Final Report
on the
Mathematical Sciences Research Institute
2016–17 Activities
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Support of Early Career Researchers at MSRI
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Mathematical Sciences Research Institute
NSA Final Report for H98230-16-1-0248

I.   INTRODUCTION

The main scientific activities of MSRI are its Programs and Workshops. MSRI hosts two to four semester-long programs each year. Each program has about forty mathematicians in residence at any given time, including seven to eight graduate students.

Generally, each semester-long program features three workshops. A program begins with a *Connections for Women Workshop*, which is designed to encourage the participation of women in the research activities of the program. If the area of mathematics is one that traditionally has a large number of women, then the workshop can be used to highlight and to showcase their individual work. However, if the number of women in the field is low, then the workshop is marketed to a wider female audience in an effort to stimulate interest in the area. In addition, another goal is to encourage new connections among the women early in the program as a catalyst for eventual collaborations. This workshop is then followed by an *Introductory Workshop*, the purpose of which is to introduce the subject to the broader mathematical community. Later during the program, there is a *Topical Workshop*, which is designed to explore some of the themes of the program in greater depth.

In addition to the scientific workshops that run parallel with the programs, MSRI hosts a Hot Topics workshop. These workshops are intended to explore emerging topics in mathematics. (See Section II.B for a brief summary)

MSRI also hosts and co-hosts Education & Outreach Workshops.   These workshops focus on improving the skills of K–12 math teachers. Their descriptions, as well as lists of speakers, talks and participants, can be found on the MSRI web site at http://www.msri.org/web/msri/education/for-k-12-educators.

Another essential activity at MSRI is its series of Summer Graduate Schools which target advanced graduate students in mathematics. During the summer of 2016, MSRI hosted four on-site and two off-site Summer Graduate Schools, with themes ranging from electronic structure theory topics to tropical curves. A complete description can be found at the URL http://www.msri.org/web/msri/scientific/workshops/summer-graduate-school.

Last but not least, each summer since 2007, MSRI has hosted a summer school (MSRI-UP) for undergraduate students with the aim of increasing the number of PhDs among members of under-represented groups. These summer schools are co-funded by the NSA and the NSF. The 2016 MSRI-UP, *Sandpile Groups*, was a successful and popular school, with 18 undergraduate participants. Since MSRI-UP is funded by an independent NSA grant, its report is filed separately. More information about MSRI-UP can be found on our website at http://www.msri.org/web/msri/education/for-undergraduates/msri-up.

II. OVERVIEW OF ACTIVITIES 2016–17

The year 2016–17 was an exciting one. In Fall 2016, we held a jumbo program: *Geometric Group Theory*, with lead organizer Mark Feighn (Rutgers). In Spring 2017, we held two programs: *Analytic Number Theory*, led by Terence Tao (UCLA), and *Harmonic Analysis*, led by Michael Christ (UC Berkeley) and Michael Lacey (Georgia Tech). MSRI also hosted a small Complementary Program for mathematicians whose interests were not closely related to the three programs. All programs are briefly summarized in Section II. A

There were 250 researchers who participated in these programs for a period of one month or longer. Of those members, there were 34 Postdoctoral Fellows, 50 Research Professors, 120 Research Members, and 46 Program Associates (Graduate Students).

The NSA grant H98230-16-1-0248 funded four Postdoctoral Fellows: Matthew Durham and Kevin Schreve participated in the fall jumbo program, *Geometric Group Theory*. Caroline Turnage-Butterbaugh and Simon Bortz participated in the spring programs, *Analytic Number Theory* and *Harmonic Analysis* respectively.

A. Major Programs and their Associated Workshops

In the list of organizers of each activity, an asterisk (*) denotes lead organizer(s).

