	of course online is much better, especially now	2/20/2021 2:50 AM
5	I differ in time zone	2/19/2021 9:54 PM
6	I watched only the recorded talks.	2/19/2021 8:26 PM
7	It was easy and useful to listen talks from my work place.	2/19/2021 7:18 PM
8	Less interaction	2/19/2021 4:10 PM
9	I could participate the workshop anywhere	2/19/2021 4:09 PM
10	Wouldn't have been possible otherwise	2/19/2021 12:27 PM
11	It was a nice experience for me to meet the researchers in the msri workshops during this period	2/19/2021 11:58 AM
12	Because there was no travels and accommodation expenses.	2/19/2021 11:54 AM
13	It has less interaction with presenters.	2/19/2021 11:45 AM
14	Good	2/19/2021 10:38 AM
15	I think I was still able to effectively participate.	2/19/2021 10:26 AM
16	This aspect didn't impact my participation in any way.	2/19/2021 9:59 AM
17	Allowed increased participation	2/19/2021 9:58 AM
18	more concentrate on speakers since I did not need to take notes	2/19/2021 9:45 AM
19	The one hour talks seem to be a bit long for an online setting.	2/19/2021 9:44 AM
20	It made it easy to watch the lectures.	2/19/2021 9:39 AM
21	Very much	2/19/2021 9:30 AM
22	.	2/19/2021 9:29 AM
23	An online workshop is not the same as an in-person workshop	2/19/2021 9:28 AM
24	It did not.	2/19/2021 9:24 AM
25	It could be Better in person,but it was fine	2/19/2021 9:17 AM
26	Not much of an impact	2/19/2021 9:17 AM
27	I was less engaged than I would have been otherwise.	2/19/2021 9:17 AM
28	increased my will of participation	2/18/2021 8:18 PM
29	Not at all	2/18/2021 9:09 AM
30	Not at all	2/15/2021 3:41 AM
31	It was a good experience.	2/14/2021 8:52 PM

32	For me, it is more convenient.	2/14/2021 7:20 PM
33	It was difficult to follow all the lectures	2/14/2021 5:29 AM
34	i am able to focus better in person	2/13/2021 9:25 AM
35	Being online it actually helped me a bit.	2/12/2021 5:50 PM
36	It is harder to motivate oneself	2/12/2021 3:51 AM
37	It was ok	2/12/2021 12:41 AM
38	The talks were all excellent and mostly as easy to follow as in person, but there was very little opportunity for the kind of extended discussions between sessions that are often the most valuable part of conferences in terms of further collaboration. The Gather Town coffee breaks were nice, but participation fell off fairly sharply after the first few days.	2/11/2021 11:31 PM
39	It actually was easier since I could attend from home and I didn't have to move. Although of course workshop in situ would have been more stimulating and allow for better interactions between participants	2/11/2021 10:34 PM
40	It was very good	2/11/2021 8:10 PM
41	it helps me to attend the workshop. I can not attend the workshop in person.	2/11/2021 6:30 PM
42	It certainly helped me attend it. Otherwise, I couldn't have visited the campus to participate. Making workshops virtual helps people like me who can't attend them in-person.	2/11/2021 6:29 PM
43	talks were accessible easily while focusing on each topic was not easy (because I was home with kids)	2/11/2021 5:45 PM
44	NA	2/11/2021 5:42 PM
45	.....	2/9/2021 6:31 PM
46	Maybe less attention when lost in explanations...	2/9/2021 12:03 PM
47	I was hoping that an online workshop would enable me to attend. However it coincided with the start of the semester which was too busy. The presented lectures didn't match the schedule that I thought I enrolled in.	2/9/2021 9:01 AM
48	It is good	2/9/2021 6:24 AM
49	I could not attend some of the lectures because I have a heavy teaching load (will I get in trouble if I say I usually have 14 to 18 units per semester)?	2/9/2021 2:44 AM
50	The time difference was quite demanding (I live in Europe). I found it impossible to attend on a regular basis the last lectures of each day. It would have been better to make a break between the Connections workshop and the Introductory workshop. Attending lectures almost every evening three weeks in a row was a bit too much, and had a negative impact on my family life.	2/9/2021 1:07 AM
51	It made it feasible, otherwise I would not have been able to attend.	2/8/2021 2:56 PM
52	No impact	2/8/2021 12:58 PM
53	Made it possible, travelling to the location feels very inaccessible, especially to people like me.	2/8/2021 8:08 AM
54	It is my first to participate in the workshop online and it is a good experience for me.	2/8/2021 3:00 AM
55	It was much easier to participate.	2/7/2021 11:22 PM
56	I skipped most lectures and watched the recorded videos instead due to the time zone difference	2/7/2021 10:31 PM
57	I'd have attended in-person as well so no impact. I think having it online probably a little easier to attend but either way would be fine.	2/7/2021 10:22 PM
58	It made a one-week workshop into a two-weeks workshop. It was hard to attend all the lectures with so many other commitments.	2/7/2021 1:07 PM
59	Not at all	2/7/2021 11:11 AM

60	I could not join if it was not online.	2/7/2021 3:55 AM
61	very important	2/7/2021 12:52 AM
62	It is accessible from home to participate in this workshop but still I always prefer physical interaction sessions.	2/6/2021 9:00 PM
63	It enhanced my understanding of subject.	2/6/2021 5:16 PM
64	Not possible otherwise.	2/6/2021 9:47 AM
65	Human interation is important but online workshop is useful if no displacement is possible.	2/6/2021 8:30 AM
66	make me easy to attend the workshop	2/6/2021 7:19 AM
67	I found it is perfect	2/6/2021 6:33 AM
68	The organization and the technical support were simply perfect, so it did not impact my participation at all!	2/6/2021 2:45 AM
69	It was a lot easier for me	2/6/2021 1:21 AM
70	I was able to attend more lectures.	2/6/2021 1:04 AM
71	no comment	2/6/2021 12:41 AM
72	It made it possible for me to attend as I am from Nigeria	2/6/2021 12:00 AM
73	Being stuck in Europe, it would have been impossible to participate if the workshop would not have been held on-line	2/5/2021 11:03 PM
74	The organization of the workshop over two weeks made participation easier, including for people overseas.	2/5/2021 10:55 PM
75	Not at all	2/5/2021 10:19 PM
76	it was nice, saving time and money by avoiding the travel. but if it was in normal mode, I could get some more contacts frequently.	2/5/2021 9:53 PM
77	Sometimes, it was hard	2/5/2021 9:50 PM
78	One benefit was that most lectures were recorded so could be viewed later on. One major disadvantage was that it was difficult to interact with other members.	2/5/2021 9:10 PM
79	It was nice	2/5/2021 8:33 PM
80	I almost attended all the sessions. It was really a rewarding time investment. I learned a lot from the speakers. I really hope to see more webinars in the future. Because moving to MSRI for a workshop or a conference etc. is not very easy especially in terms of financial impact incurred. People from low-income countries really can get benefit from this type of webinars.	2/5/2021 8:09 PM
81	Good	2/5/2021 8:04 PM
82	Wonderful & New Experience... Enhanced knowledge through Online Lectures of International Speakers	2/5/2021 7:55 PM
83	It was pretty cool to interact with the people via online also having a great posture of lectures delivered by the prof.	2/5/2021 6:36 PM
84	Very good	2/5/2021 5:21 PM
85	I had to miss a few talks in order to teach, but I was able to watch the recorded videos afterwards. I did of course miss the social aspects of an in person workshop, especially chatting over coffee between talks	2/5/2021 4:37 PM
86	none	2/5/2021 4:22 PM
87	Not at all	2/5/2021 4:12 PM
88	It made it easier	2/5/2021 4:04 PM
89	It helped me enormously to attend it from home	2/5/2021 3:21 PM
90	can watch the videos later	2/5/2021 3:17 PM

91	It was better for me because I am currently outside of the USA. If it was not online I would be able to participate.	2/5/2021 3:06 PM
92	Well	2/5/2021 3:04 PM
93	I was able to attend remotely at no cost. It did not interfere with my concurrent teaching and research duties.	2/5/2021 3:00 PM
94	Overall, I think that having the workshop online allowed me to participate. I am not certain that I would have been able to assist if it had been held in person. However, it would have been nice to have a chance to interact more face to face with other participants, which is part of the most valuable experiences when assisting to a congress/workshop.	2/5/2021 2:55 PM
95	I couldn't have attended otherwise	2/5/2021 2:36 PM
96	The earlier talks were simply too early. I would have benefited tremendously from having all talks at normal hours California time.	2/5/2021 2:31 PM
97	I was able to watch the lectures live, which otherwise I wouldn't have been able to do so.	2/5/2021 2:23 PM
98	It avoided the needed for travel to the workshop but an in person workshop is preferable to participate in.	2/5/2021 2:23 PM
99	It made it a lot easier to attend.	2/5/2021 2:21 PM
100	no material effect - offline programs are likely to be the way of the future	2/5/2021 2:21 PM
101	-	2/5/2021 2:21 PM
102	It makes the participation more flexible.	2/5/2021 2:20 PM
103	I could attend easily the workshop	2/5/2021 2:18 PM
104	It worked perfectly.	2/5/2021 2:17 PM
105	The online workshop made it possible to participate, given that I am in New Jersey.	2/5/2021 2:17 PM
106	More able to attend	2/5/2021 2:16 PM
107	None.	2/5/2021 2:16 PM

Q8 One important aspect that may have been missing due to the online format was interaction between participants. If you have any suggestions on how this can be improved in the future, please explain.

Answered: 31 Skipped: 84

#	RESPONSES	DATE
1	Having the workshop held online impacted me in a much prompter way. Since, the time-zones didn't quite match between the ist and est, I ha difficulty attending all the lectures and discussions. Besides, I think that having things online impacts the stretch of collaborations as well. It's okay till the discussions sessions go on but it's very difficult to collaborate online with the other fellow graduate students and professors because being a graduate student myself, I can say that collaborating on internet is far difficult, while on-site collaborations can give you the pleasure in doing blackboard interactions and more spontaneous discussions that might seed a collaboration, which is very difficult to pursue while during online sessions. So, I think this should be definitely be looked at so as to bring students from different backgrounds and helping them to collaborate on-site which also gives much more pleasure and fosters good collaborations I believe. One of my suggestions would be that, during this prevailing covid-19 pandemic, MSRI should look forward to organizing programs for longer periods and in a hybrid mode, so that, those who are able to join in-person should be provided the opportunity to foster their collaborations on-site which I think provides a much easier route to the graduate students to foster their collaborations and putting one's thoughts on blackboard and scribbling things spontaneously is I think the best way to collaborate in mathematics which would also fetch long-term results. Now, having said that, I would say that MSRI should definitely look forward to providing equal opportunities to those who are attending on-line and not have been able to present in on-site mode.	2/20/2021 6:29 AM
2	depending on the number of participants, maybe discussion sessions	2/20/2021 2:50 AM
3	It would be better if the presenter write or explain more instead of showing the context slide by slide.	2/19/2021 11:45 AM
4	Extend the discussion period and create collaborations between researchers	2/19/2021 10:38 AM
5	Breakout sessions or virtual happy hour	2/19/2021 9:58 AM
6	For me, that is good. Since i am a beginner, i don't really have so many questions.	2/19/2021 9:45 AM
7	No	2/19/2021 9:30 AM
8	It would be better if the slides or lecture notes shared at least on day before the workshop.	2/14/2021 8:52 PM
9	None to be honest. The gather town software is making a huge difference in the overall scheme of things.	2/12/2021 5:50 PM
10	The US government should request aid and assistance from Vietnam, Cuba, Laos, New Zealand, and/or the People's Republic of China in implementing a pandemic strategy based around eliminating, and not merely containing the virus, so that life can return to normal.	2/11/2021 11:31 PM
11	it was well organized.	2/11/2021 8:10 PM
12	Pick a group of 4 people randomly and schedule lunches.	2/11/2021 5:42 PM
13	???	2/9/2021 12:03 PM
14	IPAM uses a feature called "break out" rooms on Zoom and the break out rooms I find to be far superior than GatherTown. I have never gotten GatherTown to work correctly. The Zoom break out rooms are really neat and can be assigned by hosts or left to be chosen by participants.	2/8/2021 2:56 PM
15	No comments.	2/8/2021 3:00 AM
16	i suggest to share more informations about this area	2/7/2021 12:52 AM
17	Physical interaction with the experts	2/6/2021 9:00 PM
18	n/a	2/6/2021 7:19 AM
19	This is a very complicated problem indeed. As I am a senior researcher, I already know many colleagues and it was therefore easy for me to discuss with them (using the messaging options offered by zoom or soccoco). However, this could help to force senior researchers to interact with junior researchers. That said, I have no idea how to implement this solution without creating embarrassing situations for junior colleagues. In the same direction, I thingk that the mentoring program is a very nice idea. May be you could extend it to the rest of the junior colleagues. It does not necessarily have to be a weekly meeting, but it could include	2/6/2021 2:45 AM

	group discussions about career advice and friendly conversations between a senior colleague and some group of junior colleagues.	
20	Areas of specialization should be included by each participant so that those in the same areas can connect.	2/6/2021 12:00 AM
21	Due to time difference, it is complicated anyway. I cannot start a second (virtual) working day when I have just finished my first one !	2/5/2021 11:03 PM
22	if possible seperate arrangements for participant intraction.	2/5/2021 9:53 PM
23	No idea.	2/5/2021 9:10 PM
24	Ok	2/5/2021 8:04 PM
25	I think when the pandemic will normal then only the interaction takes place otherwise we can only interact via online mode and this is not the problem as we all do know the present scenarios.	2/5/2021 6:36 PM
26	Any better app	2/5/2021 5:21 PM
27	The gather room was a nice idea, but not many people showed up most of the time. I think it's harder for people to fully get away from their normal responsibilities like teaching or family commitments when a workshop is on-line.	2/5/2021 4:37 PM
28	I'm not sure if this has been considered before, but a Discord server perhaps?	2/5/2021 4:04 PM
29	You could have a follow-up reunion workshop when it is safe to do in person maybe.	2/5/2021 3:00 PM
30	I do not have any suggestions right now. Because of my schedule, I listened to the talks, but sadly, I didn't participate in the Tearoom in gather.town.	2/5/2021 2:55 PM
31	pass out contact information of the participants so that they can talk afterward	2/5/2021 2:21 PM

Q9 We welcome any additional comments or suggestions you may have to improve the overall online experience for future participants.

