Université de Montréal

Faculté des arts et des sciences
Département de mathématiques
et de statistique

SMS 2014: Director's report.

The 53rd *Séminaire de Mathématiques Supérieures* took place in Montréal in the period June 23- July 4, 2014. It was the largest summer school in recent years, with 112 participants.

Focused on the celebrated work of **Manjul Bhargava**, who was himself one of the featured lecturers, this school was an exceptional event for number theory and beyond, with a great impact on making Bhargava's breakthroughs accessible to a larger audience. Remarkably this year, many of the speakers, Bhargava in particular, were present the full two-week period.

The organizers, **Henri Darmon, Andrew Granville and Benedict Gross** have done a tremendous job by putting together a fantastic group of speakers and motivated students and in coordinating tightly the lectures in such a way as to insure the highest training impact. Moreover, they have already started to prepare a volume tied to the school activity that promises to play an important role in the field.

I thank all three of them for their hard work as well as **Ms. Sakina Benhima** from the CRM who assisted them and me with the administrative matters required in running this activity.

As in past years, this edition of the *SMS* was only possible with the co-operation of our main partners the **CRM**, **Fields Institute**, **PIMS** and **MSRI** as well as with support from the **ISM**, the **University of Montreal** and with support from the **Canadian Mathematical Society**. I thank all these institutions for their contributions and I also thank the board of directors of the SMS for their work and support.

In the following you will find a detailed scientific, organizational and budgetary report. I thank again the organizers for taking the time to prepare this document.

Sincerely Yours,

O. Cornea

Octav Cornea
Director, Séminaire de Mathématiques Supérieures
cornea@dms.umontreal.ca

September 10, 2014

C.P. 6128, succursale Centre-ville
Montréal QC H3C 3J7

Téléphone : 514 343-6743
Télécopieur : 514 343-5700

mathstat@dms.umontreal.ca

École d'été SMS 2014: Comptage d'objets arithmétiques

SMS 2014 Summer School: Counting Arithmetic Objects

2014-06-23 - 2014-07-04

1. Organisateurs / Organisers:

Henri Darmon (McGill University)
Andrew Granville (Université de Montréal)
Benedict Gross (Harvard University)

2. Conférenciers / Speakers :

Manjul Bhargava (Princeton)
I/ Introduction and perspective
II, III/ How to count rings and fields
IV/ Applications to the Birch and Swinnerton-Dyer conjecture
V/ Future perspectives

Henri Darmon (McGill)
I/ Curves, geometric aspects
II/ Curves, diophantines aspects

Jordan Ellenberg (Wisconsin)
I, II/ Topological and algebraic geometry method over function fields

Eknath Ghate (TIFR. Mumbai)
I/ Basic algebraic number theory
II/ Counting Artin representations and modular forms of eight one

Eyal Goren (McGill)
I, II/ Algebraic groups, representation theory, and invariant theory

Andrew Granville (U de Montreal)
I/ Basics of binary quadratic forms and Gauss composition
II/ Basic analytic number theory

Benedict Gross (Harvard)
I, II/ Arithmetic invariant theory and hyperelliptic curves

Wei Ho (Columbia)
Coregular spaces and genus one curves

Melanie Matchett-Wood (Wisconsin)
I/ Cubic rings
II/ Quartic and quintic rings
III/ Rings associated to binary n-ic forms, composition of $2 \times n \times n$ boxes and class groups
IV/ Heuristics for number field counts and applications to curves over finite fields.

Jennifer Park (MIT / CRM)
The Chabauty method and symmetric powers of curves

Bjorn Poonen (MIT)
I/ Moduli space of rings
II, III/ Selmer groups and heuristics
IV/ Chabauty methods and hyperelliptic curves

Arul Shankar (Princeton)
Binary quartic forms; bounded average rank of elliptic curves

Michael Stoll (Beyreuth)
Rational points on curves

Takashi Taniguchi (Kobe)
The zeta functions attached to prehomogeneous vector spaces

Frank Thorne (U South Carolina)
Zeta Function methods

Jerry Wang (Princeton)
Counting methods over global fields

9 problem sessions, led by Jordan Ellenberg, Wei Ho, Jennifer Park, Arul Shankar, Frank Thorne and Jerry Wang