Program 1: Geometric Group Theory
August 15, 2016 - December 16, 2016
*Organizers: Ian Agol (University of California, Berkeley), Mladen Bestvina (University of Utah), Cornelia Drutu (University of Oxford), *Mark Feighn (Rutgers University), Michah Sageev (Technion---Israel Institute of Technology), Karen Vogtmann (University of Warwick)*

The field of geometric group theory emerged from Gromov's insight that even mathematical objects such as groups, which are defined completely in algebraic terms, can be profitably viewed as geometric objects and studied with geometric techniques Contemporary geometric group theory has broadened its scope considerably, but retains this basic philosophy of reformulating in geometric terms problems from diverse areas of mathematics and then solving them with a variety of tools. The growing list of areas where this general approach has been successful includes low-dimensional topology, the theory of manifolds, algebraic topology, complex dynamics, combinatorial group theory, algebra, logic, the study of various classical families of groups, Riemannian geometry and representation theory.

The goals of this MSRI program are to bring together people from the various branches of the field in order to consolidate recent progress, chart new directions, and train the next generation of geometric group theorists.

Workshops associated with the *Geometric Group Theory* program:

Workshop 1: Connections for Women: Geometric Group Theory
August 17, 2016 - August 19, 2016
*Organizers: *Ruth Charney (Brandeis University), Indira Chatterji (Université Nice Sophia-Antipolis), Mark Feighn (Rutgers University), Talia Fernós (University of North Carolina)*

This three-day workshop featured talks by six prominent female mathematicians on a wide range of topics in geometric group theory. Each speaker gave two lectures, separated by a break-out session during which participants met in small groups to discuss ideas presented in the first lecture. The workshop was open to all mathematicians.

Workshop 2: Introductory Workshop: Geometric Group Theory
August 22, 2016 - August 26, 2016
*Organizers: Martin Bridson (University of Oxford), Benson Farb (University of Chicago), *Zlil Sela (Hebrew University), Karen Vogtmann (University of Warwick)*

This was an introductory workshop to the MSRI jumbo program Geometric Group Theory held during the Fall Semester of 2016. The purpose of the workshop was to provide an overview of key areas of research to be covered in the program, including an introduction to open problems of current interest.

Workshop 3: Groups acting on CAT(0) spaces
September 27, 2016 - September 30, 2016
*Organizers: Ian Agol (University of California, Berkeley), Pierre-Emmanuel Caprace (Université Catholique de Louvain), Koji Fujiwara (Kyoto University), Alessandra Iozzi (ETH Zürich), * Michah Sageev (Technion---Israel Institute of Technology)*

The theme of the workshop was algebraic, geometric and analytical aspects of groups that act by isometries on spaces of non-positive curvature known as CAT(0) spaces. The world of CAT(0) spaces includes classical spaces such as symmetric spaces and buildings, as well as more avant-garde arrivals, such as CAT(0) cube complex. The workshop brought together researchers studying various aspects of such groups and spaces to discuss recent developments and chart new directions in the field.

Workshop 4: Geometry of mapping class groups and Out (Fn)
October 25, 2016 - October 28, 2016
*Organizers: Yael Algom-Kfir (University of Haifa), *Mladen Bestvina (University of Utah), Richard Canary (University of Michigan), Gilbert Levitt (Université de Caen)*

A four-day workshop with research-level talks on the latest advances in the geometry of mapping class groups and Out(F_n), and spaces on which they act.

Workshop 5: Amenability, coarse embeddability and fixed point properties
December 06, 2016 - December 09, 2016
*Organizers: Goulnara Arzhantseva (University of Vienna), *Cornelia Drutu (University of Oxford), Graham Niblo (University of Southampton), Piotr Nowak (Polish Academy of Sciences)*

The main theme of the workshop is the spectrum of analytic properties running from Kazhdan's property (T) at one end to von Neumann's amenability at the other, that forms a foundational organizing structure for infinite groups and spaces. These properties can be described both analytically, via unitary representation theory, and geometrically, using embedding properties for discrete spaces. Connections with probability and combinatorics was addressed during the meeting.