Answered: 22 Skipped: 93

#	RESPONSES	DATE
1	thank you for the organization	2/20/2021 2:50 AM
2	Thanks again for your efforts to make the online workshops in this excellent form.	2/19/2021 11:58 AM
3	It is generally very good	2/19/2021 11:54 AM
4	It would be better if the presenter write or explain more instead of showing the context slide by slide.	2/19/2021 11:45 AM
5	I think that the process is good	2/19/2021 10:38 AM
6	No thanks	2/19/2021 9:30 AM
7	Thank you for accepting my participation.	2/14/2021 8:52 PM
8	I really wish to be a part of future coming workshops	2/11/2021 8:10 PM
9	???	2/9/2021 12:03 PM
10	It would be helpful to have some pre-reading materials. *Thank you for making the presentations virtual - doing so allowed me to learn a little bit from the lectures. However, I couldn't maximize the learning experience because I was just too spread out... with my heavy teaching load and my family duties at home. Thank you.	2/9/2021 2:44 AM
11	This was such a great experience, thank you so much for giving me the opportunity to actually attend some really interesting lectures! Since I am not a grad student, and had to go into the workforce to support myself, it's very hard to get back into the groove for Mathematics. A part of me hopes there will be more online workshops, or at least an online series that shows offline workshops, online but of course, I understand that that may be too much to ask. Thanks anyway!	2/8/2021 8:08 AM
12	I suggest obtaining after the workshop the list of the participants with their address email.	2/8/2021 3:00 AM
13	MRI should organized the workshop in both online and offline mode so that more participant can take benefit of the workshop.	2/6/2021 5:16 PM
14	My answer to question 4 ("Not at all") means that I was (I am) quite interested in the subject: in such a measure that it is hard to increase my interest in.	2/6/2021 9:47 AM
15	n/a	2/6/2021 7:19 AM
16	Thank you for all your efforts to maintain a scientific life in these difficult times! I think this is really essential for young colleagues. Indeed, in my mind, science is attracted by a certain flow generated by the cumulative efforts of researchers. It is always essential to keep in touch with this flow (indeed, very few people can do research in a remote place for years). These online activities can help in a crucial way many PhD students and many post-docs to keep in touch with this flow at a critical moment in their carreers.	2/6/2021 2:45 AM
17	You and your team in particular did a tremendous job by successfully arranging this webinar when there was a frightening atmosphere everywhere due to COVID. I really appreciate the efforts of MSRI in general.	2/5/2021 8:09 PM
18	Ok	2/5/2021 8:04 PM
19	The most problematic things were time management because in India we had to wait till midnight so you can just improve only these areas.	2/5/2021 6:36 PM
20	Good conversation	2/5/2021 5:21 PM
21	Overall it was nicely organized and executed! Thanks!	2/5/2021 4:37 PM
22	Thank you for the wonderful conference! I look forward to attending many more talks at MSRI.	2/5/2021 3:00 PM

Recent Developments in Fluid Dynamics

April 12, 2021 – April 30, 2021

Virtual Workshop

Organizers:

Thomas Alazard (Ecole Normale Supérieure Paris-Saclay; Centre National de la Recherche Scientifique (CNRS))

Hajer Bahouri (Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS))

Mihaela Ifrim (University of Wisconsin-Madison)

Igor Kukavica (University of Southern California)

David Lannes (Institut de Mathématiques de Bordeaux; Centre National de la Recherche Scientifique (CNRS))

Daniel Tataru (University of California, Berkeley)

REPORT ON THE MAIN MSRI WORKSHOP: "Recent Developments in Fluid Dynamics (Virtual Workshop)" April 12–April 30, 2021

Organizers:

- Thomas Alazard (Ecole Normale Supérieure Paris-Saclay; CNRS)
- Hajer Bahouri (Laboratoire Jacques-Louis Lions; CNRS)
- Mihaela Ifrim (University of Wisconsin-Madison)
- Igor Kukavica (University of Southern California)
- David Lannes (Institut de Mathématiques de Bordeaux; CNRS)
- Daniel Tataru (University of California, Berkeley)

Scientific Description

Fluid dynamics is one of the classical areas of partial differential equations and has been the subject of extensive research over hundreds of years. It is indeed one of the most difficult and exciting fields of scientific pursuit, both because of the complexity of the subject and because of the endless breadth of applications. The MSRI program "Mathematical problems in fluid dynamics" has chosen the core part of fluid dynamics, namely the study of incompressible fluids, as its main concentration area. This is still a very broad field, encompassing not only the study of the incompressible Euler and Navier-Stokes equations, but also the study of interface, free boundary problems (water waves), as well as a large array of associated

applied topics. One key objective of the program was to bring together a strong group of experts in each of these areas, and to help foster interactions and exchange of ideas.

The aim of the main workshop associated to the MSRI program was to showcase the current developments and hot topics in incompressible fluid dynamics (the Euler equations for inviscid flows and the Navier Stokes equations for viscous flows), interface problems (water waves), and other related equations. Connections to related areas of mathematics were also discussed, including the phenomena of turbulence and the zero viscosity limit, the incompressible limit, model problems for water waves and connections to complete integrability, to mention a few. Both theoretical and numerical aspects of these topics were considered.

Due to the pandemic-related constraints, the workshop was held in a virtual format. While this imposed some limitations, it also created an opportunity for many to attend across the globe; the workshop was fully open to all interested researchers, and not just to MSRI program participants. With participants and speakers attending from many time zones, we have chosen to schedule all the workshop activities in the morning, 8am–12pm, with a total of 34 talks spread over three weeks. All talks were followed by an open discussion and a question period. In addition, for one hour every day, the participants were invited to gathertown, a forum for open discussion, which emulated the traditional coffee breaks.

To foster interactions between different research area, we have chosen not to cluster the talks in various subfields, and instead to mix them in cohesively. The choice of the topics was also well-balanced by providing different aspects and approaches to the mathematical theory of fluid dynamics.

During the one-hour talks, the speakers reported on exciting new developments concerning the mathematical analysis of PDEs of fluid mechanics. The talks were very well attended, with the audience from five continents, topping 120 for some of the lectures. All the speakers delivered their talks clearly and efficiently. Discussions at the end of the talks were lively and sometimes quite lengthy, which we believe shows great interest in the subject! The participants were comfortable asking questions online, including the postdoctoral fellows who, throughout the workshop, connected and interacted with senior fellows. The excellent presentations and stimulating content have provided important opportunities both for the beginners wishing to enter the field as well as for the experts working actively in the area. The discussions and questions asked during the workshop provide ample evidence of a very healthy interaction between the participants.

Another very positive feature of the workshop was that most of the speakers agreed to have their lectures (videos and pdf) posted on the workshop's webpage, which all of us greatly appreciate.

Highlights of the Workshop

For us, the organizers, both the MSRI input and guidance in organizing the workshop virtually, and the experience gained with the earlier workshops were the key to a successful

outcome. Overall, we were guided by several main ideas that came together to provide a positive experience for all participants:

1. MSRI provided an array of tools, all of which have played key roles. This primarily included Zoom, Sococo, and GatherTown, which came on top of the main program page that served as the participants' entry point toward all other platforms. All participants benefited from the immersive experience that these software platforms provided. The talks and the discussions were held on Zoom. The breaks were designated as Tea Time, which aimed to emulate the traditional coffee breaks, and which were a real hit! We used Gathertown for this and even though in the beginning there was a bit of a learning curve, everybody quickly adapted. As an example, within a few days some groups were constantly meeting on Gathertown, even when Tea Time was not scheduled. This software, together with Sococo and Zoom, made the whole experience very pleasant and as close to a *face-to-face* experience as possible.

2. One measure of the success of the workshop was the positive, very pleasant atmosphere, so much so that many people used to join several minutes in advance just for the pleasure of having some informal conversations.

3. In addition to GatherTown, we have also experimented with another type of breaks, where participants on Zoom were randomly assigned into small groups in breakout rooms. This was also very successful and well attended, and repeated every week of the workshop.

4. The MSRI IT team was always available and took care of all inherent minor issues, both insofar as the talks were concerned, as well as for the Tea Times. All was done in a timely manner, and no significant delays or cancellations occurred during the workshop. On occasion, some of the participants were unable to use their cameras and microphones during the Gathertown meetings but these were also quickly solved for the most part.

5. The scientific component was also very well received by the audience. After-talk discussions were lively; in some cases, they were carried out for a longer time, including during the Tea Time meetings on GatherTown.

6. One feature of the Workshop, as far as the organization was concerned, was the idea of arranging the talks in a way that integrated the Chancellor's Professor lectures so participants had access to both. The graduate seminar was also held during the workshop, and the graduate students were very involved even in those sessions.

7. Quite a few participants, especially from developing countries, expressed their gratitude about the fact that the online conference was opened to everybody, as they would not have had, in normal times, the financial possibility to attend an onsite meeting so far away from their institutional home.

8. We believe that the workshop delivered a very positive experience for both the speakers, the organizers and the participants. This was reflected in the very nice comments some of the organizers received from the speakers and participants. The overall feeling was that the workshop was a success and a much needed experience during these unprecedented times!

Altogether, the success of this workshop was due in no small measure to the constant and diligent work and attention of the MSRI staff, and we are very grateful to them for this.

Organizers		
First Name	**Last Name**	**Institution**
Thomas	Alazard	Ecole Normale Supérieure Paris-Saclay; Centre National de la Recherche Scientifique (CNRS)
Hajer	Bahouri	Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)
Mihaela	Ifrim	University of Wisconsin-Madison
Igor	Kukavica	University of Southern California
David	Lannes	Institut de Mathématiques de Bordeaux; Centre National de la Recherche Scientifique (CNRS)
Daniel	Tataru	University of California, Berkeley
Speakers		
First Name	**Last Name**	**Institution**
Albert	Ai	University of Wisconsin-Madison
Valeria	Banica	Sorbonne University, Laboratoire Jacques-Louis Lions
Jacob	Bedrossian	University of Maryland
Didier	Bresch	Université de Savoie Chambéry; Centre National de la Recherche Scientifique (CNRS)
Tristan	Buckmaster	Princeton University
Nicolas	Burq	Université de Paris XI
Roberto	Camassa	University of North Carolina
Peter	Constantin	Princeton University
Anne-Laure	Dalibard	Université de Paris VI Pierre et Marie Curie
Raphaël	Danchin	Université Paris-Est Créteil Val-de-Marne
Camillo	De Lellis	Institute for Advanced Study
Jean	Marc Delort	Université de Paris XIII (Paris-Nord))
Charles	Doering	University of Michigan
Emmanuel	Dormy	École Normale Supérieure
Tarek	Elgindi	Duke University
Thierry	Gallay	Université Grenoble Alpes Université de Grenoble I - Joseph Fourier
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Paul	Milewski	University of Bath
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Frederic	Rousset	Université Paris-Saclay
Jean-Claude	Saut	Université Paris-Saclay
Franck	Sueur	Université de Bordeaux
Vladimir	Sverak	University of Minnesota Twin Cities
Terence	Tao	University of California, Los Angeles
Luis	Vega	Universidad del País Vasco/Euskal Herriko Unibertsitatea
Vlad	Vicol	New York University, Courant Institute
Erik	Wahlén	Lund University
Sijue	Wu	University of Michigan

Mathematical Sciences Research Institute

Recent Developments in Fluid Dynamics (Virtual Workshop)

April 12, 2021 - April 30, 2021

Monday, April 12, 2021		
8:00AM - 8:50AM	Jean Marc Delort	Gravity capillary wave equations on the circle, normal forms and long time existence: a review
9:00AM - 9:50AM	Herbert Koch	The KdV hierarchy at H^{-1} regularity
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Pierre Raphael	On the implosion of a viscous compressible fluid

Tuesday, April 13, 2021		
8:00AM - 8:50AM	Thierry Gallay	Arnold's variational principle and its application to the stability of viscous planar vortices
9:00AM - 9:50AM	Didier Bresch	Heterogeneities in fluid mechanics
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Fredric Rousset	Incompressible limit for the free surface Navier-Stokes system
12:10PM - 1:10PM		Virtual "Reception"

Thursday, April 15, 2021		
8:00AM - 8:50AM	Juhi Jang	Dynamics of Newtonian stars
9:00AM - 9:50AM	Albert Ai	Two dimensional gravity water waves at low regularity
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Luis Vega	Riemann's non-differentiable function and the binormal curvature flow

Friday, April 16, 2021		
8:00AM - 8:50AM	Peter Constantin	On the Nernst-Planck-Navier-Stokes System
9:00AM - 9:50AM	Nicolas Burq	Analytic Solutions For The Water-Waves System
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Roberto Camassa	Vacuum States in Hydrodynamic Models

Mathematical Sciences Research Institute

Recent Developments in Fluid Dynamics (Virtual Workshop)

April 12, 2021 - April 30, 2021

Monday, April 19, 2021		
8:00AM - 8:50AM	Peter Constantin	On the Nernst-Planck-Navier-Stokes System
9:00AM - 9:50AM	Nicolas Burq	Analytic Solutions For The Water-Waves System
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Roberto Camassa	Vacuum States in Hydrodynamic Models

Tuesday, April 20, 2021		
8:00AM - 8:50AM	Irena Lasiecka	Long time behavior in a flow-structure interaction
9:00AM - 9:50AM	Anne-Laure Dalibard	Separation and Circulation in the Stationary Prandtl Equation
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Tristan Buckmaster	Stable shock wave formation for the compressible Euler equations
11:50AM - 1:00PM		Virtual "Reception"

Thursday, April 22, 2021		
8:00AM - 8:50AM	Anna Mazzucato	Global existence for the 2D Kuramoto-Sivashinsky equation
9:00AM - 9:50AM	Charlotte Perrin	Handling congestion in fluid equations
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Benoit Pausader	Long time existence for the Euler-Coriolis system

Friday, April 23, 2021		
8:00AM - 8:50AM	Camillo De Lellis	Locally dissipative solutions of the Euler equations
9:00AM - 9:50AM	Mihaela Ignatova	Global regularity and long time behavior of solutions of electroconvection models
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Nader Masmoudi	Recent Progress in the Study of the Prandtl System and the Zero Viscosity Limit

