MSRI
Mathematical Sciences Research Institute

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Final Report on the Mathematical Sciences Research Institute 2018-19 Activities supported by NSA Grant H98230-18-1-0188 Support of Early Career Researchers at MSRI 5/24/2018 - 5/23/2019

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Mathematical Sciences Research Institute
NSA Final Report for H98230-18-1-0188

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 2018, MSRI hosted four on-site and four off-site Summer Graduate Schools, with themes ranging from derived geometry to representations of high dimensional data. A complete description can be found at:
http://www.msri.org/web/msri/scientific/workshops/summer-graduate-school.

Each summer since 2007, MSRI has hosted a summer research experience (MSRI-UP) for undergraduate students with the aim of increasing the number of Ph.D.'s among members of under-represented groups. These summer schools are co-funded by the NSA and the NSF. The 2018 MSRI-UP, *Mathematics of Data Science,* was a successful and popular school, with 18 undergraduate participants. Since MSRI-UP is funded by an independent NSA grant, its report will be filed separately. More information about MSRI-UP can be found at http://www.msri.org/web/msri/education/for-undergraduates/msri-up.

The MSRI project, *Summer Research for Women in Mathematics* (SWiM), is part of MSRI's overall activities aimed at strengthening the mathematical sciences by facilitating research and professional activities leading to or enhancing successful, productive careers. The SWiM project provides space and funds for groups of 2-6 women researchers to work on a research project for 2-3 weeks at MSRI during the summer. These are research projects that have already been started, perhaps at a conference such as *Women in …* or could be freestanding activities. Originally started in the summer of 2017, the 2018 SWiM program received applications from 22 groups (totaling 88 women) and was able to accept 20 women forming 6 groups ranging in size from 2 to 5. More information concerning SWiM can be found at
http://www.msri.org/web/msri/scientific/summer-research-for-women-in-mathematics

II. OVERVIEW OF ACTIVITIES 2018-19

The year 2018-19 was an exciting one. In fall 2018, we held a jumbo program: *Hamiltonian Systems, From Topology to Applications through Analysis,* with lead organizer Albert Fathi (Georgia Institute of Technology). In spring 2019, we held two programs, *Derived Algebraic Geometry*, led by Bhargav Bhatt (University of Michigan), and *Birational Geometry and Moduli Spaces*, led by Christopher Hacon (University of Utah). 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.

There were 260 researchers who participated in these programs. Of those members, there were 32 Postdoctoral Fellows, 63 Organizers & Research Professors, 129 Research Members, and 36 Program Associates (Graduate Students).

The NSA grant H98230-18-1-0188 funded three Postdoctoral Fellows: Connor Jackman who participated in the fall jumbo program, *Hamiltonian Systems: From Topology to Applications Through Analysis* and Laure Flapan and Paul VanKoughnett who participated in the spring programs, *Birational Geometry and Moduli Spaces and Derived Algebraic Geometry* respectively.

A. Major Programs and their Associated Workshops

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

Program 1: Hamiltonian Systems, From Topology to Applications Through Analysis (HST)
August 13, 2018 - December 14, 2018
*Organizers: Rafael de la Llave (Georgia Institute of Technology), *Albert Fathi (Georgia Institute of Technology; École Normale Supérieure de Lyon), Vadim kalsomine (University of Maryland), Robert Littlejohn (University of California, Berkeley), Philip Morrison(University of Texas, Austin), Tere Seara (Polytechnical University of Cataluña (Barcelona)), Sergei Tabachnikov (Pennsylvania State University), Amie Wilkinson (University of Chicago)*

The interdisciplinary nature of Hamiltonian systems is deeply ingrained in its history. This program brought together the communities of mathematicians with the community of practitioners, mainly engineers, physicists, and theoretical chemists who use Hamiltonian systems daily. The program covered not only the mathematical aspects of Hamiltonian systems but also their applications, mainly in space mechanics, physics and chemistry.
The mathematical aspects comprise celestial mechanics, variational methods, relations with PDE, Arnold diffusion and computation. The applications concern celestial mechanics, astrodynamics, motion of satellites, plasma physics, accelerator physics, theoretical chemistry, and atomic physics.

The goal of the program was to bring to the forefront both the theoretical aspects and the applications, by making available for applications the latest theoretical developments, and also by nurturing the theoretical mathematical aspects with new problems that come from concrete problems of applications.