Program 2: Analytic Number Theory
January 17, 2017 - May 26, 2017
*Organizers: Chantal David (Concordia University), Andrew Granville (Université de Montréal), Emmanuel Kowalski (ETH Zuerich), Philippe Michel (École Polytechnique Fédérale de Lausanne (EPFL)), Kannan Soundararajan (Stanford University), *Terence Tao (University of California, Los Angeles*

Analytic number theory, and its applications and interactions, are currently experiencing intensive progress, in sometimes unexpected directions. In recent years, many important classical questions have seen spectacular advances based on new techniques; conversely, methods developed in analytic number theory have led to the solution of striking problems in other fields.

Recent advances in analytic number theory have had repercussions in various mathematical subjects, such as harmonic analysis (including the Langlands programme), ergodic theory and dynamics (especially on homogenous spaces), additive and multiplicative combinatorics and theoretical computer science (in particular, through the theory of expander graphs).

The MSRI semester program in Spring 2017 focused on the topic of Analytic Number Theory, with workshops and other activities focused on the most impressive recent achievements in this field. We wish not only to give the leading researchers in the area further opportunities to work together, but more

importantly to give young people the occasion to learn about these topics, and to give them the tools to achieve the next breakthroughs.

Workshops associated with the *Analytic Number Theory* program:

Workshop 1: Connections for Women: Analytic Number Theory
February 02, 2017 - February 03, 2017
Chantal David (Concordia University), Kaisa Matomäki (University of Turku), Lillian Pierce (Duke University), Kannan Soundararajan (Stanford University), Terence Tao (University of California, Los Angeles)

This workshop consisted of lectures on the current state of research in analytic number theory, given by prominent women and men in the field. The workshop was opened to all graduate students, post-docs, and researchers in areas related to the program; it also included a panel discussion session among female researchers on career issues, as well as other social events.

Workshop 2: Introductory Workshop: Analytic Number Theory
February 06, 2017 - February 10, 2017
*Andrew Granville (Université de Montréal), *Emmanuel Kowalski (ETH Zuerich), Kaisa Matomäki (University of Turku), Philippe Michel (École Polytechnique Fédérale de Lausanne (EPFL))*

There were three minicourses, each three hours long: (1) K. Matomäki and M. Radziwill on multiplicative functions (2) Ph. Michel on trace functions and their applications (3) I. Petrow on Kuznetsov formula, Kloostermania and applications All other talks were one-hour long and targeted to a wide audience. In particular, speakers attempted to give lectures that are also accessible to the participants of the Harmonic Analysis Program.

Workshop 3: Recent developments in Analytic Number Theory
May 01, 2017 - May 05, 2017
*Tim Browning (University of Bristol), Chantal David (Concordia University), Kannan Soundararajan (Stanford University), *Terence Tao (University of California, Los Angeles)*

This workshop focused on presenting the latest developments in analytic number theory, including (but not restricted to) recent advances in sieve theory, multiplicative number theory, exponential sums, arithmetic statistics, estimates on automorphic forms, and the Hardy-Littlewood circle method.

Program 3: Harmonic Analysis
January 17, 2017 to May 26, 2017
*Michael Christ (University of California, Berkeley), Allan Greenleaf (University of Rochester), Steven Hofmann (University of Missouri), *Michael Lacey (Georgia Institute of Technology), Svitlana Mayboroda (University of Minnesota, Twin*

Cities), Betsy Stovall (University of Wisconsin-Madison), Brian Street (University of Wisconsin-Madison)

The field of Harmonic Analysis dates back to the 19th century, and has its roots in the study of the decomposition of functions using Fourier series and the Fourier transform. In recent decades, the subject has undergone a rapid diversification and expansion, though the decomposition of functions and operators into simpler parts remains a central tool and theme.