Mathematical Sciences Research Institute

Recent Developments in Fluid Dynamics (Virtual Workshop)

April 12, 2021 - April 30, 2021

Monday, April 26, 2021		
8:00AM - 8:50AM	Tarek Elgindi	Remarks on 2D Euler stationary states
9:00AM - 9:50AM	Jacob Bedrossian	Vortex filament solutions of the 3D Navier-Stokes equations
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Paul Milewski	Mode Two Solitary Waves in Stratified Flows

Tuesday, April 20, 2021		
8:00AM - 8:50AM	Vlad Vicol	Shock formation for compressible Euler
9:00AM - 9:50AM	Valeria Banica	Unbounded growth of the energy density associated to the Schrödinger map and the binormal flow
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Franck Sueur	Motion of several slender rigid filaments in a Stokes flow
11:50AM - 1:00PM		Virtual "Reception"

Thursday, April 22, 2021		
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Emmanuel Dormy	Modeling inviscid water waves

Friday, April 23, 2021		
8:00AM - 8:50AM	Terence Tao	Universality and possible blowup in fluid equations
9:00AM - 9:50AM	Pierre Germain	Vortex filament solutions for the Navier-Stokes equations
10:00AM - 11:00AM		Gathertown Break
11:00AM - 11:50AM	Vladimir Sverak	On spectra of certain linearized operators

Identifiable Participants		
First name	**Last name**	**Institution name**
Amit	Acharya	Carnegie Mellon University
Siddhant	Agrawal	University of Massachusetts Amherst
Albert	Ai	University of Wisconsin-Madison
Thomas	Alazard	Ecole Normale Supérieure Paris-Saclay
Dallas	Albritton	New York University, Courant Institute
amal	Aldakhil	Morgan State University
Diego	Alonso-Oran	University of Bonn
David	Ambrose	Drexel University
Ovidiu-Neculai	Avadanei	University of California, Berkeley
Tahmineh	Azizi	Kansas State University
Hajer	Bahouri	Laboratoire Jacques-Louis Lions; Centre National de la Recherche Scientifique (CNRS)
Valeria	Banica	Sorbonne University, Laboratoire Jacques-Louis Lions
Jacob	Bedrossian	University of Maryland
Roberta	Bianchini	Consiglio Nazionale delle Ricerche (CNR)
Edoardo	Bocchi	University of Sevilla
Marco	Bravin	Basque Center for Applied Mathematics
Didier	Bresch	Université de Savoie (Chambéry)
Tristan	Buckmaster	Princeton University
Nicolas	Burq	Université de Paris XI
Adriana Valentina	Busuioc	Université Jean Monnet
Suncica	Canic	University of California, Berkeley
Anthony	Chen	University of California, Berkeley
Gong	Chen	Fields Institute for Research in Mathematical Sciences
Jiajie	Chen	California Institute of Technology
Didier	Clamond	Universite de Nice Sophia Antipolis
Charles	Collot	Centre National de la Recherche Scientifique (CNRS)
Peter	Constantin	Princeton University
Anne-Laure	Dalibard	Université de Paris VI (Pierre et Marie Curie)
Raphaël	Danchin	Université Paris-Est Créteil Val-de-Marne
Camillo	De Lellis	Institute for Advanced Study
Latifa	Debbi	Universite M'hammed Bouguerra de Boumerdes (UMBB)
Jean Marc	Delort	Université de Paris XIII (Paris-Nord)
Clément	Denis	Université d'Aix-Marseille (AMU)
Bamdeb	Dey	Assam Don Bosco University
Marcelo	Disconzi	Vanderbilt University
Michele	Dolce	Imperial College, London
Hongjie	Dong	Brown University
Emmanuel	Dormy	École Normale Supérieure
Mats	Ehrnstrom	Norwegian University of Science and Technology (NTNU)
David	Eisenbud	MSRI - Mathematical Sciences Research Institute
Tarek	Elgindi	Duke University
Daniel	Erickson	Oregon State University
Lucas	Ertzbischoff	École Polytechnique
Wen	Feng	Niagara University
Luca	Franzoi	New York University Abu Dhabi (NYUAD)
Susan	Friedlander	University of Southern California
Isabelle	Gallagher	École Normale Supérieure

Identifiable Participants		
First name	**Last name**	**Institution name**
Thierry	Gallay	Université Grenoble Alpes (Université de Grenoble I - Joseph Fourier)
Eduardo	Garcia-Juarez	Universitat de Barcelona
Mark	Groves	Universitàt des Saarlandes
Binan	Gu	New Jersey Institute of Technology
Andre	Guerra	University of Oxford
Colette	Guillopé	Université Paris-Est Créteil Val-de-Marne
Dengjun	Guo	University of Science and Technology of China
Mason	Haberle	University of California, Berkeley
Mostafa	Hassan	Johns Hopkins University
Siming	He	Duke University
Jiao	He	MSRI - Mathematical Sciences Research Institute
Lars Eric	Hientzsch	Université Grenoble Alpes (Université de Grenoble I - Joseph Fourier)
Yiran	Hu	University of Texas, Austin
Weiwei	Hu	University of Georgia
John	Hunter	University of California, Davis
Vera Mikyoung	Hur	University of Illinois at Urbana-Champaign
Hussain	Ibdah	Texas A & M University
Slim	Ibrahim	University of Victoria
Mihaela	Ifrim	University of Wisconsin-Madison
Dragos	Iftimie	Université Claude-Bernard (Lyon I)
Mihaela	Ignatova	Temple University
Sameer	Iyer	Princeton University
Juhi	Jang	University of Southern California
Min Jun	Jo	University of British Columbia
Muhammad	Kamran	COMSATS University Islamabad, Wah Campus
Jim	Kelliher	University of California, Riverside
Boris	Khesin	University of Toronto
Friedrich	Klaus	Karlsruhe Institute of Technology
Herbert	Koch	Rheinische Friedrich-Wilhelms-Universitàt Bonn
Jeffrey	Kuan	University of California, Berkeley
Igor	Kukavica	University of Southern California
David	Lannes	Institut de Mathématiques de Bordeaux
Irena	Lasiecka	University of Memphis
Quinn	Le	University of Southern California
Fizay-Noah	Lee	Princeton University
Trevor	Leslie	University of Southern California
Linfeng	Li	University of Southern California
Su	Liang	University of Minnesota, Twin Cities
Xian	Liao	Institute of Analysis
En-Bing	Lin	Central Michigan University
Quyuan	Lin	Texas A & M University
Xiao	Liu	Georgia Institute of Technology
Shizhe	Liu	University of California, Berkeley
Jiaqi	Liu	University of Southern California
Yue	Liu	University of Texas
Wenjie	Lu	University of Minnesota, Twin Cities
Yuchen	Mao	University of California, Berkeley

Identifiable Participants		
First name	**Last name**	**Institution name**
Jeffrey	Marino	Johns Hopkins University
Jeremy	Marzuola	University of North Carolina
David	Massatt	University of Southern California
Hussein	Mastaneh	Iran Meteorology Organization
Anna	Mazzucato	Pennsylvania State University
Dylan	McKnight	University of Nebraska
Milton	Mi	University of California Berkeley
Paul	Milewski	University of Bath
Evan	Miller	McMaster University
Mei	Ming	Yunnan University
Sylvie	Monniaux	Aix-Marseille Université
Matthew	Munson	U.S. Army Research Office
Camil	Muscalu	Cornell University
Sara	Myers	University of Nebraska
Arruna	Nandhini	Government Arts College
Evangelos	Nastas	University at Albany (SUNY)
Quoc-Hung	Nguyen	Institute of Mathematical Sciences
Matthew	Novack	New York University, Courant Institute
Marc	Nualart	Imperial College, London
Helena	Nussenzveig Lopes	Federal University of Rio de Janeiro
Sung-Jin	Oh	University of California, Berkeley
Gayathri	Palanisamy	PSG College of Arts & Science
Emilian	Parau	University of East Anglia
Federico	Pasqualotto	University of California, Berkeley
Matthieu	Pauron	Ecole Normale Supérieure de Rennes
Galina	Perelman	University Paris Est Creteil
Charlotte	Perrin	Centre National de la Recherche Scientifique (CNRS)
Tuan	Pham	Brigham Young University
Ben	Pineau	University of California, Berkeley
Pooja	Rao	State University of New York, Stony Brook
Calum	Rickard	University of Southern California
Ayman	Rimah Said	École Normale Supérieure de Cachan
Brayan Mauricio	Rodriguez Garzon	Universidade Federal do Rio de Janeiro
Cesar Alberto	Rosales-Alcantar	Universidad Nacional Autónoma de México (UNAM)
James	Rowan	University of California, Berkeley
Marco	Sammartino	Università di Palermo
Bhupesh	Sharma	VIT-AP University
Hyungeun	Shin	University of Victoria
Jingyang	Shu	Temple University
Annalaura	Stingo	University of California, Davis
John	Stockie	Simon Fraser University
Robert	Strain	University of Pennsylvania
Qingtang	Su	University of Southern California
Franck	Sueur	Université de Bordeaux
changzhen	sun	LMO
Chenmin	Sun	Université de Cergy-Pontoise
Vladimir	Sverak	University of Minnesota Twin Cities
Terence	Tao	University of California, Los Angeles
Zhongkai	Tao	University of California, Berkeley

Identifiable Participants		
First name	**Last name**	**Institution name**
Andrei	Tarfulea	Louisiana State University
Daniel	Tataru	University of California, Berkeley
Mitchell	Taylor	University of California, Berkeley
Roberto	Triggiani	University of Memphis
Duoc	Trinh	University of Science, Vietnam National University, Hanoi
Tien	Truong	Lund University
Tai-Peng	Tsai	University of British Columbia
Amjad	Tuffaha	American University of Sharjah
Kristoffer	Varholm	Norwegian University of Science and Technology (NTNU)
Luis	Vega	Universidad del Paà-s Vasco/Euskal Herriko Unibertsitatea
Gaston	Vergara-Hermosilla	Institut de Mathématiques de Bordeaux
Vlad	Vicol	New York University, Courant Institute
Collin	Victor	University of Nebraska
Erik	Wahlén	Lund University
Lizhe	Wan	University of Wisconsin-Madison
Weinan	Wang	University of Arizona
Shan	Wang	Université Paris-Est Créteil Val-de-Marne
Jörg	Weber	Lund University
Bobby	Wilson	University of Washington
Sijue	Wu	University of Michigan
Xuming	Xie	Morgan State University
Xiangjin	Xu	Binghamton University (SUNY)
Liaosha	Xu	University of Virginia
Cheng	Yang	University of Toronto
Zhuolun	Yang	Rutgers University
Ruoxuan	Yang	Massachusetts Institute of Technology
Gael	Yomgne	Rheinische Friedrich-Wilhelms-Universitàt Bonn
Lei	Yu	Tongji University
Xu	Yuan	Centre de Mathématiques Laurent Schwartz, École Polytechnique
Chongchun	Zeng	Georgia Institute of Technology
Qingtian	Zhang	West Virginia University
Xinyu	Zhao	University of California, Berkeley
Lifeng	Zhao	University of Science and Technology of China
Hui	Zhu	University of Michigan
Yuzhe	Zhu	École Normale Supérieure
Claude	Zuily	Université de Paris XI (Paris-Sud)

Identifiable Participants Information

Identifiable Participants		179

Gender		179
Male	74.30%	133
Female	23.46%	42
Other	0.00%	0
Declined to state	2.23%	4

Ethnicity*		180
White	45.00%	81
Asian	39.44%	71
Hispanic	2.22%	4
Pacific Islander	0.00%	0
Black	1.11%	2
Native American	0.00%	0
Declined to state	12.22%	22

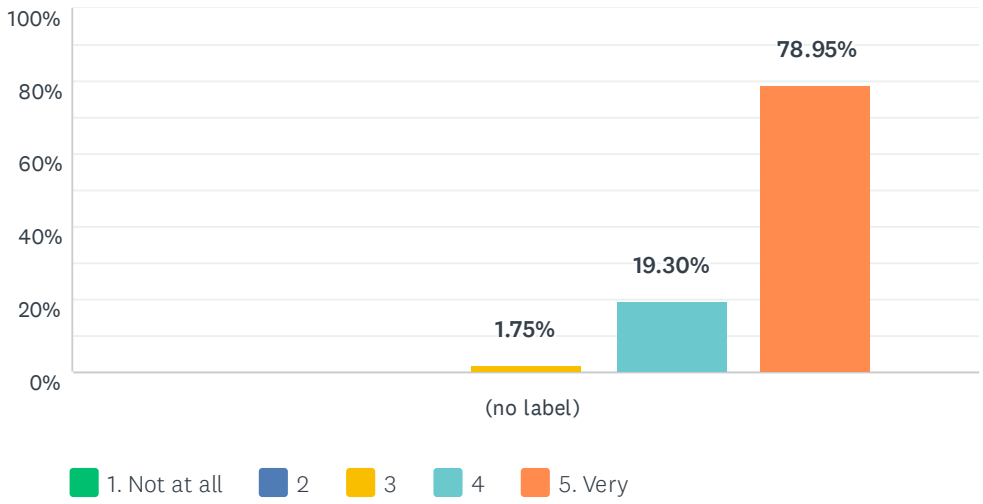
* ethnicity specifications are not exclusive