Workshops associated with the *Hamiltonian Systems* program:

Workshop 1: Connections for Women: Hamiltonian Systems, From Topology to Applications Through Analysis
August 16, 2018 - August 17, 2018
*Organizers: Marie-Claude Arnaud (Université d'Avignon), *Basak Gurel (University of Central Florida), Tere Seara (Polytechnical University of Cataluña (Barcelona)*

This workshop featured lectures on a variety of topics in Hamiltonian dynamics given by leading researchers in the area. The talks focused on recent developments in subjects closely related to the program such as Arnold diffusion, celestial mechanics, Hamilton-Jacobi equations, KAM methods, Aubry-Mather

theory and symplectic topological techniques, and on applications. The workshop was open to all mathematicians in areas related to the program.

Workshop 2: Introductory Workshop: Hamiltonian Systems, From Topology to Applications Through Analysis
August 20, 2018 - August 24, 2018
*Organizers: Marie-Claude Arnaud (Université d'Avignon), Wilfrid Gangbo (University of California, Los Angeles), *Vadim Kaloshin (University of Maryland), Robert Littlejohn (University of California, Berkeley), Philip Morrison (University of Texas, Austin)*

The introductory workshop covered the large variety of topics of the semester: weak KAM theory, Mather theory, Hamilton-Jacobi equations, integrable systems and integrable planar billiards, instability formation for nearly integrable systems, celestial mechanics, billiards, spectral rigidity, Astrodynamics, motion of satellites, Plasma Physics, Accelerator Physics, Theoretical Chemistry, and Atomic Physics.

The workshop consisted of approximately 18 lectures which introduced the main topics relevant to the semester. That left time for discussions and exchange between the participants.

Workshop 3: Hamiltonian Systems, From Topology to Applications Through Analysis I
October 08, 2018 – October 12, 2018
*Organizers: Alessandra Celletti (Seconda Università di Roma "Tor Vergata"), Rafael de la Llave (Georgia Institute of Technology), Diego del-Castillo-Negrete (Oak Ridge National Laboratory), Lawrence Evans (University of California, Berkeley), *Philip Morrison (University of Texas, Austin), Sergei Tabachnikov (Pennsylvania State University), Amie Wilkinson (University of Chicago)*

This was a main workshop of the program “Hamiltonian Systems, From Topology to Applications through Analysis” and was a companion to the workshop in November 26-30. Both workshops featured current developments pertaining to finite and infinite-dimensional Hamiltonian systems, with a mix of rigorous theory and applications. A broad range of topics was included, e.g., existence of and transport about invariant sets (Arnold diffusion, KAM, etc.), techniques for projection/reduction of infinite to finite systems, and the role of topological invariants in applications.

Workshop 4: Hamiltonian Systems, From Topology to Applications Through Analysis II
November 26, 2018 – November 30, 2018
Alessandra Celletti (Seconda Università di Roma "Tor Vergata"), Rafael de la Llave (Georgia Institute of Technology), Diego del-Castillo-Negrete (Oak Ridge

*National Laboratory), Lawrence Evans (University of California, Berkeley), *Philip Morrison (University of Texas, Austin), Sergei Tabachnikov (Pennsylvania State University), Amie Wilkinson (University of Chicago)*

This was a main workshop of the program "Hamiltonian Systems, From Topology to Applications Through Analysis." It featured current developments pertaining to finite and infinite-dimensional Hamiltonian systems, with a mix of rigorous theory and applications. A broad range of topics was included, e.g., existence of and transport about invariant sets (Arnold diffusion, KAM, etc.), techniques for projection/reduction of infinite to finite systems, and the role of topological invariants in applications.

Program 2: Birational Geometry and Moduli Spaces (BGMS)
January 22, 2019 – May 24, 2019
*Organizers: Antonella Grassi (University of Pennsylvania), *Christopher Hacon (University of Utah), Sándor Kovács (University of Washington), Mircea Mustaţă (University of Michigan), Martin Olsson (University of California, Berkeley)*

Birational Geometry and Moduli Spaces are two important areas of Algebraic Geometry that have recently witnessed a flurry of activity and substantial progress on many fundamental open questions. In this program we aimed to bring together key researchers in these and related areas to highlight the recent exciting progress and to explore future avenues of research.