This program brought together researchers representing the breadth of modern Harmonic Analysis and seek to capitalize on and continue recent progress in four major directions:

-Restriction, Kakeya, and Geometric Incidence Problems

-Analysis on Nonhomogeneous Spaces

-Weighted Norm Inequalities

-Quantitative Rectifiability and Elliptic PDE

Many of these areas draw techniques from or have applications to other fields of mathematics, such as analytic number theory, partial differential equations, combinatorics, and geometric measure theory.

Workshop 1: Connections for Women: Harmonic Analysis
January 19, 2017 - January 20, 2017
*Svitlana Mayboroda (University of Minnesota, Twin Cities), *Betsy Stovall (University of Wisconsin-Madison)*

This workshop highlighted the work of several prominent women working in harmonic analysis, including some of the field's rising stars. There was a panel discussion and a contributed poster session. This workshop was open to all, and poster contributions were welcomed from all mathematicians.

Workshop 2: Introductory Workshop: Harmonic Analysis
January 23, 2017 - January 27, 2017
*Allan Greenleaf (University of Rochester), *Michael Lacey (Georgia Institute of Technology), Svitlana Mayboroda (University of Minnesota, Twin Cities), Betsy Stovall (University of Wisconsin-Madison), Brian Street (University of Wisconsin-Madison)*

This week-long workshop served as an introduction for graduate students, postdocs, and other researchers to the main themes of the program. It featured accessible talks by a number of leading harmonic analysts, including several

short courses on the core ideas and techniques in the field. There was a problem session, to which all participants were encouraged to contribute.

Workshop 3: Recent Developments in Harmonic Analysis
May 15, 2017 - May 19, 2017
*Michael Christ (University of California, Berkeley), Steven Hofmann (University of Missouri), *Michael Lacey (Georgia Institute of Technology), Betsy Stovall (University of Wisconsin-Madison), Brian Street (University of Wisconsin-Madison)*

Topics for this workshop was drawn from the main research directions of this conference, including:
(1) Restriction, Kakeya, and geometric incidence problems
(2) Analysis on nonhomogenous spaces
(3) Weighted estimates
(4) Quantitative rectifiability and other topics in PDE

Program 4: Complementary Program (2016-17)
The Complementary Program had a limited number of memberships that were open to mathematicians whose interests were not closely related to the core programs; special consideration was given to mathematicians who were partners of an invited member of a core program.

B. Hot Topics Workshop

Hot Topics: Galois Theory of Periods and Applications
March 27, 2017 - March 31, 2017
*Organizers: *Francis Brown (University of Oxford), Clément Dupont (Université de Montpellier), Richard Hain (Duke University), Vadim Vologodsky (University of Oregon)*

Periods are integrals of algebraic differential forms over algebraically-defined domains and are ubiquitous in mathematics and physics. A deep idea, originating with Grothendieck, is that there should be a Galois theory of periods. This general principle provides a unifying approach to several problems in the theory of motives, quantum groups and geometric group theory. This conference brought together leading experts around this subject and cover topics such as the theory of multiple zeta values, modular forms, and motivic fundamental groups.

III.   PARTICIPATION SUMMARY

A. All MSRI Members

The table below indicates the number of participants for the major programs and workshops that took place at MSRI during the 2016–17 academic year.