There were 59 additional virtual participants who were not identifiable

57 responses out of 179 participants = 32% response rate

Q1 The workshop was intellectually stimulating

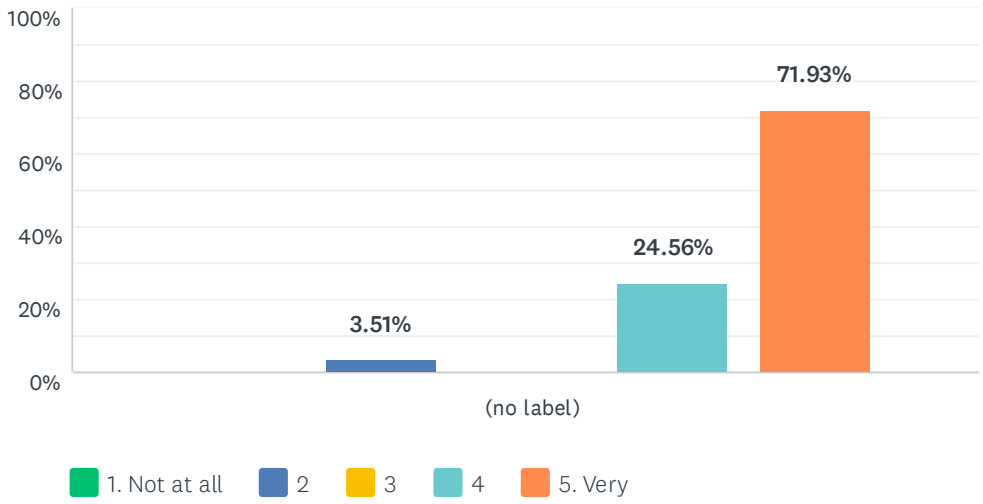
Answered: 57 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	1.75% 1	19.30% 11	78.95% 45	57	4.77

Q2 The overall experience of the workshop was worthwhile

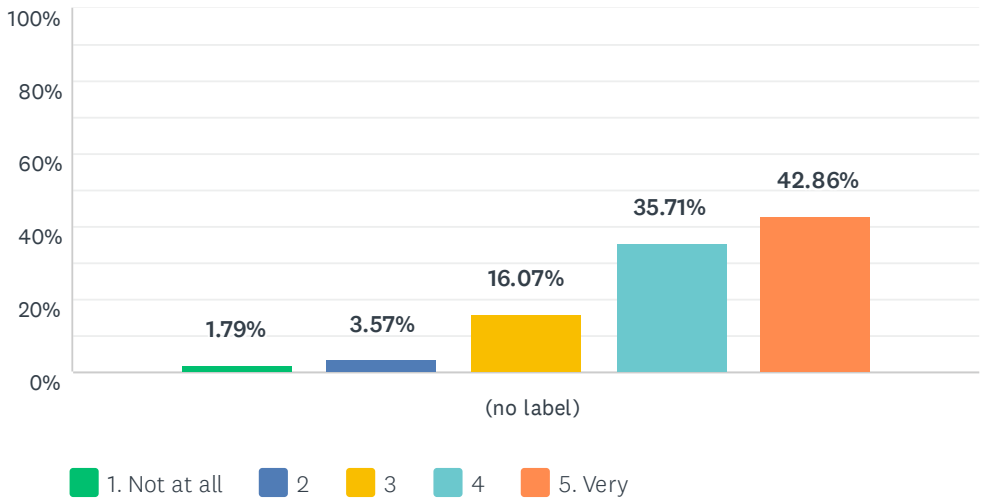
Answered: 57 Skipped: 0



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	3.51% 2	0.00% 0	24.56% 14	71.93% 41	57	4.65

Q3 I was well prepared to benefit from the lectures

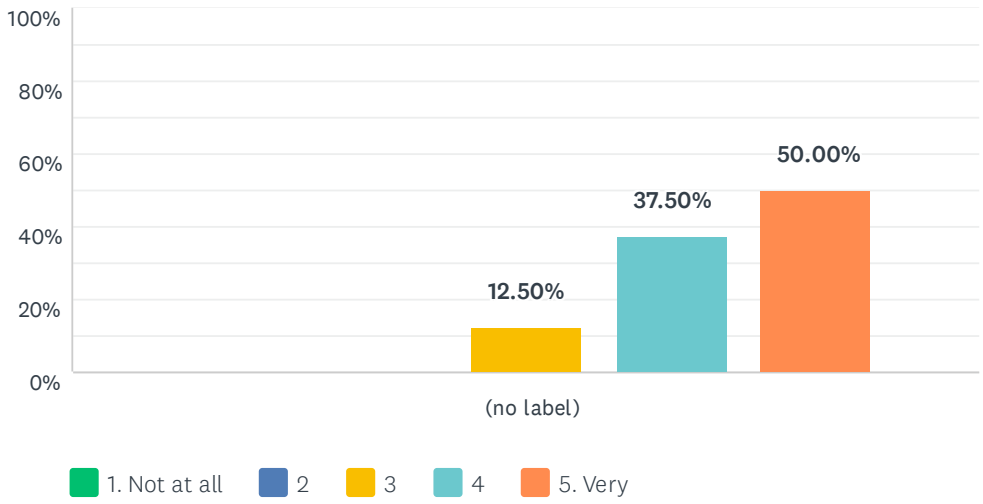
Answered: 56 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	1.79% 1	3.57% 2	16.07% 9	35.71% 20	42.86% 24	56	4.14

Q4 My interest in the subject matter was increased by the workshop

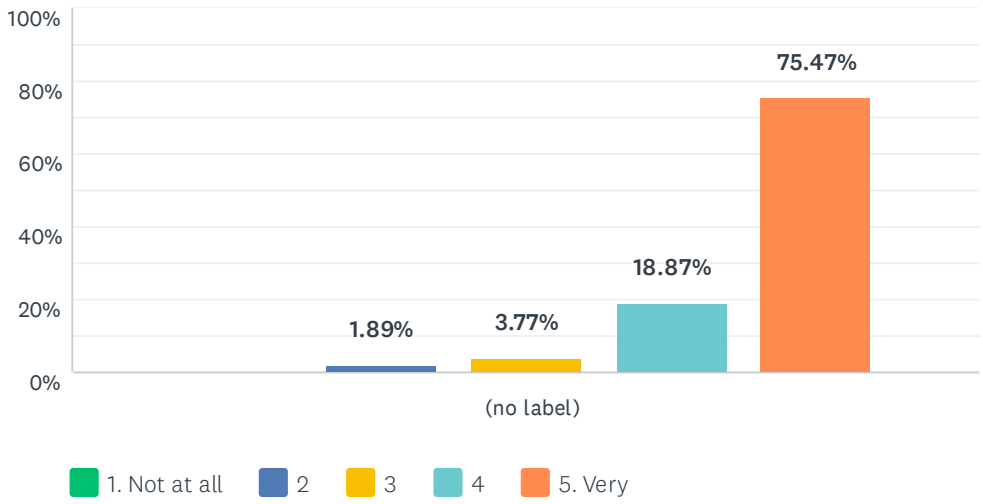
Answered: 56 Skipped: 1



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	12.50% 7	37.50% 21	50.00% 28	56	4.38

Q5 I found the MSRI staff helpful

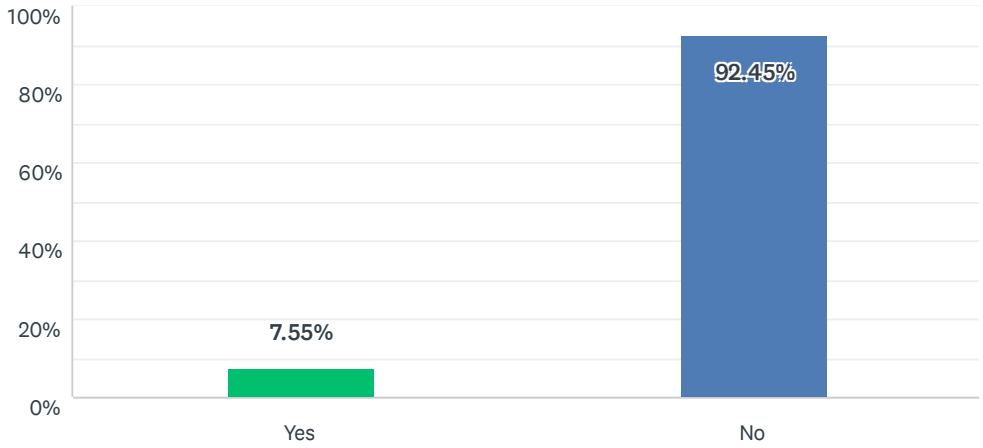
Answered: 53 Skipped: 4



	1. NOT AT ALL	2	3	4	5. VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	1.89% 1	3.77% 2	18.87% 10	75.47% 40	53	4.68

Q6 Did you experience any technical difficulties accessing the online workshop?

Answered: 53 Skipped: 4



ANSWER CHOICES	RESPONSES	
Yes	7.55%	4
No	92.45%	49
TOTAL		53

#	IF YES, PLEASE EXPLAIN	DATE
1	During coffee times my mic didn't work.	6/24/2021 7:54 AM
2	Internet connection interruption from my home country.	6/8/2021 11:21 AM
3	some times network problems but it may be from my side also.	5/21/2021 7:28 AM
4	Poor internet at my rented apartment in Berkeley (connection was fine at MSRI building).	5/19/2021 10:55 AM

Q7 How did having the workshop held online impact your participation?

Answered: 53 Skipped: 4

#	RESPONSES	DATE
1	Perhaps inevitably, the online format caused me to feel less engaged with the lectures.	7/7/2021 9:18 PM
2	It was limited.	6/24/2021 10:16 AM
3	it made it more convenient	6/24/2021 8:02 AM
4	If it didn't, I could not participate at all.	6/24/2021 7:54 AM
5	yes	6/24/2021 5:15 AM
6	In online events, it is difficult to interrupt the speaker and ask questions comparing the face to face events.	6/24/2021 3:12 AM
7	Greatly. Due to the time zone difference, I found it hard to follow the lectures/interact with the other participants after a full day at work.	6/24/2021 12:19 AM
8	My participation in the talks wasn't affected, but I wasn't able to chat informally with researchers working on problems related to mine outside of sessions, and this is normally very valuable.	6/23/2021 4:29 PM
9	I have the chance to attend some talks which I would miss in a regular workshop due to time constraint for travel.	6/23/2021 3:55 PM
10	It was really well-organized. Online was scientifically better than in person, easier to follow talk. But I didn't really make as many friends as I would in person. And it is friendships that lead to collaborations.	6/23/2021 2:34 PM
11	The three-week long format made it very difficult to remain engaged in the talks throughout the week.	6/23/2021 2:13 PM
12	It makes it easier to attend talks without impacting my teaching duties, also I appreciate that the talks are recorded.	6/23/2021 2:11 PM
13	As a researcher from a developing country, where there are a lot of corruption and bureaucracy preventing us doing research, the online workshop was a gift for me in all senses.	6/8/2021 11:21 AM
14	I have learned ideas, techniques and found out more results in areas I was not familiar with and having the online lectures helped me going back to lectures I did not fully understood. It was very easy to talk to program's members via platforms as sococo, gather town and zoom. I am sure some of the upcoming projects I am currently pursuing will reflect that the online setting was very well suited for this times.	6/1/2021 8:29 PM
15	It made it much easier to participate, except for the early mornings for those of us on the Pacific Coast (though I totally understand and support such scheduling).	5/22/2021 3:33 PM
16	it was easier to attend	5/22/2021 1:34 PM
17	It was very effective.	5/21/2021 10:17 PM
18	Thanks to MSRI, for holding the workshop online, otherwise it will not be possible for me to participate.	5/21/2021 7:28 AM
19	It was convenient for me to attend online.	5/21/2021 12:09 AM
20	Online participation now a days are very usual so i do not think that it went wrong. The things is that you should have better preparation before online so that you can learn a lot.	5/20/2021 10:02 PM
21	I am a GTA and I am not able to travel because of my assignment, I could easily attend virtually in this online workshop which was related to my research area needless to travel and I could do my teaching as well.	5/20/2021 8:15 PM

22	My participation was undoubtedly more superficial than if I could visit MSRI physically.	5/20/2021 11:33 AM
23	For me works great because I live in Brazil, hence this online format help me to attend.	5/20/2021 6:32 AM
24	I barely attended, owing to time difference and too many local occupations, both professional and private.	5/20/2021 5:53 AM
25	I think that it's good for me since we can recall the workshop (by the record) after it finished. Although some meetings are missed, I can pick them up by record videos.	5/20/2021 1:06 AM
26	I certainly had a positive impact as I could attend the online version without having to worry about travel and expenses, which would have been an unlikely scenario personally.	5/19/2021 8:25 PM
27	The interaction is less.	5/19/2021 6:48 PM
28	More accessible	5/19/2021 4:36 PM
29	In a good way. I do not have to apply for funds to come to USA. I would not have the chance to participate in person.	5/19/2021 3:54 PM
30	For me, holding any workshop online has a significant negative impact over being able to interact directly with participants. Time constraints for people joining from many different time-zones are also awkward.	5/19/2021 2:40 PM
31	In spite of the difference of time between California and Europe, I could attend all the talks.	5/19/2021 12:40 PM
32	No impact	5/19/2021 12:06 PM
33	More convenient, however an in person workshop would provide a more engaging experience	5/19/2021 12:02 PM
34	For participants from poor developing countries, it was an excellent opportunity. Because moving to MSRI physically not affordable for everyone.	5/19/2021 11:37 AM
35	It is obvious that present workshop is better than an online one, but I find this online workshop at MSRI is the best one that I've never participate before. I benefit so much from it.	5/19/2021 11:35 AM
36	It was more convenient.	5/19/2021 11:17 AM
37	Interactions were not as useful as in person, but otherwise I thought that everything worked out fine.	5/19/2021 11:08 AM
38	My small research meetings were not affected. My seminar attendance was affected slightly, as I had to be careful not to overload my Zoom schedule.	5/19/2021 11:04 AM
39	The online +9h jetlag impacted a lot my participation.	5/19/2021 11:01 AM
40	It made it harder to chat with speakers after their talk (since invited speakers could/would not access GatherTown). In an in-person workshop, I could ask them questions during lunch/breaks; instead, I asked some of my questions via email.	5/19/2021 10:55 AM
41	One obvious drawback of online conferences is that we missed the informal discussions after the lectures. We were able to discuss through gathertown, but it is not comparable to a discussion with a blackboard.	5/19/2021 10:53 AM
42	Less interaction with senior members.	5/19/2021 10:44 AM
43	I participate all the time	5/19/2021 10:41 AM
44	In a effective way	5/19/2021 10:35 AM
45	Not a big difference, even if "in person" workshops are way better	5/19/2021 10:34 AM
46	Not at all	5/19/2021 10:27 AM
47	The online workshop makes it more accessible to wider range of audience	5/19/2021 10:27 AM
48	The positive side is that it makes the participation more flexible and accessible. The negative side is less personal interaction.	5/19/2021 10:23 AM
49	The time shift was a problem in some cases	5/19/2021 10:22 AM
50	I could participate while keeping all my other commitments going, but the virtual format stretched the workshop over three weeks, which was too much. It was time consuming and	5/19/2021 10:20 AM

	hard to keep focused for such a long time.	
51	Not too much interaction with other people.	5/19/2021 10:19 AM
52	I found the discussions less engaging and it was harder to connect to other people at a personal level. Though I liked the fact that the lectures were recorded.	5/19/2021 10:17 AM
53	Only because the workshop was held online, I was able to attend it amidst this pandemic.	5/19/2021 10:17 AM

Q8 One important aspect that was missing due to the online format was interaction between participants. Do you have any suggestions on how we can provide this interaction if we hold future workshops online?

