

Institute for Computational and Experimental Research in Mathematics

Annual Report May 1, 2015 – January 31, 2016

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ICERM's Reporting Dates

ICERM received its NSF renewal grant for years 2015-2020 in the fall of 2015. ICERM ceased utilizing funds from its *original* 2010-2015 NSF grant as of January 31, 2016. Therefore, ICERM is submitting this abbreviated report for only the programs and events that were funded by its original 2010-2015 grant, starting May 1, 2015 and running through January 31, 2016. Since ICERM typically reports on its programs and events annually from May to the following May, a report detailing programs and events run at ICERM from February 1, 2016 through May 10, 2016 (and funded with its 2015-2020 renewal grant), will be submitted separately.

Mission

"The mission of the Institute for Computational and Experimental Research in Mathematics ICERM is to support and broaden the relationship between mathematics and computation: specifically, to expand the use of computational and experimental methods in mathematics, to support theoretical advances related to computation, and address problems posed by the existence and use of the computer through mathematical tools, research and innovation."

Core Programs and Events

ТҮРЕ	TITLE	DATE	# ATTENDED
Special Workshop/ Event	Houghton Conference on Non- Equilibrium Statistical Mechanics (This workshop was partially funded by Brown University	May 4-5, 2015	77
	Department of Physics)	17.00.0015	24
VI-MSS International Program	Graduate Student Team-Based Research: Computational Symplectic Topology (@Tel Aviv)	May 17-26, 2015, and July 27-Aug. 5, 2015	24
Topical Workshop A	Integrability in mechanics and geometry: theory and computations	June 1-5, 2015	42
Undergraduate	Summer@ICERM: Computational Dynamics and Topology	Jun 15 - Aug 7, 2015	28
Special Workshop/ Event	Conference for African American Researchers in the Mathematical Sciences (CAARMS)	Jun 24 - 27, 2015	68
Special Workshop/ Event	IdeaLab: Inverse Problems and Uncertainty Quantification	Jul 6 - 10, 2015	19
Topical Workshop B	Computational Geometric Topology in Arrangement Theory	July 6 - 10, 2015	39
Topical Workshop C	Computational and Analytical Aspects of Image Reconstruction	Jul 13 - 17, 2015	63
Topical Workshop D	Mathematics in Data Science	Jul 28 - 30, 2015	112
VI-MSS	Graduate Student Team-Based	May 17-31, 2015	26

ICERM's programs and events from May 1 2015 through January 31, 2016

International Program	Research: Brown-ICERM-Kobe Simulation Summer School		
Topical Workshop E	Numerical Methods for Large- Scale Nonlinear Problems and Their Applications	Aug 31, 2015 - Sep 4, 2015	62
Semester Program	Computational Aspects of the Langlands Program	Sep 9, 2015 - Dec 4, 2015	71
Program Workshop 1	Modular Forms and Curves of Low Genus: Computational Aspects	Sep 28, 2015 - Oct 2, 2015	94
Public Lecture	"Lotteries and Geometries" featuring Jordan Ellenberg	Oct 19, 2015	250
Program Workshop 2	Explicit Methods for Modularity of K3 Surfaces and Other Higher Weight Motives	Oct 19, 2015 - Oct 24, 2015	80
Program Workshop 3	Computational Aspects of L- functions	Nov 9, 2015 - Nov 13, 2015	96
Public Lecture	"From Flapping Birds to Space Telescopes: The Mathematics of Origami", featuring Robert J. Lang	November 12, 2015	400

Virtual Institute of Mathematical and Statistical Sciences VI-MSS

ICERM's supplemental proposal for the two-year pilot program "Virtual Institute of Mathematical and Statistical Sciences VI-MSS" was awarded in August 2011, creating a partnership that formally connects two US mathematical sciences institutes ICERM and SAMSI with several mathematics and statistics institutes in India. ICERM was granted a no-cost extension through 2016, which allowed the program to expand further on its original mission. ICERM presently includes jointly funded international collaborations with institutes and institutions in Brazil, Israel, Japan, and South Africa. These collaborations create a thriving "virtual" institute in the mathematical and statistical sciences.

VI-MSS Goals

- 1. Collaborative workshops held in US and other contributing international Institutes
- 2. Research visits by international faculty, postdocs and students to ICERM semester programs and workshops funded by their home institution.
- 3. Satellite workshops funded by international institutions associated with long programs at ICERM held abroad.
- 4. Graduate/postdoc joint training events.
- 5. Research visits abroad to participating international institutions.