This program focused on the following themes: Geometry and Derived Categories, Birational Algebraic Geometry, Moduli Spaces of Stable Varieties, Geometry in Characteristic p>0, and Applications of Algebraic Geometry: Elliptic Fibrations of Calabi-Yau Varieties in Geometry, Arithmetic and the Physics of String Theory

Workshops associated with the *Birational Geometry and Moduli Spaces* program:

Workshop 1: Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces
January 28, 2019 – January 30, 2019
*Organizers: Julie Bergner (University of Virginia), *Antonella Grassi (University of Pennsylvania), Bianca Viray (University of Washington), Kirsten Wickelgren (Georgia Institute of Technology)*

This workshop covered different aspects of Algebraic Geometry relating Derived Algebraic Geometry and Birational Geometry. In particular, the workshop focused on connections to other branches of mathematics and open problems. There were several colloquium style lectures as well as shorter research talks. The workshop was open to all.

Workshop 2: Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces
January 31, 2019 – February 08, 2019
*Organizers: Julie Bergner (University of Virginia), Bhargav Bhatt (University of Michigan), Christopher Hacon (University of Utah), *Mircea Mustaţă (University of Michigan), Gabriele Vezzosi (Università di Firenze)*

The workshop surveyed several areas of algebraic geometry, providing an introduction to the two main programs hosted by MSRI in spring 2019. It consisted of 7 expository mini-courses and 7 separate lectures, each given by top experts in the field.
The workshop focused on the recent progress in derived algebraic geometry, birational geometry and moduli spaces. The lectures were aimed at a wide audience including advanced graduate students and postdocs with a background in algebraic geometry.

Workshop 3: Recent Progress in Moduli Theory
May 06, 2019 – May 10, 2019
*Organizers: Lucia Caporaso (Roma Tre University), *Sándor Kovács (University of Washington), Martin Olsson (University of California, Berkeley)*

This workshop focused on presenting the latest developments in moduli theory, including (but not restricted to) recent advances in compactifications of moduli spaces of higher dimensional varieties, the birational geometry of moduli spaces, abstract methods including stacks, stability criteria, and applications in other disciplines.

Program 3: Derived Algebraic Geometry (DAG)
January 22, 2019 – May 24, 2019
*Organizers: Julie Bergner (University of Virginia), *Bhargav Bhatt (University of Michigan), Dennis Gaitsgory (Harvard University), David Nadler (University of California, Berkeley), Nick Rozenblyum (University of Chicago), Peter Scholze (Universität Bonn), Gabriele Vezzosi (Università di Firenze)*

Derived algebraic geometry is an extension of algebraic geometry that provides a convenient framework for directly treating non-generic geometric situations (such as non-transverse intersections in intersection theory), in lieu of the more traditional perturbative approaches (such as the “moving” lemma). This direct approach, in addition to being conceptually satisfying, has the distinct advantage of preserving the symmetries of the situation, which makes it much more applicable. In particular, in recent years, such techniques have found applications in diverse areas of mathematics, ranging from arithmetic geometry, mathematical physics, geometric representation theory, and homotopy theory. This semester long program was dedicated to exploring these directions further, and finding new connections.

Workshops associated with the *Derived Algebraic Geometry* program:

Workshop 1: Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces
January 28, 2019 – January 30, 2019
*Organizers: Julie Bergner (University of Virginia), *Antonella Grassi (University of Pennsylvania), Bianca Viray (University of Washington), Kirsten Wickelgren (Georgia Institute of Technology)*
This workshop covered different aspects of Algebraic Geometry relating Derived Algebraic Geometry and Birational Geometry. In particular the workshop focused on connections to other branches of mathematics and open problems. There were several colloquium style lectures as well as shorter research talks. The workshop was open to all.

Workshop 2: Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces
January 31, 2019 – February 8, 2019
*Organizers: Julie Bergner (University of Virginia), Bhargav Bhatt (University of Michigan), Christopher Hacon (University of Utah), *Mircea Mustaţă (University of Michigan), Gabriele Vezzosi (Università di Firenze)*

The workshop surveyed several areas of algebraic geometry, providing an introduction to the two main programs hosted by MSRI in spring 2019. It consisted of 7 expository mini-courses and 7 separate lectures, each given by top experts in the field.

The workshop focused on the recent progress in derived algebraic geometry, birational geometry and moduli spaces. The lectures were aimed at a wide audience including advanced graduate students and postdocs with a background in algebraic geometry.