Answered: 25 Skipped: 32

#	RESPONSES	DATE
1	The following idea was mentioned to me by someone else, and I think it is a good one: A good way to use the "Gathertown" interface (and to encourage participants to really use it) would be to replace or supplement the 5-minute talks at the beginning of the semester with a virtual poster session. This has the potential to be much more interactive, and could boost participation in the virtual teas that follow.	7/7/2021 9:18 PM
2	Workshops were more like lectures. I think discussion time needs to increase.	6/24/2021 10:16 AM
3	The gathertown platform worked well when there was high attendance, but attendance was somewhat sporadic and buy-in wasn't necessarily that high. I think that can be attributed to virtual interaction burnout more than a year into the pandemic, and might work better in normal times. On the other hand, there really is no substitute from getting a group of people physically together away from their day-to-day lives to talk about research.	6/23/2021 4:29 PM
4	It's hard. We need the environment, coffee, and atmosphere.	6/23/2021 3:55 PM
5	I really hope we will not have any meetings online anymore. We mathematicians need to meet in person once in a while. I really wish we would be given an opportunity to redo the whole semester in near future since covid robbed us of a nice semester together.	6/23/2021 2:34 PM
6	I truly believe that all the online platforms used by MSRI were the way to keep a healthy interaction pace among participants. The organized teas via gather town and the interactive ones via groups randomly selected in zoom were a hit. Sococo else helped loads as it made it possible to have around the idea of an office. I personally believe that the amount of interaction that took place between members was the maximum anyone can achieve: for people being on different continents and being stuck at home with families (including kids that due to the pandemic were full time at home) was clearly not an easy task to do. Some members were as active as in a regular times program regardless the time difference. It was a mix but overall I think we achieved the best outcome!	6/1/2021 8:29 PM
7	A better tea room app.	5/22/2021 3:33 PM
8	It is difficult to substitute for a spontaneous interaction with the colleagues. Gather town was too artificial -in addition to being time consuming. After several hours of lectures it is nice to have a time off from the computer -rather than attending another computer dependent event.	5/22/2021 1:34 PM
9	By filling the Google form (survey) we can do the interaction between participants.	5/21/2021 10:17 PM
10	Per week some online discussion sessions, apart from regular discussion.	5/21/2021 7:28 AM
11	As said above the only way to learn something far from your home is the online mode. You have to be more focus on this platform. Since the organizers are also providing video lectures of the past events that help anyway. The way you people are organizing the events are highly appreciable. It may be that you can give some more time for the students and speakers which make discussions more clear between them.	5/20/2021 10:02 PM
12	It was totally perfect.	5/20/2021 8:15 PM
13	This is an unsolvable problem, but all what is possible was done already.	5/20/2021 11:33 AM
14	I have seen in some workshops, the creation of talk rooms in the breaks, the link is sent just before some lecture finish and the attendees decide if to enter or not.	5/20/2021 6:32 AM
15	Taking the conditions into account, I doubt it is possible to do much better.	5/20/2021 5:53 AM
16	Maybe we need a chat space(to create another chat space), which is a space the speaker and	5/20/2021 1:06 AM

	the listener can discuss directly.	
17	I had recently come across interactivity enabling portals such as Gathertown or a workspace on Slack. I reckon these could provide an extensive experience that could go beyond the workshop hours.	5/19/2021 8:25 PM
18	No.	5/19/2021 6:48 PM
19	MSRI did its best to provide interaction tools (Sococo, GatherTown) to participants. Of course, this does not replace "real life" contacts, but was the best one could expect for in the present situation.	5/19/2021 12:40 PM
20	No, I do not.	5/19/2021 12:06 PM
21	I think the online tea time is very useful for us to communicate with others.	5/19/2021 11:35 AM
22	Maybe encourage invited speakers (or give them the ability) to join GatherTown?	5/19/2021 10:55 AM
23	Gathertown was a good idea. However, the connection was not so good. It could be improved a bit.	5/19/2021 10:53 AM
24	Hands on training is not possible on virtual interaction..	5/19/2021 10:35 AM
25	Zoom preassigned breakout rooms	5/19/2021 10:20 AM

Q9 We welcome any additional comments or suggestions you may have to improve the overall online experience for future participants.

Answered: 13 Skipped: 44

#	RESPONSES	DATE
1	I don't see any possible improvements. The organization from MSRI was terrific! But don't have online semesters any more. Also, allow the fluids semester to be held again in few years, we need the time together (I am aware of the reunion, but I think we need the whole semester).	6/23/2021 2:34 PM
2	There is nothing that MSRI did not think at:) I loved all their suggestions, their attention to detail, and willingness to assist everyone with any problems small or big. MSRI is lucky to have such a great family running it! None of the success of this program was possible without the the help of Helene, David, Chirs, Joey, Ben, Tracy, Berthram, Arthur, and the many others that worked at MSRI, with us hand in hand! Thank you all for being the best team ever!	6/1/2021 8:29 PM
3	Great workshop	5/22/2021 1:34 PM
4	It was very impressive, I learnt from there.	5/21/2021 10:17 PM
5	If MSRI conduct some workshop explaining various numerical techniques to solve nonlinear differential equations in detail, then it would be very helpful.	5/21/2021 7:28 AM
6	My humble suggestion would be timings could be optimized if possible, since participants belong to different countries.	5/21/2021 12:09 AM
7	May be you can make WhatsApp group so that the participants will get the information on time (for those who did not receive emails or did not look email at the time) might be helpful. You should also provide the certificate of participation if anyone want to attach with his/her CV. That's all. Thank you.	5/20/2021 10:02 PM
8	Thank you so much to all organizers. It was a great opportunity to me to get to know the researchers in my field during COVID time.	5/20/2021 8:15 PM
9	I would like to enter the list emails distribution of workshops, postdoctoral position in Fluid Dynamics. My email is bramau901007@gmail.com Thanks	5/20/2021 6:32 AM
10	This will never replace face-to-face experience	5/20/2021 5:53 AM
11	No.	5/19/2021 6:48 PM
12	After the COVID, MSRI must arrange virtual/online seminars/conferences. The reason is mentioned at point 7.	5/19/2021 11:37 AM
13	Just thank you a lot for all your efforts! It was ten times better than all the other online experiences that I had during the last year elsewhere!	5/19/2021 10:53 AM

Introduction to water waves (summer school held online)

July 27, 2020 - August 07, 2020

MSRI, Berkeley, CA, USA

Organizers:

Mihaela Ifrim (University of Wisconsin-Madison)

Daniel Tataru (University of California, Berkeley)

REPORT ON THE MSRI SUMMER GRADUATE SCHOOL

October 1, 2020

"Introduction to water waves (virtual)"
July 27 – August 07, 2020

Organizers:

- Mihaela Ifrim (University of Wisconsin-Madison)
- Daniel Tataru (University of California, Berkeley)

Description

The purpose of this two weeks summer school was to introduce graduate students to the state of the art methods and results in the study of incompressible Euler's equations in general, and water waves in particular. This is a research area which is highly relevant to many real life problems, and in which substantial progress has been made in the last decade.

The goal was to present the main current research directions in water waves, starting from a common denominator which included some basic knowledge in partial differential equations, theory of distributions and Fourier analysis, based on a list of prerequisites assigned before the beginning of the summer.

The lectures were organized on two tracks. One was focused directly on the Euler equations and then the derivation of the water wave equations and continuing with the study of the water wave equations using normal forms methods. The goal of the secod track was to connect this with the broader context of nonlinear dispersive equations. These two tracks were designed to converge in the last 2-3 pairs of lectures, where some of the current research results were presented. The final goal was two-fold, namely (i) to understand the local solvability of the Cauchy problem for water waves, as well as (ii) to describe the long time behavior of solutions.

Through the lectures and associated problem sessions, students learned about a number of new analysis tools which are not routinely taught in a graduate school curriculum. The goal was to help students acquire the knowledge needed in order to start research in water waves and Euler equations, or in many other related areas in partial differential equations.

Highlights of the School

For us the organizers, the COVID-19 pandemic created an unexpected array of difficulties to overcome, one for which there was no prior experience to guide appropriate actions. One key change was that we had

to organize the summer school fully in a virtual fashion; indeed, this was the first virtual summer school organized at MSRI. What we set out to do was to provide the participants with a full day immersion into the program, guided by several main ideas that came together to provide a positive experience for the participants, as can be seen from the absolutely positive and rewarding feedback from the participants:

1. While initially we thought it might be easier to stay with a single type of software (e.g. zoom) for the summer school, we quickly realized that this will not be enough, and by the start of the summer school we had adopted an array of tools, all of which have played key roles. This included zoom, jamboard, slack and overleaf. This all came on top of a main program page that served as the participants entry point toward all other platforms. While this was perhaps a bit overwhelming in the beginning both for us and for the participants, just about everybody quickly joined in and adapted. As an example, within a few days some groups ran out of their initially alotted jamboard space, and they ended up using literally hundreds of pages in their discussions. A key to making this work was to insure that all participants had access to appropriate hardware (e.g. tablets). This issue was understood already two month before the start of the school, and the burden fell on MSRI to insure this was taken care of. Despite the occasional hiccup, by and large this matter was well addressed.

2. In addition to the morning zoom lectures, a key component of our strategy was to provide a hands on experience for the participants via daily homework assignments. The proposed problems assigned each day were given such that they covered a full range of mathematical levels : starting with some easier problems at first, and finishing with some open problems by the last assignment. The problems were carefully chosen to fit within the broader context of the lectures, and often to provide illuminating examples for later lectures. Having such a structure in a two weeks long program contributed to the enthusiasm and hence the full participation of the students, as they knew that at he end they will be able to attempt some open problems! This of course came after well planed lectures and thorough discussion sessions, long office hours, and ad-hoc messages and emails that the organizers diligently answered throughout the two weeks long. The organizers designed the submission of the proposed problems via mathovearleaf. Participants were encouraged to write their solutions in assigned groups. The idea was to not only teach them state of the art mathematics but to also show them what collaboration, and collegiality is; they each had to submit three solutions, (or more if the wished to do so) written by themselves but in a file that was like a paper authored by all of the members of the group! (from each group of 5 we would get 15 such solutions). Our intention was to have them discuss right from the beginning on how they will split the problems so that no repetitions will occur; more advanced students might decide on the problems they would want to work on later in the program, as the material was becoming more challenging. This idea turned out useful as students determined their status and leaders in their group and this helped them seek help from their more experienced colleagues. A few days after the end of the summer school, they had a deadline to submit their solutions. These we carefully read and returned with our comments and suggestions a few days later.

3. One main feature of the summer school, as far as the organization was concerned, was the idea of arranging the participants in groups. Each group was composed of 5 students, and overall we had 10 groups. The way the students were grouped was not random: we made sure that a certain balance is attained: people from various backgrounds and time-zones (as much as possible) were grouped together. This idea turn out to work very well, and kept the groups effective and balanced rather than having large discrepancies between them. Friendships, and probably long time collaborations, were formed as a consequence of this "group" idea. Some of the groups even requested to have their Slack channels and Jamboard access continued so that they could further work on certain continuations associated with the summer school projects. This is more than a desired outcome for us the organizers !

4. One main feature which we thought was very helpful for the students was our **mandatory** *Discussion Sessions*, which were scheduled daily from 3pm - 5pm, and in which problems were proposed and discussed. The students were organized in groups of 5, so there were 10 groups overall. They all had their own Zoom room, Jamboard paper, and Slack channel, and they were encouraged to work on the

given problems. Both organizers and the teaching assistant moderated these meetings very closely. Specifically, in a given day, one or both of the organizers and the TA would visit the group Zoom rooms, each from a different end of the 10 groups sequence, and engage in giving hints, answering questions related with potential attempts on solving the problems, encouraging communication among the members of the group and most importantly, they maintained a very positive attitude that promoted competitiveness and enthusiasm at the levels that one can only hope to achieve. We made sure that each of the groups was visited twice during each *Discussion Session*, both by the TA and by at least one of us.

We believe that this full and complete engagement of the majority of the students in the *Discussion Sessions* was in part due to the organizers full involvement (as organizers we realized our level of enthusiasm grew even more when we saw the enthusiasm and flow of questions and willingness to assimilate so much information that came from the students; and hence, the positive attitude and accessibility we displayed rewarded us with one of the most satisfying experience one can have in his/her carrier as a research and educator) that made the students aware that this is a serious activity and that their participation is counted on. We even allowed some of them to float in between groups, so that more connections and more ideas will be transmitted between them. We did not want to switch/reform groups from scratch in a continuous manner as the students were slowly forming friendships and collaborations in each group. When we asked their opinion on such of idea, they all seemed to indicate that a full makeover of the groups is not something they want.

5. The office hours were also a reference point for many of the students; it was the time they would all ask questions about the course, and problems from the previous days. We both had long lines of people waiting to ask questions, and we stayed until we answered to all of their questions. Sometimes, we will receive messages on Slack about questions they would have after the office hours and discussion sessions were done. It felt good to see that the summer school went on every day beyond the 5pm mark and that students were so interested in learning new material!

6. Early in the summer school we realized that the students had very limited interaction opportunities with others not in their group, and decided to organize also some social meetings to alleviate this. These meetings turned out to have been an excellent idea, if anything, in retrospect, we should have organized more of them. At the time zoom did not yet have some of the group splitting features it has now, and we tried to do our best with the available tools.

7. Among the positive feedback we received: one student said he now can solve his thesis problem. Another said he has to rewrite his thesis and improve it. Another said this was the highlight of his graduate school. Many others had very positive things to say at the end, and some of this is reflected in their comments on the MSRI questionnaire.