3. Nombre de participants / Number of participants :112

4. Résumé de l'activité / Activity resume :

This was the first summer school to focus on the new approach to arithmetic geometry which has been led by Manjul Bhargava, and resulting in several extraordinary results, including that almost 2/3rds of elliptic curves satisfy the Birch-Swinnerton Dyer

conjectures (up to the 2-part of the Tate-Safarevic group). The vast majority of the work in this area has come from Princeton and Boston, and one goal was to allow a much wider cohort into the subject. The lecturers were specifically asked to help the listeners develop an intuition for the area, and not worry about all of the details. One difficulty in understanding the subject is that the published papers often focus on the more geometric intuition, though much of the (key) ring theory can be developed through simpler algebraic insights and combinatorial constructions. Again the lecturers were asked to bring these to the fore, and did so.

Bhargava himself is a fantastic lecturer and enjoyed, not only gearing his own talks to a wider audience, but working with some of the (fairly junior) lecturers to appropriately focus their talks. The series by Melanie Wood (on all of the rings involved) and by Arul Shankar (on how to count the arithmetic objects involved) were masterful, and gave the listeners the opportunity to delve deep into this important subject with a great sense of the intuition behind these techniques. Bjorn Poonen managed to explain quite a bit of challenging algebraic geometry in a way that brought everyone along, giving insight into conjectures on ranks, as well as the new ways of exploiting Chabauty's method to determine all of the rational points on a given (high genus) curve. Taniguchi and Frank Thorne exposed the deeper analytic techniques, all the while respecting that the majority of the audience were algebraists so needed to be carefully led through the meaning behind each step.

Dick Gross is one of the great arithmetic geometers of our time, and a fantastic expositor, as he once again showed, using the invariant theory (as explained by Jerry Wang) to attack rational points on hyperelliptic curves. There were also excellent "one-off" lectures by Wei Ho, Jennifer Park, Eknath Ghate (though actually two "one-off" lectures) and Michael Stoll, on various exciting parts of the theory. And a rather different perspective explained by the always entertaining and inspiring Jordan Ellenberg.

Each day was rounded off by an extensive problem session, challenging the participants to immerse themselves in the details of the theory of that day. Each day's problem session was led by some of the the more junior lecturers.

5. Record of activities :

The SMS lecture series started on Monday morning and got off to a fantastic start with a masterful lecture by Manjul Bhargava on "Introduction and Perspective", laying out the broad themes for the entire program of lectures.The following lectures that day were devoted to covering essential background topics on algebraic groups, representation theory, and invariant theory (Eyal Goren) and algebraic number theory (Eknath Ghate). The day closed with a historically motivated and insightful discussion of Gauss's theory of composition of binary quadratic forms, delivered by Andrew Granville.

Tuesday was devoted to further nuts an bolts. Henri Darmon lectured on the theory of

algebraic curves, including such basic topics as the Riemann-Roch theorem and its applications, as well as various diophantine aspects, culminating with the corresopndence, discovered by Swinnerton-Dyer, between two-torsion elements in the Selmer group of an elliptic curve and equivalence classes of binary quartic forms. Andrew Granville covered basic topics in analytic number thoery and in the geometry of numbers.

Wednesday saw further discussion of representation theory by Eyal Goren, and the start of Melanie Matchett Wood's masterful expose of the classification of rings of low degree, followed by a stimulating problem session that was run by Jennifer Park, Arul Shankar and Frank Thorne.

On Thursday, Bhargava and Wood both discussed techniques for parametrising and counting rings and fields of low degree, and Takashi Taniguchi contrasted their approach with more traditional ones based on the notion of the zeta function attached to a prehomogenous vector space. The day closed with a problem session animated by Arul Shankar and Frank Thorne.

On Friday Bhargava continued with his lecture series on counting rings and fields, while Matchett-Wood reviewed various heuristics for number field counts, with special emphasis on the fruitful analogy with the theory of curves over finite fields. Bjorn Poonen closed the week with a lovely discussion of his notion of a ``moduli space of rings" which resonated nicely with many of the themes of the summer school.