Workshop 3: Derived Algebraic Geometry and Its Applications
March 25, 2019 – May 29, 2019
*Organizers: Dennis Gaitsgory (Harvard University), David Nadler (University of California, Berkeley), *Nick Rozenblyum (University of Chicago), Peter Scholze (Universität Bonn), Brooke Shipley (University of Illinois at Chicago)*

This workshop brought together researchers at various frontiers, including arithmetic geometry, representation theory, mathematical physics, and homotopy theory, where derived algebraic geometry has had recent impact. The aim was to explain the ideas and tools behind recent progress and to advertise appealing questions. A focus was on moduli spaces, for example, principal bundles with decorations that arise in many settings, and their natural structures.

Program 4: Complementary Program (2018-19)
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: Shape and Structure of Materials
October 1, 2018 – October 5, 2018
*Organizers: Myfanwy Evans (TU Berlin), *Frank Lutz (TU Berlin), Dmitriy Morozov (Lawrence Berkeley National Laboratory), James Sethian (University of California, Berkeley), Ileana Streinu (Smith College)*

The fascinating and complicated microstructures of materials that are now visible through advanced imaging techniques challenge the frontiers of characterization and understanding. At the same time, developments in modern geometric and topological techniques are beginning to illuminate important features of material structures, while the microstructures themselves and the analysis and prediction of their macroscopic properties are inspiring new directions in pure and applied mathematics. In a collaboration with the Lawrence Berkeley National Laboratory (LBNL), this workshop aimed at intensifying the interaction of mathematicians with material scientists, physicists and chemists on the structural description and design of materials.

Hot Topics: Recent Progress in Langlands Program
April 8, 2019 – April 12, 2019
*Organizers: Mark Kisin (Harvard University), Elena Mantovan (California Institute of Technology), *Xinwen Zhu (California Institute of Technology)*

The purpose of the workshop was to explain Vincent Lafforgue's ground breaking work, constructing the automorphic to Galois direction of the Langlands correspondence for function fields. There were also a number of talks on more recent developments and related results.

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 2018-19 academic year.

DATES	ACTIVITY TYPE	TITLE	PARTICIPANTS
6/11/18 – 8/3/18	Summer Research	Summer Research for Women in Mathematics	20
6/16/18 – 7/29/18	MSRI-UP	MSRI-UP 2018: The Mathematics of Data Science	18
6/11/18 – 6/22/18	Summer Graduate School	The ∂-Problem in the Twenty-First Century	35
6/11/18 – 6/22/18	Summer Graduate School	Séminaire de Mathématiques Supérieures 2018: Derived Geometry and Higher Categorical Structures in Geometry	34
6/17/18 – 6/30/18	Summer Graduate School	Mathematical Analysis of Behavior	24
6/25/18 – 7/6/18	Summer Graduate School	Derived Categories	56
6/25/18 – 7/6/18	Summer Graduate School	H-principle	15
7/1/18 – 7/21/18	Summer Graduate School	IAS/PCMI 2018: Harmonic Analysis	36
7/3/18 – 7/20/18	Summer Graduate School	Representations of High Dimensional Data	53
7/23/18 – 8/3/18	Summer Graduate School	From Sympletic Geometry to Chaos	33
Fall 2018	**Scientific Program**	**Hamiltonian systems, from topology to applications through analysis (HST)**	**107**
8/16/18 – 8/17/18	Programmatic Workshop	Connections for Women: Hamiltonian systems, from topology to applications through analysis	57
8/20/18 – 8/24/18	Programmatic Workshop	Introductory Workshop: Hamiltonian systems, from topology to applications through analysis	111
10/8/18 – 10/12/18	Programmatic Workshop	Hamiltonian systems, from topology to applications through analysis I	123
10/1/18 – 10/5/18	Hot Topics Workshop	Hot Topics: Shape and Structure of Materials	55
11/26/18 – 11/30/18	Programmatic Workshop	Hamiltonian systems, from topology to applications through analysis II	95
Spring 2019	**Scientific Program**	**Birational Geometry and Moduli Spaces (BGMS)**	**67**

Spring 2019	Scientific Program	Derived Algebraic Geometry (DAG)	69
1/28/19 – 1/30/19	Programmatic Workshop	Joint Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces	115
1/31/19 – 2/8/19	Programmatic Workshop	Joint Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces	209
3/25/19 – 3/29/19	Programmatic Workshop	Derived Algebraic Geometry and Its Applications	150
4/8/19 – 4/12/19	Hot Topics Workshop	Hot Topics: Recent Progress in Langlands Program	89
5/6/19 – 5/10/19	Programmatic Workshop	Recent Progress in Moduli Theory	147
8/13/18 – 5/24/19	**Scientific Program**	**Complementary Program 2018-19**	**17**