Organizers		
First Name	**Last Name**	**Institution**
Mihaela	Ifrim	University of Wisconsin-Madison
Daniel	Tataru	University of California, Berkeley
Lecturers		
First Name	**Last Name**	**Institution**
Mihaela	Ifrim	University of Wisconsin-Madison
Igor	Kukavica	University of Southern California
Daniel	Tataru	University of California, Berkeley
Teaching Assistant		
First Name	**Last Name**	**Institution**
Albert	Ai	University of Wisconsin-Madison

Mathematical Sciences Research Institute

Introduction To Water Waves

(summer school held online)

July 27, 2020 - August 07, 2020

Monday, July 27, 2020			
9:00 AM - 9:10 AM	Online/Virtual		Welcome
9:10 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 1
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 1
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual		Office hours
11:45 AM - 12:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Tuesday, July 28, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 2
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 2
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual	Igor Kukavica	Lecture by guest speaker
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Wednesday, July 29, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 3
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 3
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual		Office hours
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Thursday, July 30, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 4
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 4
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual	Igor Kukavica	Lecture by guest speaker
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Friday, July 21, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 5
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 5
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual		Office hours
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Monday, August 3, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 6
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 6
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual		Office hours
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Tuesday, August 4, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 7
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 7
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual	Igor Kukavica	Lecture by guest speaker
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Wednesday, August 5, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 8
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 8
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual		Office hours
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Thursday, August 6, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 9
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 9
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual	Igor Kukavica	Lecture by guest speaker
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Friday, August 7, 2020			
9:00 AM - 10:20 AM	Online/Virtual	Mihaela Ifrim	Lecture 10
10:30 AM - 11:50 AM	Online/Virtual	Daniel Tataru	Lecture 10
11:50 AM - 1:30 PM			Lunch Break
1:30 PM - 2:30 PM	Online/Virtual		Office hours
2:30 PM - 3:00 PM			Break
3:00 PM - 5:00 PM	Online/Virtual		Mandatory work sessions

Students		
First Name	**Last Name**	**Institution**
Omar	Abdelhameed	University of Wisconsin-Madison
Jeric	Alcala	University of Houston
Ovidiu-Neculai	Avadanei	University of California, Berkeley
Shalmali	Bandyopadhyay	University of North Carolina
Hannah	Barta	Oregon State University
Debdeep	Bhattacharya	George Washington University
Fei	Cao	Arizona State University
Ángel	Crespo Blanco	TU Berlin
Pablo	Gerlach Mena	University of Sevilla
Yuxi	Han	University of Wisconsin-Madison
Mostafa	Hassan	University of Wisconsin-Madison
Antonio	Hidalgo	University of Sevilla
Margaret	Hoeller	University of Illinois, Chicago
Narges	Hosseini	University of Victoria
Wei-Yu	Hsu	Colorado State University
Yiran	Hu	University of Texas, Austin
Tianqiao	Hu	University of Texas
Syed	Husain	North Dakota State University
Min Jun	Jo	University of British Columbia
Uyen	Le	McMaster University
Quyuan	Lin	Texas A & M University
Kyle	Liss	University of Maryland
Xiao	Liu	Georgia Institute of Technology
Shi-Zhuo	Looi	University of Kentucky
Yuchen	Mao	University of California, Berkeley
Jeffrey	Marino	Johns Hopkins University
Michael	McNulty	University of California, Riverside
Ryan Chris	Moreno-Vasquez	University of California, Davis
Itamar	Oliveira	Cornell University
Ben	Pineau	University of California, Berkeley
Abba	Ramadan	University of Kansas
Calum	Rickard	University of Southern California
Eric	Roon	University of Arizona
James	Rowan	University of California, Berkeley
Elena	Salguero Quirós	University of Sevilla
Jingyang	Shu	Temple University
Daniel	Sinambela	University of Missouri
Gavin	Stewart	New York University, Courant Institute
Krutika	Tawri	Indiana University
Mitchell	Taylor	University of California, Berkeley
Lizhe	Wan	University of Wisconsin-Madison
Weinan	Wang	University of Southern California
Erik	Wendt	University of Connecticut
Ruoxuan	Yang	Massachusetts Institute of Technology

Students		
First Name	**Last Name**	**Institution**
Jincheng	Yang	University of Texas, Austin
Gael	Yomgne	Rheinische Friedrich-Wilhelms-Universität Bonn
Dongxiao	Yu	University of California, Berkeley
Jiaxin	Zhang	California Institute of Technology
Tianyu	Zhou	University of Toronto

Officially Registered Student Information

Participants		53

Gender		53
Male	69.81%	37
Female	26.42%	14
Declined to state	3.77%	2

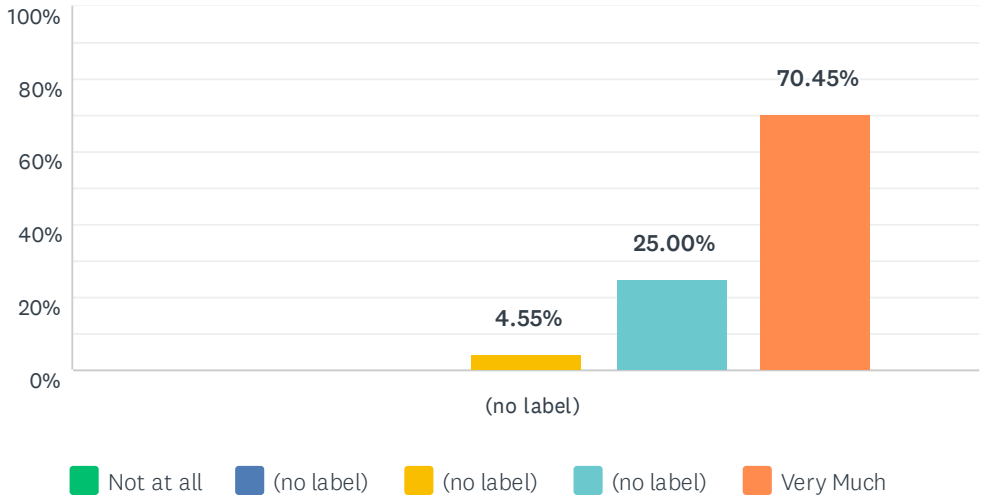
Ethnicity*		55
White	38.18%	21
Asian	47.27%	26
Hispanic	3.64%	2
Pacific Islander	1.82%	1
Black	3.64%	2
Native American	0.00%	0
Mixed	1.82%	1
Declined to state	3.64%	2

* ethnicity specifications are not exclusive

44 responses out of 53 participants = 83% response rate

Q1 The various topics within the summer school integrated into a coherent picture

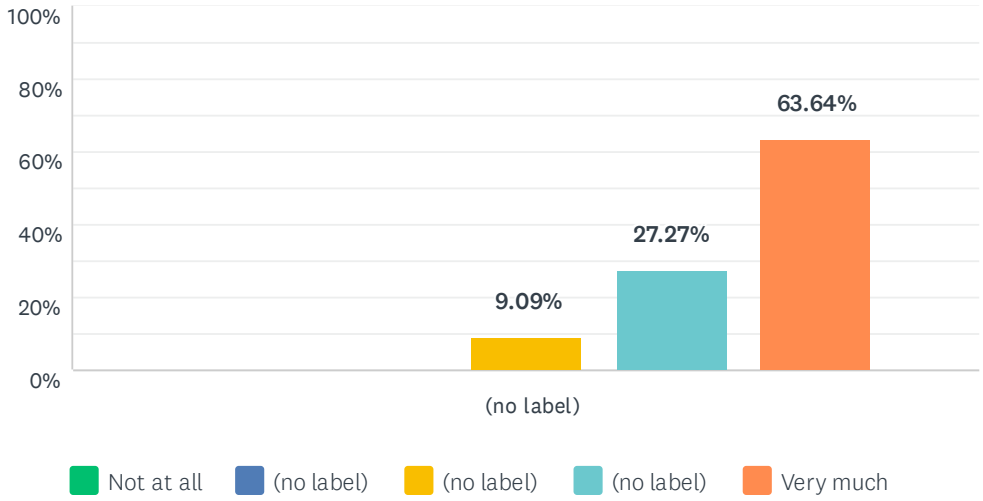
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY MUCH	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	4.55% 2	25.00% 11	70.45% 31	44	4.66

Q2 The speakers were generally clear and well organized in their presentation

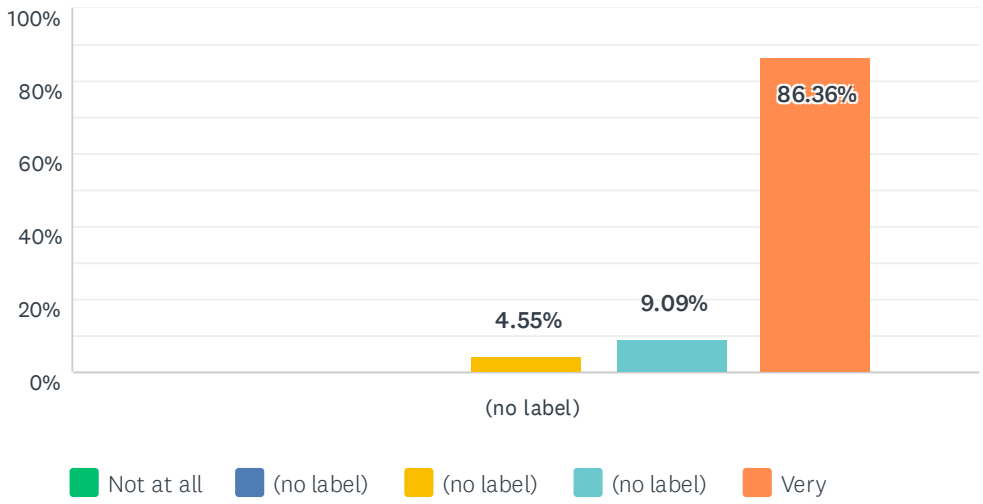
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY MUCH	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	9.09% 4	27.27% 12	63.64% 28	44	4.55

Q3 The school was intellectually stimulating

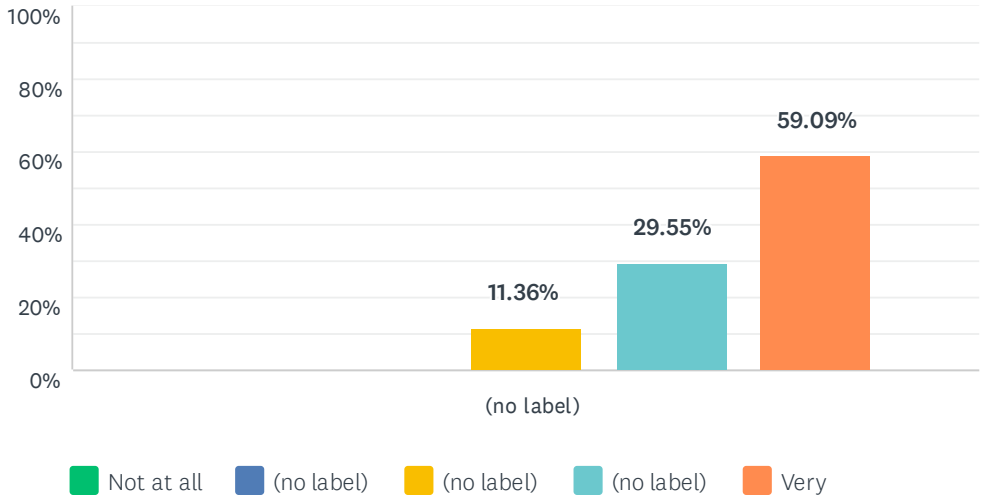
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	4.55% 2	9.09% 4	86.36% 38	44	4.82

Q4 My fellow students were appropriately selected to make the event interesting

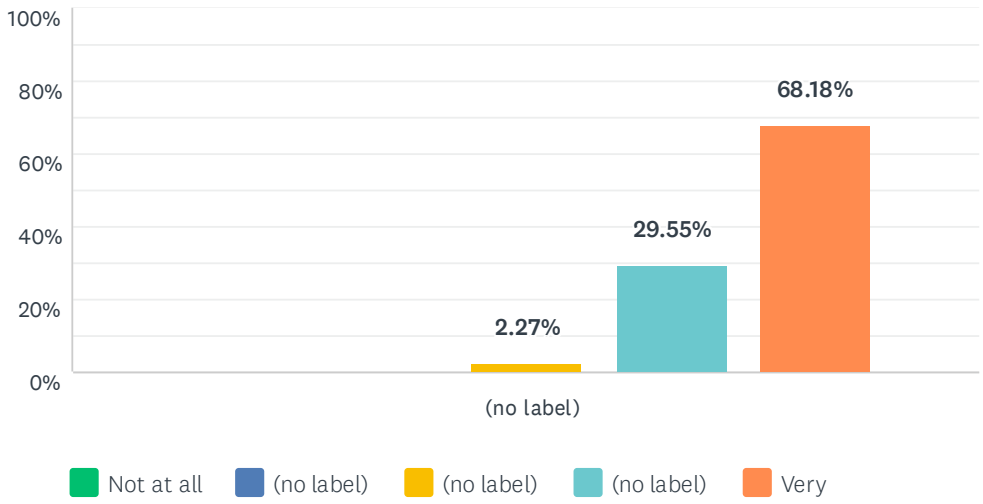
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	11.36% 5	29.55% 13	59.09% 26	44	4.48