In response to overwhelming demand from the participants, some extra lectures were scheduled on Saturday. Frank Thorne was thus able to discuss zeta function methods in greater depth, and Eknath Ghate was able to describe the connection between modular fors of weight one and certain Artin representations, of the kind that have been successfully parametrised and counted by Bhargava and his school.

While the first week was devoted to basic background material and to the problem of parametrizing the integral orbits in prehomogenous vector spaces, the second week turned to the more challenging task of counting analogous orbits in settings where the group action has a free ring of invariants. Such actions arise, for instance, in parametrising elements of small order in the Selmer groups of elliptic curves. Arul Shankar thus explained how the relation between 2-selmer elements and equivalence classes of binary quaartic forms could be parlayed into striking upper bounds for the average rank of elliptic curves over the rationals. Bjorn Poonen followed with a discussion of the heuristics that such Selmer groups are expected to obey, while Stoll explained the significance of these results for the study of rational points on curves of higher genus. The successful first day of the second week concluded with a well-attended problem session run by Jennifer Park and Arul Shankar.

Tuesday was devoted to a lecture by Wei Ho on the theory of coregular spaces and to Benedict Gross's first lecture, on the theme of arithmetic invariant theory. The problem session, run this time by Wei Ho and Jerry Wang, was as always well attended and much appreciated by the younger participants.

The Wednesday lectures explored in greater depth the results on ranks of elliptic curves, with Manjul Bhargava explaining how they imply (when combined with deep arithmetic results of Gross-Zagier, Kolyvagin, Skinner-Urban, and others) that the Birch and Swinnerton-Dyer conjecture is true for a large, positive proportion of all elliptic curves over the rationals. Poonen described how Bhargava's rank estimates are consistent with various heuristics on the behaviour of Selmer groups which have emerged in recent times, spurred partly by the progress arising from the work of Bhargava, and Gross concluded his two-part series on arithmetic invariant theory.

The Thursday program was devoted to a discussion of hyperelliptic curves, with lectures by Bjorn Poonen, Jordan Ellenberg, and Jerry Wang on the Chabauty method, function field methods, and various counting methods over global fields.

Some of these themes were futher amplified in the condluding lectures of Friday, in which Jennifer Park discussed how the Chabauty method can be applied to symetic powers of curves to yield strong upper bounds on average for the number of rational points of fixed (small) degree on cruves of a given genus. Ellenberg concluded his inspiring lecture series on topological and geometric methods in the function field setting. Finally, the SMS ended in grand style, with an ambitious lecture on future perspectives in the subject by Manjul Bhargava,which is sure to have inspired the younger students with the many possibilities still to be explored in this burgeoning new branch of number theory.

6. Organisation :

There were a little over 150 applications received. The 82 participants that were eventually selected were later joined by another 14 well-qualified researchers and local students that registered later in the process. The main selection criterion was the relevance of the SMS theme to the applicant's scientific interests. It was also decided early on to give absolute priority to young researchers without a PhD, and this in itself was enough to narrow down the applicant list to one in which everyone who had a decent scientific justification for wanting to attend could be supported. Among the participants there were 25 women participants of which 3 speakers, 15 postdoctoral researchers and 12 more advanced researchers.

7. List of Participants :

SPEAKERS	Institution
Manjul Bhargava	Princeton
Henri Darmon	McGill
Jordan Ellenberg	U Wisconsin
Eknath Ghate	TIFR
Eyal Goren	McGill
Andrew Granville	U de Montréal
Benedict Gross	Harvard
Wei Ho	Columbia
Melanie Matchett-Wood	U Wisconsin
Jennifer Park	CRM
Bjorn Poonen	MIT
Arul Shankar	Princeton
Michael Stoll	Bayreuth
Takashi Taniguchi	Kobe
Frank Thorne	U South Carolina
Jerry Wang	Princeton