Time	Activity Type	Activity Title	No. of participants
Fall 2016	Scientific Program	Geometric Group Theory	107
August 17, 2016 - August 19, 2016	Programmatic Workshop	Connections for Women: Geometric Group Theory	92
August 22, 2016 - August 26, 2016	Programmatic Workshop	Introductory Workshop: Geometric Group Theory	148
September 27, 2016 – September 30, 2016	Programmatic Workshop	Groups acting on CAT(0) spaces	140
October 25, 2016 – October 28, 2016	Programmatic Workshop	Geometry of mapping class groups and Out(Fn)	145
December 06, 2016 – December 09, 2016	Programmatic Workshop	Amenability, coarse embeddability and fixed point properties	95
Spring 2017	Scientific Program	Analytic Number Theory	57
February 02, 2017 – February 03, 2017	Programmatic Workshop	Connections for Women: Analytic Number Theory	70
February 06, 2017 – February 10, 2017	Programmatic Workshop	Introductory Workshop: Analytic Number Theory	138
May 01, 2017 – May 05, 2017	Programmatic Workshop	Recent developments in Analytic Number Theory	138
Spring 2017	Scientific Program	Harmonic Analysis	73
January 19, 2017 - January 20, 2017	Programmatic Workshop	Connections for Women: Harmonic Analysis	65
January 23, 2017 – January 27, 2017	Programmatic Workshop	Introductory Workshop: Harmonic Analysis	124
May 15, 2017 – May 19, 2017	Programmatic Workshop	Recent Developments in Harmonic Analysis	106
Academic Year 2016-17	Scientific Program	Complementary Program 2016-17	13
June 11, 2016 – July 24, 2016	MSRI-UP 2016	Sandpile Groups	18
May 30, 2016 - June 11, 2016	Summer Graduate School (2016)	Séminaire de Mathématiques Supérieures 2016: Dynamics of Biological Systems	25
June 13, 2016 - July 24, 2016	Summer Graduate School (2016)	Harmonic Analysis and Elliptic Equations on real Euclidean Spaces and on Rough Sets	51
June 20, 2016 – July 01, 2016	Summer Graduate School (2016)	Mixed Integer Nonlinear Programming: Theory, algorithms and applications	11
July 11, 2016 - July 22, 2016	Summer Graduate School (2016)	An Introduction to Character Theory and the McKay Conjecture	41
July 18, 2016 - July 29, 2016	Summer Graduate School (2016)	Electronic Structure Theory	39

July 25, 2016 - August 05, 2016	Summer Graduate School (2016)	Chip Firing and Tropical Curves	50
March 27, 2017 – March 31, 2017	Other Scientific Workshop	Hot Topics: Galois Theory of Periods and Applications	75

B. NSA supported Postdoctoral Fellows

There were 34 postdoctoral fellows who participated in the 2016–17 programs. The NSA grant, H98230-16-1-0248, funded four out of the 34 postdoctoral fellows.

Matthew Durham participated in the fall 2016 program, *Geometric Group Theory.*

Durham, Matthew

Name: Matthew Durham
Year of Ph.D: 2014
Institution of Ph.D.: University of Illinois at Chicago
Dissertation title: The Coarse Geometry of Teichmuller Space
Ph.D. advisor: Daniel Groves

Mentor while at MSRI: Kenneth Bromberg

Institution prior to obtaining the MSRI PD fellowship: University of Michigan
Position at that institution: Assistant Professor
Mentor (if applicable): Dick Canary

Institution (or company) where you are going after the MSRI PD
fellowship: University of Michigan
Position at that institution: RTG postdoctoral fellow

Postdoctoral fellow comments:

My semester at MSRI has been one of the most rewarding mathematical experiences of my life.
Nearly every important person in geometric group theory is either in residence or has visited MSRI at some point during the semester. This has provided for a wonderful opportunity to begin new collaborations and work through difficult problems. Specifically toward the former, I have begun three collaborative projects since I arrived at MSRI, with one hopefully finishing by the end of the semester. The concentration of talent at MSRI has also gathered several of my other collaborators here at various points, and I have been able to finish two other projects during my time here.
Along with the people at MSRI, I love the working environment here. The quiet hum of mathematical chatter and being surrounded by people working hard in their offices has been beneficial to my productivity, helping me make significant progress on a major problem I have been working on for nearly three years now. Moreover, I have had many productive mathematical conversations with people with whom I would normally have a chance to interact simply because they are here. My best days at MSRI have been spent meeting with one group of colleagues after another, going home exhausted and satisfied.