Q5 The overall experience of the school was worthwhile

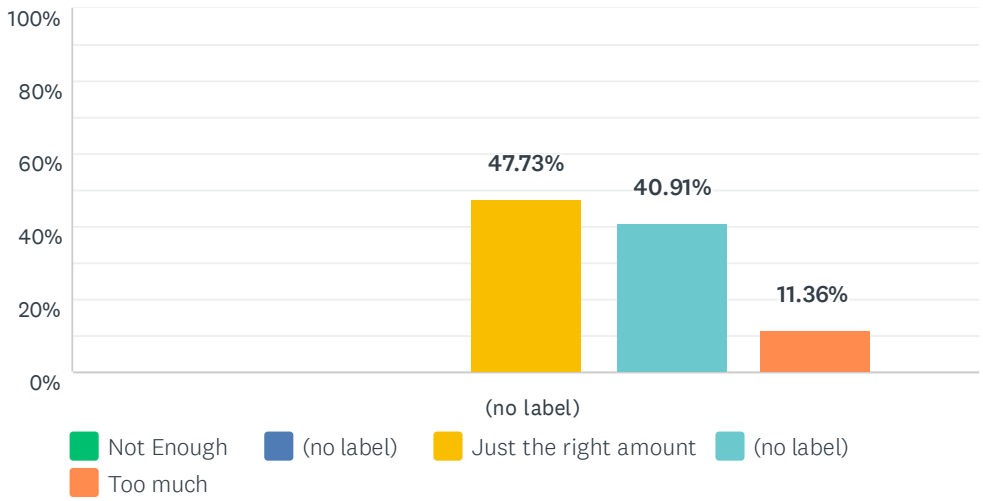
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	2.27% 1	29.55% 13	68.18% 30	44	4.66

Q6 The amount of material presented was:

Answered: 44 Skipped: 0



	NOT ENOUGH	(NO LABEL)	JUST THE RIGHT AMOUNT	(NO LABEL)	TOO MUCH	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	47.73% 21	40.91% 18	11.36% 5	44	3.64

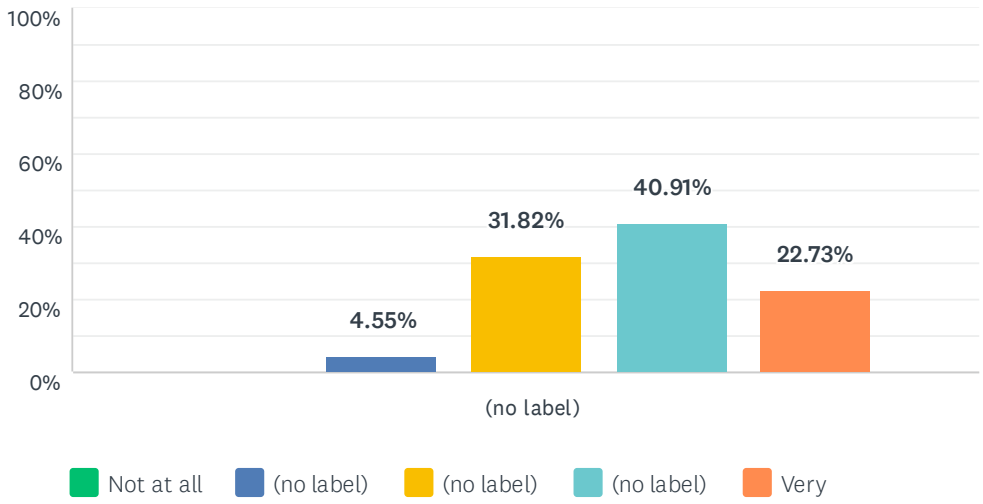
Q7 Additional comments on the topic presentation and organization

Answered: 5 Skipped: 39

#	RESPONSES	DATE
1	The teachers were always kind with us. I don't have any improvement suggestion.	8/12/2020 1:37 AM
2	It was beautifully organized	8/11/2020 1:24 PM
3	Daniel and Mihaela have done a great job in organizing this summer school. Their lectures were clear and covered a lot of important concepts and techniques in water wave. Their homework problems were interesting and enlightening. Both of them, including our TA Albert, are very helpful in the office hours or in the discussion sections. Thanks!	8/11/2020 11:22 AM
4	One thing is, because of the online format, the communication between group members were not very effective. Also there were people in my group who did research in this topic for years but others were new with the topic. People were not aware of the discrepancy between the experience in the topic. Sometimes, it was hard for people to follow what was discussed and they kept silent during discussion. It seemed TA was not aware of this either. I understand there were many groups waiting for TA but if TA could spend more time with us would be great. Also I have one suggestion. I think it would be more effective if everyday after group discussion, all the groups could gather together in one zoom lecture room, and TA could talk to the whole class about each homework problem. Since up to now, some homework problems are still not clear to me because everyday during group discussion, TA and the lecturer only stayed with my group for 5 minutes or so.	8/11/2020 10:19 AM
5	Miheala is Just the best	8/11/2020 10:00 AM

Q8 I was well prepared to benefit from the school

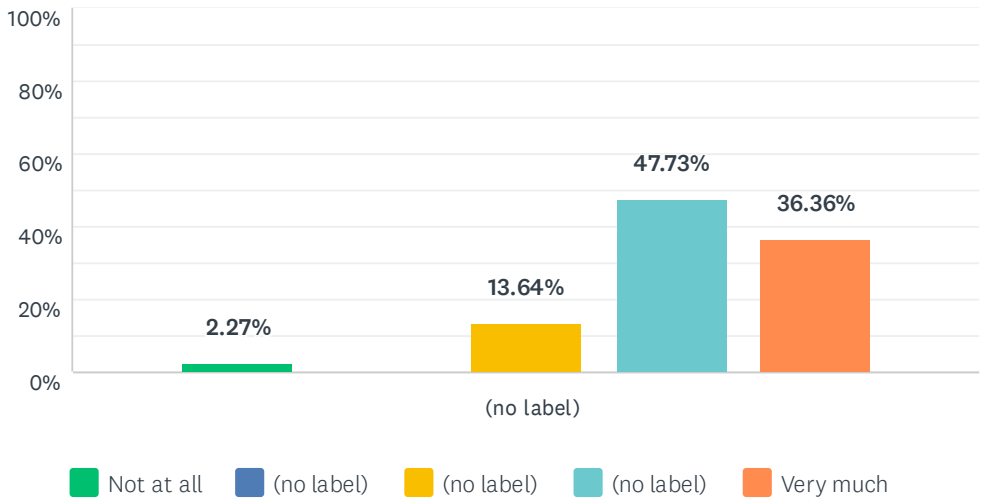
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	4.55% 2	31.82% 14	40.91% 18	22.73% 10	44	3.82

Q9 My interest in the subject matter was increased by the school

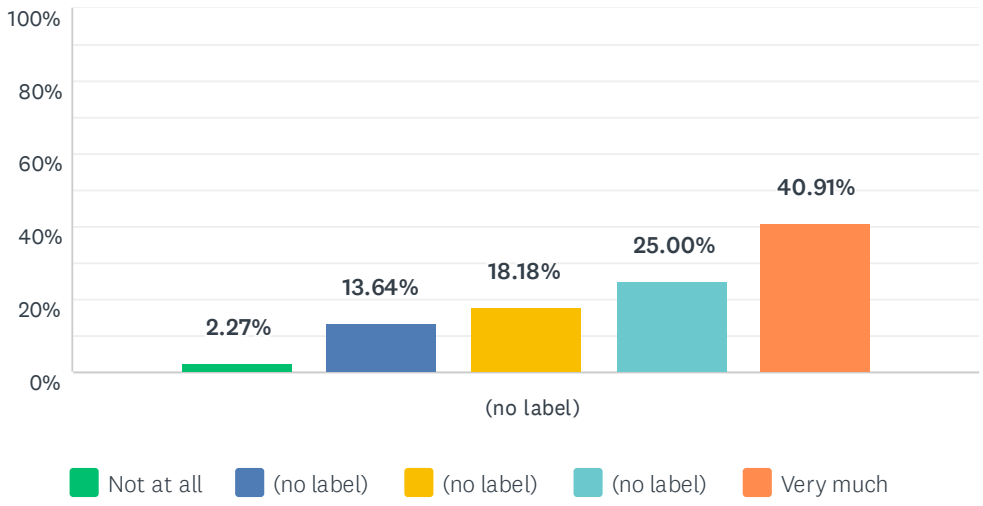
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY MUCH	TOTAL	WEIGHTED AVERAGE
(no label)	2.27% 1	0.00% 0	13.64% 6	47.73% 21	36.36% 16	44	4.16

Q10 The school helped me meet people with similar scientific interests

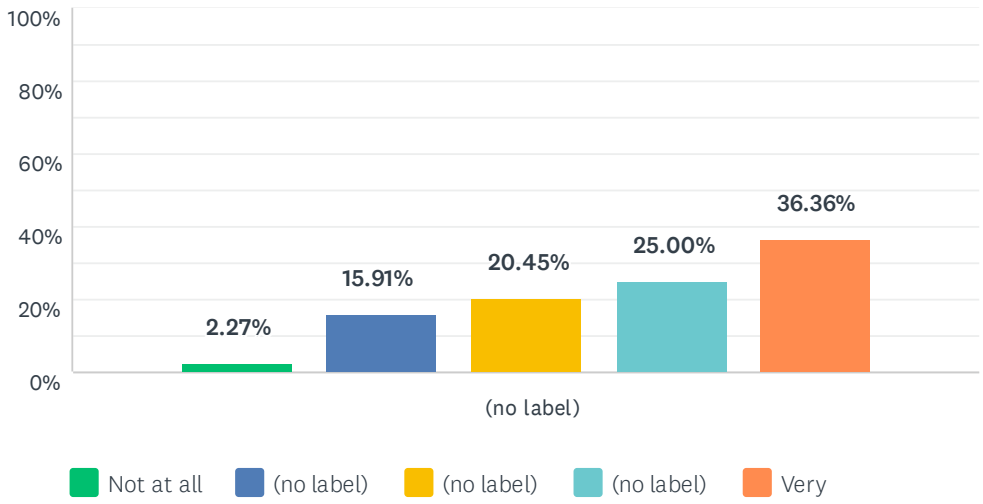
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY MUCH	TOTAL	WEIGHTED AVERAGE
(no label)	2.27% 1	13.64% 6	18.18% 8	25.00% 11	40.91% 18	44	3.89

Q11 It is likely that I will work in the area of the school subject in the future

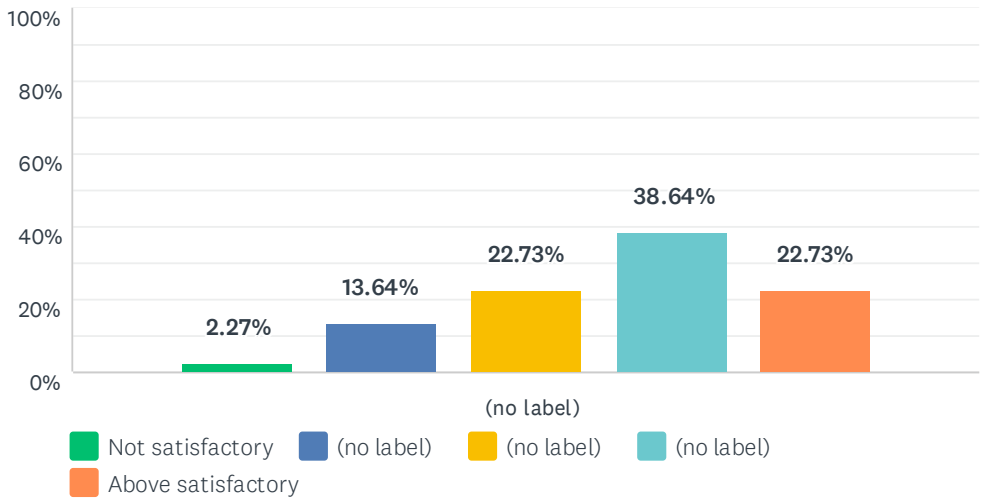
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	TOTAL	WEIGHTED AVERAGE
(no label)	2.27% 1	15.91% 7	20.45% 9	25.00% 11	36.36% 16	44	3.77

Q12 How would you evaluate your interaction with other participants?

Answered: 44 Skipped: 0



	NOT SATISFACTORY	(NO LABEL)	(NO LABEL)	(NO LABEL)	ABOVE SATISFACTORY	TOTAL	WEIGHTED AVERAGE
(no label)	2.27% 1	13.64% 6	22.73% 10	38.64% 17	22.73% 10	44	3.66

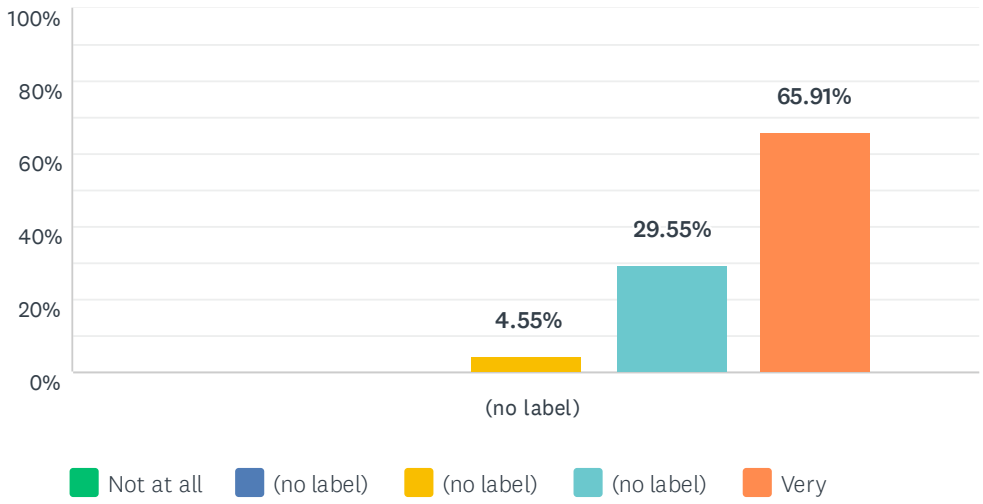
Q13 Additional comments on your personal assessment

Answered: 6 Skipped: 38

#	RESPONSES	DATE
1	The online aspect made this very difficult.	8/13/2020 10:40 AM
2	In an online summer school is more difficult to interact. Despite this, it has been done a very good job in this sense.	8/12/2020 1:56 AM
3	Personally, I feel that I could have been better prepared for the summer school. Unfortunately, I had a very heavy teaching load in addition to research which prevented me from preparing sufficiently. One of my groupmates, although a nice person, was very difficult to work with. On one day, I began typing up my work for one of the homework problems. I hadn't finished typing my solution before this student had deleted my work and replaced it with theirs. In hindsight, I should have spoken up but I was honestly too exhausted to do so. This was a bit discouraging but I did not let it stop me from learning something.	8/11/2020 3:06 PM
4	Loved the lectures. The group work was mixed, as clearly some people knew more than others, and some put in more effort than others. Can't really blame Mihaela and Daniel for this though.	8/11/2020 1:24 PM
5	This is probably a function of the school being remote, but I feel like I did not get good interaction with my fellow participants aside from a few mathematical discussions.	8/11/2020 11:44 AM
6	I enjoyed this summer school very much. Before this, I barely know anything about the topic. But I learned a lot through this summer school and am sure I will continue to benefit from it in my future study. Thank you very much for organizing this summer school!	8/11/2020 10:19 AM