PARTICIPANTS	Institution
Akhtari Shabnam	Univ of Oregon
Alzahrani Manal	Concordia
Amoros Carafi Laia	Université du Luxembourg
Ananth Shankar	Harvard University
Aryan Farzad	University of Lethbridge
Ataei Jaliseh Masoud	Western University
Bardestani Mohammad	University of Ottawa
Bates Matthew	University of Massachusetts
Bettin Sandro	Université de Montréal
Blakestad Clifford	University of Colorado Boulder
Blanco-Chacon Ivan	Aalto University School of Science
Carter Brandon	University of Michigan
Castillo Abel	University of Illinois at Chicago
Chiche-Lapierre Valentine	Concordia
Chow Dylon	University of Illinois at Chicago
Coatney Ryan	University of Arizona
Cowan Alex	Coulumbia University
David Chantal	Concordia
Davidoff Giuliana	Mount Holyoke College
Davis Rachel	Purdue University
Debaene Korneel	Ghent University
Destagnol Kevin	Université Paris 7
Dixit Anup	University of Toronto
Dupuy Taylor	UCLA
Felix Adam	University of Lethbridge
Fiorilli Daniel	University of Michigan
Freiberg Tristan	University of Missouri
Garcia-Fritz Natalia	Queen's University
Gunton Cody	University of Arizona
Habsieger Laurent	CRM
Hortsch Ruthi	Massachusetts Institute of Technology
Huang Zili	Northwestern University
Ishitsuka Yasuhiro	Kyoto
Jana Subhajit	University of British Columbia
Kamenetsky Daniel	University of South Carolina
Khayutin Ilya	Hebrew University
Klagsbrun Zev	CCR-La Jolla
Krishnamoorthy Raju	Columbia University
Lalin Matilde	Univeristé de Montréal
Lang Jaclyn	University of California - Los Angeles

Le Boudec Pierre	Ecole Polytechnique Fédérale de Lausanne
Lee Seok Hyeong	Princeton University
Lemke Oliver Robert	Stanford University
Leshin Jonah	Brown University
Long Misty	Kansas State University
Maffucci Riccardo Walter	King's College London
Malik Amita	University of Illinois at Urbana-Champaign
Manber Shelly	UC Berkeley
Mangerel Alexander	University of Toronto
McGown Kevin	Ursinus College
McMeekin Christine	Cornell University
Meleleo Giulio	Roma Tre
Milione Piermarco	Universitat de Barcelona
Miller Alison	Princeton University
Miller Daniel	Cornell University
Milovic Djordjo	Leiden University
Mocs Lucia	Princeton University
Morgan Adam	University of Bristol
Najman Filip	University of Zagreb
Nakahara Masahiro	Rice University
Parks James	University of Lethbridge
Pasten Hector	Queen's University
Roe David	University of Calgary
Saha Arnab	Australian National University
Scarfy Justin	The University of British Columbia
Shnidman Ari	University of Michigan
Simard Nicolas	McGill
Singh Vijaykumar	UBC & Simon Fraser University
Somoza Henares Ana	Universitat Politècnica de Catalunya
Su Heng	UC Irvine
Tang Yunqing	Harvard University
Trinh Tien	Rutgers University
Tsang Cindy (Sin Yi)	University of California, Santa Barbara
Tse Ling-Sang	University of Waterloo
Turner Lise	McGill
Vincent Christelle	Stanford University
Wong Peng-Jie	Queen's University
Xia Yuhou	Princeton University
Xio Stanley	University of Waterloo
Yamagishi Shuntaro	University of Waterloo
Youcis Alex	University of California, Berkeley
Zomervrucht Wouter	Leiden University

Late registrations	Institution
Amalega Bitongo François	UdM
Beauchamps Houde Gabriel	UdM
Brakocevic Miljan	McGill
Bujold Crystel	UdM
Dias Dimitri	UdM
Elias Yara	McGill
Kisilevski Hershy	Concordia
Koukoulopoulos Dimitris	UdM
Link Sofie	Concordia
Mehdizadeh Marzieh	Concordia
Meisner Patrick	Concordia
Nam Jungbae	Concordia
Sadoughianzadeh Reza	Concordia
Sprung Florian	IHES