B. NSA supported Postdoctoral Fellows

There were 32 postdoctoral fellows who participated in the 2018-19 programs. The NSA grant, H98230-18-1-0188, funded three out of the 32 postdoctoral fellows. As outlined in the grant budget, we funded one postdoctoral fellow in the fall and two in the spring with an average stipend of $6,000 per month for five months. Since the provisional Indirect Cost rate decreased from the proposed 21.48% to 20.132%, we were able to fund more in postdoc travel. Detailed financial information can be found in Section V.

Connor Jackman participated in the fall 2018 program, *Hamiltonian Systems (HST).*

Jackman, Connor

Name: Connor Jackman
Year of Ph.D: 2018
Institution of Ph.D: UC Santa Cruz
Dissertation title: Free Homotopy Classes in some N-body problems
Ph.D. advisor: Richard Montgomery

Mentor while at MSRI: Jacques Fejoz

Institution prior to obtaining the MSRI PD fellowship: UC Santa Cruz
Position at that institution: Graduate Student
Mentor (if applicable): Gil Bor

	Institution (or company) where you are going after MSRI: Centro de Investigación en Matemáticas (CIMAT) Position at that institution: Postdoc **Postdoctoral fellow comments:** I am very grateful for having participated in the program this semester at MSRI. The seminars and library were very inspiring to me, and the chance to meet with experts has helped guide my future projects. One of these projects is to describe symbol sequences for Poincare's second species solutions. These are solutions of the restricted 3-body problem which as the mass tends to zero tend to a collision. To get symbol sequences, we will need to find which side the massless body passes when the mass is non-zero. Meeting Laurent Niedermann here, who in one of his first papers with J.P. Marco proved the existence of second species orbits, has helped me understand the analysis and ideas in this paper. I now confirmed that the bounds I am seeking to improve will indeed tell us this information. Currently I am writing a paper about symbol sequences arising from such methods (work I did in my thesis), and these last bounds will be the final piece in the paper. Also, Laurent and Jacques Féjoz have helped guide me to useful references and taught me nice tricks for averaging over resonances. With Jacques, I am using this to examine the existence of a solution (with non-zero angular momentum) to the spatial 4-body problem which never lies in a plane -- which would answer a question posed by Montgomery at this Program. Another topic I learned more about here was the Jacobi-Maupertuis metric in celestial mechanics. Discussions with Rick Moeckel have interested me in the embedding problem of JM-metrics. These metrics may have a Hill boundary -- points at which the metric becomes zero, and the curvature goes to infinity. For central force problems, Moeckel proved this obstructs embeddings as surfaces of revolution in a whole neighborhood of the Hill boundary. For these examples, the Hill boundary is a curve. I have found examples, when the Hill boundary is a point, which do embed all the way up to this Hill boundary. To make these examples we start with the surface of revolution of an involute and then determine the appropriate JM-metric. It will be an interesting future project to see if any interesting JM-metrics can arise this way. I think this fellowship has given my research program better focus on some specific projects, which other researchers will be interested in. And so, will be helpful for finding a future position.

Laure Flapan participated in the spring 2019 program, *Birational Geometry and Moduli Spaces (BGMS).*

Flapan, Laure

Name: Laure Flapan
Year of Ph.D: 2017
Institution of Ph.D: UCLA
Dissertation title: Hodge Structures with Hodge Numbers (n, 0,…,0,n) and their Geometric Realizations
Ph.D advisor: Burt Totaro

Mentor while at MSRI: Claire Voisin

Institution prior to obtaining the MSRI PD fellowship: Northeastern University
Position at that institution: Postdoctoral Fellow and Research Instructor
Mentor (if applicable):

Institution (or company) where you are going after the MSRI PD fellowship: Massachusetts Institute of Technology (MIT)
Position: Postdoctoral Fellow and Pure Math Instructor
Anticipated length: 2 years
Mentor: Davesh Maulik

Postdoctoral fellow's comments:
Was your experience at MSRI beneficial?
I had a very productive semester at MSRI. For the most part I worked on projects and collaborations that I had started prior to coming to MSRI. I revised and resubmitted two papers to journals as well as completed a rough draft of a paper for a new project I had begun just before coming to MSRI. I also began a new collaboration with two other postdocs at MSRI, Alex Perry and David Stapleton (both of whom were visiting in an unofficial capacity), which would not have been possible without the regular interaction facilitated by the program. Additionally, I helped organize together with my mentor Claire Voisin, a learning seminar to read a paper that both of us had been interested in for a long time but had found too inaccessible to read alone.