It cannot go without saying that the location is fantastic. Not only is the view spectacular, but I have made regular use of the hiking trails nearby, which are great for clearing my head, refreshing my spirit, and regaining focus after a long work session or lunch.

Finally, I was applying for jobs this semester. While this was a necessary and often frustrating use of my time, the senior members were especially supportive, and having my fellow postdocs (who were also on the job market) to commiserate with made the process less painful.

Kevin Schreve participated in the fall 2016 program, *Geometric Group Theory*

Schreve, Kevin

Name: Kevin Schreve
Year of Ph.D: 2015
Institution of Ph.D.: University of Wisconsin-Milwaukee
Dissertation title: The L^2-Cohomology of Discrete Groups
Ph.D. advisor: Boris Okun

Mentor while at MSRI: Alessandra Iozzi

Institution prior to obtaining the MSRI PD fellowship: University of Michigan-Ann Arbor
Position at that institution: Visiting RTG Postdoc
Mentor (if applicable): Ralf Spatzier

Institution (or company) where you are going after the MSRI PD fellowship:
University of Michigan-Ann Arbor
Position: Visiting RTG Postdoc
Anticipated length: May 2018
Mentor: Ralf Spatzier

Postdoctoral fellow's comments:

My main project was with Michael Davis and Giang Le, where we extended work that I had done with Davis, Grigori Avramidi and Boris Okun. With Michael and Giang, we studied the minimal dimension of contractible manifold that a graph product can act properly discontinusouly on. I also started a project with Robert Kropholler on computing the invariants due to Bieri-Geoghegan for right angled Artin groups.

Was your experience at MSRI beneficial?

It was very beneficial to my research. The member and postdoc seminars gave me a much broader view of geometric group theory. My mentor was very helpful in helping me with both my research and professional activities such as preparing document for job applications and NSF postdoc.

Caroline Turnage-Butterbaugh participated in the spring 2017 program, *Analytic Number Theory*

Turnage-Butterbaugh, Caroline

Name: Caroline Turnage-Butterbaugh
Year of Ph.D.: 2014
Institution of Ph.D.: University of Mississippi
Dissertation title: Moments of products of L-functions
Ph.D. advisor: Micah B. Milinovich

Mentor while at MSRI: Dan Goldston
Institution prior to obtaining the MSRI PD fellowship: Duke University
Position at that institution: Elliott Assistant Research Professor
Mentor (if applicable): Lillian B. Pierce

Institution (or company) where you are going after the MSRI PD fellowship: Duke University
Position: Elliott Assistant Research Professor (postdoctoral position)
Anticipated length (if it is a tenure track position just write tenure-track): 1 year (completing a 3 year appointment)
Mentor (if applicable): Lillian B. Pierce

Postdoctoral fellow's comments:
During my time at MSRI, I focused on finishing a manuscript with Lillian Pierce and Melanie Wood on bounding l-torsion in class groups. I collaborated on a new project concerning the zeros of the zeta function with Dan Goldston, my MSRI postdoctoral mentor. We are still working on this project. I was able to visit (and be visited by) Brian Conrey from AIM to collaborate on a project concerning zeros of the zeta-function. We are now writing up these results. During the Introductory Workshop I spoke with Arindam Roy, who was attending the conference, on a new collaboration. I was subsequently invited to his department at Rice University to give a seminar talk and continue our discussions. During the Recent Developments Workshop I spoke with Winston Heap, who was attending the conference, on another new collaboration.

Was your experience at MSRI beneficial? Why or why not?
My experience at MSRI has been immensely beneficial. My pairing with Dan Goldston as a mentor has been incredibly valuable; we are working on a project together and have had long discussions on connections of our work to deep questions in analytic number theory. I have been able to speak in front of some of the most accomplished number theorists of our time, and then have one-on-one conversations with some of them. This experience of sharing my ideas and being heard has pushed me to apply to positions at research universities next fall. (Prior to my time at MSRI I was primarily considering positions at liberal arts colleges.)