8. Program :

SEMAINE I / WEEK I: RINGS AND REPRESENTATIONS WITH ONE INVARIANT
Lundi 23 juin/ Monday June 23 – Background
8:00-9:00. Breakfast and registration.
9:00-10:30 : Manjul Bhargava
Introduction and perspective
10 :30. Pause Café/ Coffee break
11:00-12:00 : Eyal Goren
Algebraic groups, representation theory, and invariant theory
12:00-2:00. Dîner/Lunch
2:00-3:00 : Eknath Ghate
Basic algebraic number theory (number fields, class groups, why they are useful/interesting)
3 :00. Pause Café/ Coffee break
3:30-5:00. : Andrew Granville
Basics of binary quadratic forms and Gauss composition.

Mardi 24 juin/ Tuesday June 24 – Background, II
8 :30. Petit-déjeuner/ Breakfast
9:00-10:00 : Henri Darmon
Curves, geometric aspects
10 :00. Pause Café/ Coffee break

10:30-12:00 : Andrew Granville
Basic analytic number theory
12:00-2:00. Dîner/Lunch
2 :00-3 :30 : Henri Darmon
Curves, diophantines aspects
3 :30. Pause Café/ Coffee break

Mercredi 25 juin/ Wednesday June 25 – Rings and representations with one invariant,I
8 :30. Petit-déjeuner/ Breakfast
9:00-10:30 : Eyal Goren
More algebraic groups, representation theory and invariant theory.
10 :30. Pause Café/ Coffee break
11:00-12:30 : Melanie Matchett-Wood
Cubic rings
12:30-2:30. Dîner/Lunch
2:30-4:00 : Melanie Matchett-Wood
Quartic and quintic rings
4 :00. Pause Café/ Coffee break
4:30-5:30. : Jennifer Park, Arul Shankar and Frank Thorne
Problem session

Jeudi 26 Juin/ Thursday June 26 – Rings and representations with one invariant, II
8 :30. Petit-déjeuner/ Breakfast
9:00-10:30 : Manjul Bhargava
How to count rings and fields I
10 :30. Pause Café/ Coffee break
11:00-12:30 : Melanie Matchett-Wood
Rings associated to binary n-ic forms, composition of $2 \times n \times n$ boxes and class groups
12:30-2:30. Dîner/Lunch
2 :30-4 :00 : Takashi Taniguchi
The zeta functions attached to prehomogeneous vector spaces
4 :00. Pause Café/ Coffee break
4 :30-5 :30 : Arul Shankar and Frank Thorne
Problem session

Vendredi 27 juin / Friday June 27 – Rings and representations with one invariant, III
8 :30. Petit-déjeuner/ Breakfast
9:00-10:30 : Manjul Bhargava
How to count rings and fields II
10 :30. Pause Café/ Coffee break
11:00-12:30 : Melanie Matchett-Wood
Heuristics for number field counts and applications to curves over finite fields.
12:30-2:30. Dîner/Lunch
2:30-3:30 : Bjorn Poonen
Moduli space of rings

3 :30. Pause Café/ Coffee break
4:00-6:00. : Arul Shankar and Frank Thorne
Problem session

Samedi 28 juin / Saturday June 28
8 :30. Petit-déjeuner/ Breakfast
9 :00-10 :30 : Frank Thorne
Zeta Function methods
10 :30. Pause Café/ Coffee break
11 :00-12 :30 : Eknath Ghate
Counting Artin representations and modular forms of eight one

SEMAINE II/ WEEK II: CURVES AND REPRESENTATIONS WITH A FREE RING OF INVARIANTS
Lundi 30 juin / Monday, June 30
8 :30. Petit-déjeuner/ Breakfast
9:00-10:30 : Arul Shankar
Binary quartic forms; bounded average rank of elliptic curves I
10 :30. Pause Café/ Coffee break
11:00-12:30 : Bjorn Poonen
Selmer groups and heuristics I
12:30-2:30. Dîner/Lunch
2:30-3:30. :Michael Stoll
Rational points on curves
3 :30. Pause Café/ Coffee break
4:00-5:00 : Jennifer Park and Arul Shankar
Problem session