I found the experience of participating in the seminar very helpful and I learned a lot of new things from it. I anticipate that what I learned will have great research implications for me in the future. Also as a result of my mentorship by Claire Voisin, I received an invitation to officially visit her in Paris this coming spring and attend her series of lectures at the College de France. This also will be of enormous professional benefit to me.

Paul VanKoughnett participated in the spring 2019 program, *Derived Algebraic Geometry (DAG).*

VanKoughnett, Paul

Name: Paul VanKoughnett
Year of Ph.D.: 2018
Institution of Ph.D: Northwestern University
Dissertation title: Localizations of E-theory and Transchromatic Phenomena in Stable Homotopy Theory
Ph.D. advisor: Paul Goerss

Mentor while at MSRI: Craig Westerland
Institution prior to obtaining the MSRI PD fellowship: Purdue University

Institution (or company) where you are going after the MSRI PD fellowship: Purdue University Position: Golomb Visiting Assistant Professor
Anticipated length (if it is a tenure track position just write tenure-track): 3 years total, 2 more starting next year
Mentor (if applicable): None

Postdoctoral fellow's comments:
I spent much of the beginning of the semester on old collaborations - a paper on tmf-cooperations with Dominic Culver (still in progress) and one on Goerss-Hopkins obstruction theory with Piotr Pstragowski. Though neither of my coauthors was here, I found the supportive research environment, and the wonderful audience of homotopy theorists to share my work with, incredibly helpful.

I also got a lot out of the numerous seminars and reading groups, particularly one on prismatic cohomology and one on Lurie's approach to elliptic cohomology, and a seminar I ran with some of the other postdocs on p-adic geometry and topological Hochschild homology. The time available for me to spend with this new and innovative material helped me move from acquaintance with it down the road to mastery. I've begun over the last month to work on a project related to elliptic cohomology that applies Lurie's technology to exterior powers of p-divisible groups.

But by far my favorite thing about working here has been collaborating. I've had a really successful collaboration with Irina Bobkova, Tobias Barthel, and Craig Westerland, using a broad mix of ideas from homotopy theory and derived algebraic geometry to get a decomposition of the Picard group of the K(n)-local homotopy category. Irina and I have also been working on a number of other projects, including one investigating relationships between notions of K(n)-local duality and one attempting to prove a conjecture of Mark Behrens about a factorization of the K(2)-local sphere into "hemispheres" having to do with elliptic curves.

	Was your experience at MSRI beneficial? Why or why not? Do you believe it had helped you find a position? I'm not going on the job market next year, and it's hard to say how MSRI will affect whatever happens when I do. But mathematically speaking, my time here has helped me develop a new and more mature direction in my research. I think these programs are incredible and hope MSRI keeps doing them for years to come.

PUBLICATIONS SUMMARY

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

Member Name	Paper Titles	Co-author(s)	Paper Status
Connor Jackman	A Solution Of The 4-Body Problem With No Plane Configuration	Jacques Fejoz	Rough/Draft
Connor Jackman	On The Sectional Curvature Along Central Configurations	Josue Melendez	Submitted
Connor Jackman	Syzygy Sequences In Planar 3-Body Problems		Working Notes
Laure Flapan	Chow Motives And Algebraic Hecke Characters	Jaclyn Lang	Working Notes
Laure Flapan	Complete Families Of Abelian Varieties With Prescribed Monodromy		Rough/Draft
Laure Flapan	P-Adic Height Pairings In Families	Preston Wake	Working Notes
Paul Van Koughnett	Abstract Goerss-Hopkins Theory	Piotr Pstragowski	Submitted
Paul Van Koughnett	Exterior Powers Of Spectral P-Divisible Groups And Higher Orientations		Working Notes
Paul Van Koughnett	On The K(1)-Local Homotopy Of Tmf ^ Tmf	Dominic Culver	Rough/Draft
Paul Van Koughnett	Splitting Of The K(N)-Local Picard Group	Tobias Barthel, Irina Bobkova, and Craig Westerland	Working Notes