Q14 I found the MSRI staff helpful

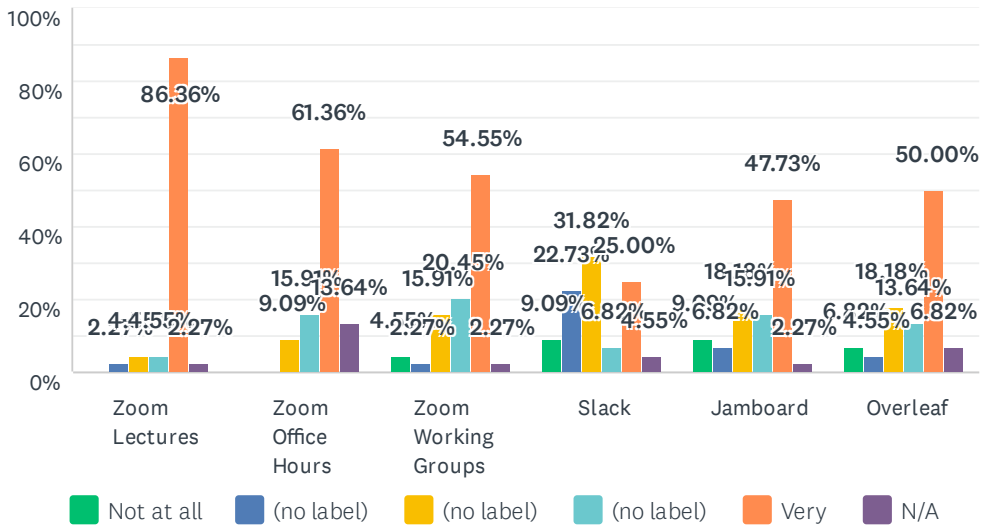
Answered: 44 Skipped: 0



	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	0.00% 0	4.55% 2	29.55% 13	65.91% 29	44	4.61

Q15 How helpful did you find each of these collaboration tools

Answered: 44 Skipped: 0

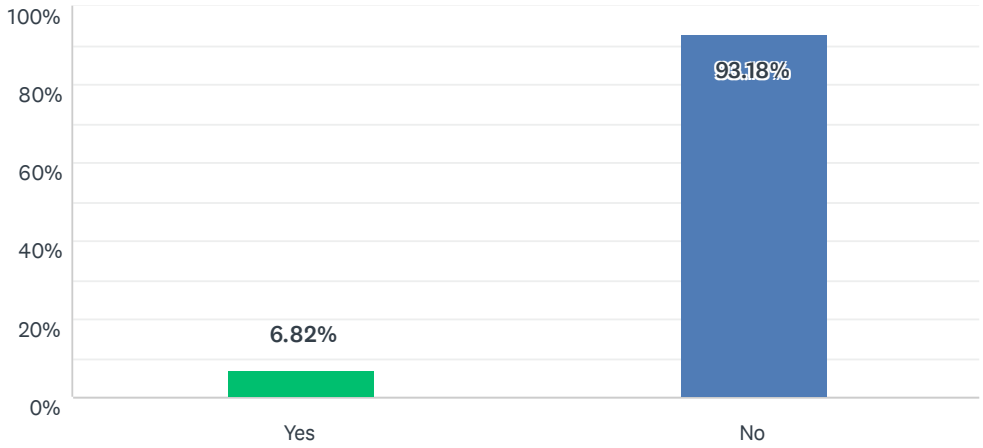


	NOT AT ALL	(NO LABEL)	(NO LABEL)	(NO LABEL)	VERY	N/A	TOTAL	WEIGHTED AVERAGE
Zoom Lectures	0.00% 0	2.27% 1	4.55% 2	4.55% 2	86.36% 38	2.27% 1	44	4.79
Zoom Office Hours	0.00% 0	0.00% 0	9.09% 4	15.91% 7	61.36% 27	13.64% 6	44	4.61
Zoom Working Groups	4.55% 2	2.27% 1	15.91% 7	20.45% 9	54.55% 24	2.27% 1	44	4.21
Slack	9.09% 4	22.73% 10	31.82% 14	6.82% 3	25.00% 11	4.55% 2	44	3.17
Jamboard	9.09% 4	6.82% 3	18.18% 8	15.91% 7	47.73% 21	2.27% 1	44	3.88
Overleaf	6.82% 3	4.55% 2	18.18% 8	13.64% 6	50.00% 22	6.82% 3	44	4.02

#	COMMENTS	DATE
1	All of them were necessary, and we didn't need any other tool.	8/12/2020 2:01 AM
2	Jamboard is less effective as a whiteboard than the Zoom shared whiteboard (it has much less resolution, at least for me)	8/11/2020 11:48 AM
3	I think the videos are very helpful. It would be better if the videos of guest speakers were provided.	8/11/2020 10:29 AM

Q16 Did you experience any technical difficulties accessing the online summer school?

Answered: 44 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	6.82%	3
No	93.18%	41
TOTAL		44

#	IF YES, PLEASE EXPLAIN	DATE
1	Operating zoom while trying to use Jamboard caused Jamboard to run extremely slowly virtually making it impossible to write anything.	8/11/2020 3:11 PM
2	I experienced internet disconnection.	8/11/2020 10:29 AM
3	Zoom links we're hard to find.	8/11/2020 9:50 AM

Q17 How did having the summer school held online impact your participation?

Answered: 44 Skipped: 0

#	RESPONSES	DATE
1	No	8/23/2020 7:39 PM
2	we can only meet with a small group of participants.	8/20/2020 10:14 AM
3	On one hand, no one could have participated in person, so in some sense it allowed my participation. It did make interactions feel less organic, however.	8/17/2020 4:51 PM
4	In a not strictly related to the online organization way, things have been more chaotic at my place and I could prepare less for the summer school. Strictly speaking about the online organization, I spent more time with people not related to the summer school (neighbors and so) than in other summer schools and because of this I was a little less focused/motivated.	8/16/2020 12:08 PM
5	The school was very well prepared to be held online. However, the interaction between participants in the group work hours had limitations which in my opinion are impossible to avoid in the online format.	8/16/2020 8:23 AM
6	I couldn't attend most of the second week due to a power outage from Isaias. Other than that, I interacted with people a bit less than I would have if it was in person.	8/15/2020 11:46 AM
7	I needed to adjust with the time differences.	8/14/2020 9:17 PM
8	I probably ended up having less active participation in homework problem discussions than I would have had in person.	8/14/2020 3:38 PM
9	1. The timezone difference forced me to miss a few sessions, but the recording of the sessions were useful 1. Communicating mathematical ideas to other participants (during group work, for example) was slower via software, compared to in-person discussions with pen and paper	8/14/2020 2:49 PM
10	Having the summer school held online didn't impact my participation in any way.	8/14/2020 2:37 PM
11	I found it difficult to connect with other students, and groupmates gave up on working together.	8/13/2020 10:41 AM
12	I live on the East Coast, so it was difficult to work all the way until 8pm on challenging mathematics.	8/12/2020 3:09 PM
13	It would have been great to participate in the summer school in person but online was just as good.	8/12/2020 8:58 AM
14	I thought that being online would have a more negative impact on my experience, but the organizers have done a good job.	8/12/2020 2:01 AM
15	Didn't meet any other students outside my working group.	8/11/2020 10:20 PM
16	Not very much.	8/11/2020 8:45 PM
17	Probably it is not because of the zoom, but it is the group meeting hours make me more engaging than I expected. In the future even if MSRI holds onsite summer school, I suggest to continue breaking people into groups.	8/11/2020 7:30 PM
18	not too much	8/11/2020 4:11 PM
19	I think it decreased my participation. However, I also appreciated that it was held online because I had other responsibilities (teaching a class), and I felt the online structure afforded me more flexibility.	8/11/2020 4:04 PM
20	I think it was structured well. It did not to negatively affect participation for me.	8/11/2020 3:44 PM
21	Work groups were not ideal over Zoom. For instance, an in-person work group could have involved all of the participants working out problems on a chalkboard. This has the effect of allowing us to see what the others are doing and ask questions easily. When working through Zoom, most of us worked out problems on paper which did not allow us to see each other's work.	8/11/2020 3:11 PM
22	It gave me larger flexibility regarding participation.	8/11/2020 2:53 PM
23	Not meeting enough people.	8/11/2020 1:51 PM
24	Surprisingly online summer school was even more convenient and efficient than I thought it would, I was fully engaged	8/11/2020 1:28 PM

25	Honestly, it was great. Mihaela and Daniel should be commended for taking the challenge of an online school and nailing it.	8/11/2020 1:28 PM
26	I was able to participate a fair amount, so I’m not sure.	8/11/2020 12:22 PM
27	Jamboard and zoom are great, but I find it not convenient to present math ideas and computations. It takes me more time to write on a tablet than on a piece of paper or on a real board.	8/11/2020 11:57 AM
28	My academic participation was not impacted, but I felt more isolated from my fellow students being online.	8/11/2020 11:48 AM
29	Efficiency decreased	8/11/2020 11:43 AM
30	Of course in person is better but I was still able to participate fully online.	8/11/2020 11:19 AM
31	It might have lessen the interaction among groups in discussing notes and homeworks. Nevertheless, it does not impact learning significantly.	8/11/2020 10:51 AM
32	It was a bit harder since información Germany the course was from 6pm until 2 am.	8/11/2020 10:45 AM
33	The group discussion was not very effective. When people got lost, they jus kept silent.	8/11/2020 10:29 AM
34	Discussion is hard but overall is not bad.	8/11/2020 10:19 AM
35	It didn’t impact me.	8/11/2020 10:08 AM
36	Not at all.	8/11/2020 10:06 AM
37	The learning experience is great, but it is too focused! I think on-site would have been better	8/11/2020 10:02 AM
38	Not able to interact face to face.	8/11/2020 9:59 AM
39	It was a bit harder to concentrate.	8/11/2020 9:55 AM
40	I am in different time zone, and I have to adapt the meeting schedule.	8/11/2020 9:53 AM
41	Would definitely pay more effort if in person. Also I am in Eastern time it’s slightly inconvenient	8/11/2020 9:52 AM
42	It made it significantly easier to participate.	8/11/2020 9:50 AM
43	It gave me too much workload. And it limited my connection with people.	8/11/2020 9:46 AM
44	Shipping iPad is great, but didn’t give Apple Pencil. The stylus pen is not good.	8/11/2020 9:46 AM

Q18 One important aspect that may have been missing due to the online format was interaction between participants. Do you have any suggestions on how we can improve this interaction if we hold future summer schools online?

Answered: 16 Skipped: 28

#	RESPONSES	DATE
1	Maybe during the breaks or after the classes there could be some "social" rooms that people could join just to meet other students attending the school. The purpose would be to talk about other stuff than only the topic of the summer school, also get to know each other or where each of us live. This should be voluntary and separated from the professors; but encouraged to attend via, for example, proposing some game or puzzle (at least the first days) that requires social collaboration of the students and whose final solution gives them hints or some internal joke about the school. I guess this should not take too much effort.	8/16/2020 12:08 PM
2	At a past summer school I attended some students gave short talks on their research. I think this would be good for connecting students at the school with overlapping interests.	8/14/2020 3:38 PM
3	1. Tea time with other participants and presenters, broken into randomized groups that change every day	8/14/2020 2:49 PM
4	Perhaps a social meet&greet on the first day of the school?	8/12/2020 3:09 PM
5	Maybe some group games could help, but they can also result forced.	8/12/2020 2:01 AM
6	While I enjoyed working with my working group and getting to know them, I think reassigning groups every day or every few days would be better for networking with other grads	8/11/2020 10:20 PM
7	I don't know if there is a way to improve the interaction. The group work didn't seem very clear all the time -- most of us wanted to try the problems on our own before asking for help instead of working together to try to solve them. I guess maybe extra encouragement to just say "It's okay to dive into the problems together." I wasn't very comfortable with my group because I never really felt like I could ask questions or say "Hey can we work through this problem?"	8/11/2020 4:04 PM
8	I believe an ice breaker could have helped build comradery. Having the opportunity to talk a bit about ourselves (which school we attend, what year we're in, research interests, other interesting things, etc.) could have helped us connect to each other more easily.	8/11/2020 3:11 PM
9	Rotation of group members	8/11/2020 1:51 PM
10	Not sure. In this setting we really only interact with our group members, but this seems unavoidable. I guess the office hours and social are a good chance to meet people, but then the groups are too big for my taste.	8/11/2020 1:28 PM
11	I hope that there are more chances for us to meet students from other groups. Regular social hour on zoom seems a good idea. In addition, there can be a channel on slack or on other platforms which is used only for chatting.	8/11/2020 11:57 AM
12	Large-group online social gatherings do not really work (since it's hard to have side discussions); breakout rooms or other non-homework-oriented small group times might be more effective.	8/11/2020 11:48 AM
13	Perhaps alternate the groups so you meet different participants and encourage introductions and so on.	8/11/2020 11:19 AM
14	One suggestion is maybe before the summer school starts, some social events can be held. There were one social Friday night after the school started. But then, we were overwhelmed with homework study and did not have time to attend. Another suggestion is, maybe besides the slack, some instant social media can be used. I feel instant communication was absent or hard during this summer school.	8/11/2020 10:29 AM
15	Invite people to the site on the last weekend of the summer school	8/11/2020 10:02 AM
16	Apple Pencil is really important. It’s really hard to use jamboard without it.	8/11/2020 9:46 AM

Q19 We welcome any additonal comments or suggestions you may have to improve the overall experience for future participants.

Answered: 0 Skipped: 44

#	RESPONSES	DATE
	There are no responses.	