Do you believe it had helped you find a position?
I have one more year at my postdoctoral position at Duke University, so we will see if the position at MSRI will help me find a position when I am on the job market this coming fall.

After submitting that paper to Classical and Quantum Gravity, I split the remainder of my time at MSRI between two projects. The first was an independent effort to analyze the sign of the energy density associated to the Alcubierre metric in the conformal gravity model. I have made progress, thanks in large part to the access to Mathematica which MSRI granted me. Though this project is still ongoing, I expect this work to result in a published paper in the near future.

The other project is a joint work with both my MSRI mentor, Robert Kusner, and my Ph.D. advisor, Rafe Mazzeo. Early in the semester, my advisor proposed the following question to me: Is the cylinder the only conformally flat Riemannian manifold with constant positive scalar curvature and a finite number of asymptotically cylindrical ends? There is an analogue to this question in the mean curvature setting as well. We currently believe that we can construct a counterexample which suggests that the answer to this question is "no", though there are still gaps in the proof which we believe we can fix. If we are successful, this project will also certainly result in a published paper.

Simon Bortz participated in the spring 2017 program, *Harmonic Analysis*

Bortz, Simon

Name: Simon Bortz
Year of Ph.D.: 2016
Institution of Ph.D.: University of Missouri
Dissertation title: Harmonic Measure and Rectifiability
Ph.D. advisor: Steve Hofmann

Mentor while at MSRI: Guy David
Institution prior to obtaining the MSRI PD fellowship: University of Minnesota
Position at that institution: Postdoc
Mentor (if applicable): Svitlana Mayboroda

Institution (or company) where you are going after the MSRI PD fellowship: University of Minnesota
Position: Postdoc
Anticipated length: (if it is a tenure track position just write tenure-track): 1-2 more years
Mentor (if applicable): Svitlana Mayboroda

Postdoctoral fellow's comments:

My experience at MSRI was great. I am not sure whether it was exceptional but I believe to have done enough work for five or more future publications. I am sure that nearly completing five projects at MSRI will help me find a position after my postdoc. I thought that perhaps the most important thing about this visit was being able to work with mathematicians at all stages of their careers. The mentorship given by the senior mathematicians opened many avenues for future work and working with younger mathematicians was important to what I hope will be lifelong collaborations. All of the projects I did while at MSRI were different from my previous work and I am not sure that would be possible without the collaborative environment.

VI.   PUBLICATIONS SUMMARY

The four NSA funded postdoctoral fellows worked on a total of nine papers during their stay at MSRI.

Member Name	Paper Titles	Co-author(s)	Paper Status
Simon Bortz	Self-improvement for reverse Halder inequality with tails	Pascal Auscher, Moritz Egert, Olli Saari	Rough/Draft
Matthew Durham	Middle Recurrence and pulling back subgroup stability	Tarik Aougab, Samuel Taylor	Submitted
Matthew Durham	Graphs of curves of infinite type surfaces with mapping class group actions	Federica Fanoni, Nicholas Vlamis	Submitted
Matthew Durham	The mapping class group and Teichmuller space are semihyperbolic	Daniel Groves	Rough/Draft
Matthew Durham	Subgroup stability and universal acylindrical actions in hierarchically hyperbolic groups	Carolyn Abbott, Jason Behrstock	Rough/Draft
Matthew Durham	Geometric finiteness in the mapping class group	Leininger, S. Dowdal, A. Sisto	Working notes
Kevin Schreve	Determining the action dimension	Michael Davis, Giang Le	Rough/Draft
Caroline Turnage-Butterbaugh	A new effective Chebotarev density theorem for families of fields, and applications to class numbers	Lillian Pierce, Melanie Wood	Rough/Draft
Caroline Turnage-Butterbaugh	A weighted pair correlation method with applications to the zeros of the Riemann zeta-function	D.A. Goldston	Rough/Draft