Mardi 1er juillet / Tuesday, July 1
8 :30. Petit-déjeuner/ Breakfast
9:00-10:30 : Arul Shankar
Binary quartic forms; bounded average rank of elliptic curves II
10 :30. Pause Café/ Coffee break
11:00-12:30. : Wei Ho
Coregular spaces and genus one curves
12:30-2:30. Dîner/Lunch
2:30-4:00 : Benedict Gross
Arithmetic invariant theory and hyperelliptic curves I
4 :00. Pause Café/ Coffee break
4:30-5:30 : Wei Ho and Jerry Wang
Problem session

Mercredi 2 juillet / Wednesday, July 2
8 :30. Petit-déjeuner/ Breakfast

9:00-10:30 : Manjul Bhargava
Applications to the Birch and Swinnerton-Dyer conjecture.
10 :30. Pause Café/ Coffee break
11:00-12:30 : Bjorn Poonen
Selmer groups and heuristics II
12:30-2:30. Dîner/Lunch
2:30-3:00 : Jerry Wang
Pencils of quadrics ; the geometry
3 :00-4 :00 : Benedict Gross
Arithmetic invariant theory and hyperelliptic curves II
4 :00. Pause Café/ Coffee break
4:30-6:00 : Jennifer Park and Jerry Wang
Problem session

Jeudi 3 juillet / Thursday, July 3
8 :30. Petit-déjeuner/ Breakfast
9:00-10:30 : Bjorn Poonen
Chabauty methods and hyperelliptic curves
10 :30. Pause Café/ Coffee break
11:00-12:30 : Jordan Ellenberg
Topological and algebraic geometry method over function fields I
12:30-2:30. Dîner/Lunch
2:30-3:30 : Jerry Wang
Counting methods over global fields
3 :30. Pause Café/ Coffee break
4:00-6:00 : Jordan Ellenberg, Jennifer Park and Jerry Wang
Problem session

6 :00 : RECEPTION

Vendredi 4 juillet / Friday, July 4
8 :30. Petit-déjeuner/ Breakfast
9:00-10:00 : Jennifer Park
The Chabauty method and symmetric powers of curves
10 :00. Pause Café/ Coffee break
10:30-12:00 : Jordan Ellenberg
Topological and algebraic geometry methods over function fields II
12:30-2:00. Dîner/Lunch
2 :00-4:00 : Manjul Bhargava
Future perspectives

Appendix 1: Budget

- The expenditures are estimated at this time as we are still processing reimbursments.

- The MSRI support consists of housing and travel support; the travel is reimbursed by the MSRI directly to the participants that it supports and it is only estimated below for accouting purposes (so that the MSRI supported participants have total expenditures equal to 20.000$).

a. Summary

Funding support.	
CRM	$20,000.00
FIELDS	$10,000.00
PIMS	$10,000.00
ISM	$7,500.00
MSRI	$20,000.00
CMS	$2,000.00
Registration fees.	$1,840.00
Personal grants and lab support	$3000
Total support	**$74,340.00**
Summary of Expenditures.	
Media, poster etc	$1,845.09
Receptions, coffee, speaker meals etc.	$7,206.25
Speakers housing and travel	$28,607.75
Student housing and travel	$26,387.83
MSRI supported students, estimated travel	$10,340.00
Total expenditures	$74,386.92

b. Expenditures for each participant (estimated).

Speakers	Institution	Support	
Manjul Bhargava	Princeton	2,100.00$	
Jordan Ellenberg	U Wisconsin	400.00$	
Eknath Ghate	TIFR	3,510.00$	
Benedict Gross	Harvard	2,580.00$	
Wei Ho	Columbia	1,285.00$	
Melanie Matchett-Wood	U Wisconsin	1,390.00$	
Jennifer Park	CRM	2,405.00$	
Bjorn Poonen	MIT	3,615.00$	
Arul Shankar	Princeton	2,000.00$	
Michael Stoll	Bayreuth	3,500.00$	
Frank Thorne	U South Carolina	2,984.41$	
Jerry Wang	Princeton	2,838.34$	
TOTAL		28,607.75$	
PARTICIPANTS	**Institution**	**Support**	**Funding Type**
Amoros Carafi Laia	Université du Luxembourg	420.00$	SMS
Ananth Shankar	Harvard University	420.00$	MSRI
Aryan Farzad	University of Lethbridge	420.00$	SMS
Ataei Jaliseh Masoud	Western University	420.00$	SMS
Bates Matthew	University of Massachusetts	420.00$	MSRI
Blakestad Clifford	University of Colorado Boulder	420.00$	MSRI
Carter Brandon	University of Michigan	420.00$	MSRI
Castillo Abel	University of Illinois at Chicago	420.00$	MSRI
Chow Dylon	University of Illinois at Chicago	420.00$	MSRI
Coatney Ryan	University of Arizona	420.00$	MSRI
Davis Rachel	Purdue University	420.00$	SMS
Debaene Korneel	Ghent University	420.00$	SMS
Destagnol Kevin	Université Paris 7	420.00$	SMS
Dixit Anup	University of Toronto	420.00$	SMS
Dupuy Taylor	UCLA	660.00$	SMS
Felix Adam	University of Lethbridge	420.00$	SMS
Garcia-Fritz Natalia	Queen's University	660.00$	SMS
Gunton Cody	University of Arizona	420.00$	SMS
Hortsch Ruthi	Massachusetts Institute of Technology	420.00$	MSRI
Huang Zili	Northwestern University	420.00$	MSRI
Jana Subhajit	University of British Columbia	420.00$	SMS
Kamenetsky Daniel	University of South Carolina	420.00$	SMS
Khayutin Ilya	Hebrew University	420.00$	SMS
Krishnamoorthy Raju	Columbia University	420.00$	SMS
Lang Jaclyn	University of California - Los Angeles	420.00$	MSRI
LeBoudec Pierre	Ecole Polytechnique Fédérale de Lausanne	420.00$	SMS
Lee Seok Hyeong	Princeton University	420.00$	SMS
Lemke Oliver Robert	Stanford University	660.00$	SMS
Leshin Jonah	Brown University	420.00$	MSRI
Long Misty	Kansas State University	420.00$	MSRI
Maffucci Riccardo Walter	King's College London	420.00$	SMS

Malik Amita	University of Illinois at Urbana-Champaign	420.00$	MSRI
Manber Shelly	UC Berkeley	420.00$	MSRI
Mangerel Alexander	University of Toronto	420.00$	SMS
McGown Kevin	Ursinus College	420.00$	SMS
McMeekin Christine	Cornell University	420.00$	MSRI
Milione Piermarco	Universitat de Barcelona	420.00$	SMS
Miller Alison	Princeton University	420.00$	SMS
Miller Daniel	Cornell University	420.00$	MSRI
Milovic Djordjo	Leiden University	420.00$	SMS
Mocs Lucia	Princeton University	420.00$	SMS
Morgan Adam	University of Bristol	420.00$	SMS
Najman Filip	University of Zagreb	420.00$	SMS
Nakahara Masahiro	Rice University	420.00$	MSRI
Saha Arnab	Australian National University	420.00$	SMS
Scarfy Justin	The University of British Columbia	673.60$	CMS
Shnidman Ari	University of Michigan	420.00$	SMS
Somoza Henares Ana	Universitat Politècnica de Catalunya	420.00$	SMS
Su Heng	UC Irvine	420.00$	MSRI
Tang Yunqing	Harvard University	420.00$	SMS
Trinh Tien	Rutgers University	420.00$	MSRI
Tsang Cindy (Sin Yi)	University of California, Santa Barbara	420.00$	MSRI
Tse Ling-Sang	University of Waterloo	420.00$	MSRI
Wong Peng-Jie	Queen's University	420.00$	SMS
Xia Yuhou	Princeton University	420.00$	MSRI
Xio Stanley	University of Waterloo	1,054.23$	CMS
Yamagishi Shuntaro	University of Waterloo	420.00$	SMS
Youcis Alex	University of California, Berkeley	420.00$	MSRI
Zomervrucht Wouter	Leiden University	420.00$	SMS
TOTAL Participants		26,387.83$	