Participating Institutions and Organizations

In US

• Institute for Computational and Experimental Research in Mathematics ICERM, Providence, RI

In Brazil:

Instituto Nacional de Matemática Pura e Aplicada IMPA

In Israel:

• School of Mathematical Sciences at the Tel Aviv University

In Japan:

• Kobe University

In South Africa:

• University of the Witwaterstrand, Johannesburg WITS and the African Institute for Mathematical Sciences AIMS

During this reporting period, ICERM held two international team-based summer schools jointly with Kobe University in Japan, and Tel-Aviv University in Israel. See the VI-MSS section later in this report for more details.

Participant Summaries by Program Type

For this reporting term (May 1, 2015 to January 31, 2016) 669 unique participants were enrolled in one semester long program and/or 8 workshops, Summer@ICERM, and IdeaLab. Of the 669, 442 received some sort of funding to attend an ICERM program. ICERM actively seeks women and members of underrepresented ethnic groups to participate in its programs as speakers and participants. While most participants choose to report their gender and ethnicity, some choose not to do so. All data below includes all organizers and is as of May 1, 2016.

					Gende	er and Et	hnicity			Geographical Point of Origin									
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
S	ummer@ICERM 2015	24	0	1	0	0	0	0	1	10	8	3	1	0	0	0	1	1	0
	IdeaLab	19	1	10	0	0	3	0	8	1	3	6	6	0	0	0	3	0	0
	CAARMS	26	9	18	17	0	0	1	18	2	11	12	1	0	0	0	0	0	0
Ho	ughton Conference	14	0	14	0	0	4	0	14	0	10	0	0	0	0	0	4	0	0
5	Semester Program	63	15	53	0	0	9	0	43	6	12	6	9	0	4	2	22	1	1
er '15	Workshop 1	83	19	68	0	0	10	0	53	6	23	8	13	0	2	3	25	2	1
leste	Workshop 2	68	11	53	0	0	7	0	39	6	18	8	10	0	2	4	17	2	1
Sen	Workshop 3	84	16	67	0	0	15	0	59	8	23	14	10	0	4	5	19	0	1
Fall	Total	298	61	241	0	0	41	0	194	26	76	36	42	0	12	14	83	5	4
	% of # Reporting		25%		0%	0%	21%	0%		9%	26%	12%	14%	0%	4%	5%	28%	2%	1%
	Workshop A	33	4	21	0	0	3	1	18	3	6	4	3	0	1	2	12	2	0
	Workshop B	35	5	26	0	0	8	1	25	7	4	5	2	0	3	2	11	1	0
'15	Workshop C	39	10	29	0	0	6	0	28	3	10	5	7	0	2	0	12	0	0
ical	Workshop D	66	19	53	2	0	18	1	44	3	20	14	23	1	0	2	3	0	0
Top	Workshop E	43	4	28	0	0	8	0	26	3	11	10	13	0	1	0	5	0	0
	Total	215	42	156	2	0	42	3	140	19	51	38	47	1	7	6	43	3	0
	% of # Reporting		27%		1%	0%	30%	2%		9%	24%	18%	22%	0%	3%	3%	20%	1%	0%

ICERM Funded Participants

	•					Geographical Point of Origin					
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Sun	mer@ICERM 2015	28	0	1	0	0	0	0	1	25	3
	IdeaLab	19	1	10	0	0	3	0	8	16	3
	CAARMS	68	15	37	36	0	0	0	38	77	1
Но	ughton Conference	77	6	48	0	0	11	1	40	62	14
	Semester Program	71	19	59	0	0	11	0	49	39	32
r '15	Workshop 1	94	24	78	0	0	12	0	62	59	35
iester '15	Workshop 2	80	13	61	0	0	8	0	46	53	27
Sem	Workshop 3	96	21	78	0	0	17	0	67	65	31
all	Total	341	77	276	0	0	48	0	224	216	125
H	% of # Reporting		28%		0%	0%	21%	0%		63%	37%
	Workshop A	42	5	26	1	0	4	1	22	24	18
	Workshop B	39	6	29	0	0	9	1	28	21	18
'15	Workshop C	63	13	50	0	1	11	0	46	38	25
ical	Workshop D	112	30	90	4	0	26	4	76	100	12
Top	Workshop E	62	5	45	0	0	14	2	43	52	10
	Total	315	59	238	5	1	63	8	214	232	83
	% of # Reporting		25%		2%	0%	29%	4%		74%	26%

All Participants ICERM funded and Non-ICERM funded

ICERM Funded Speakers

					Gender	and Eth	hnicity Geographical Point of Origin												
	Program Type	T otal Participants	Female	# Reporting Gender	A frican American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Summer@ICERM 2015		3	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
	IdeaLab	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CAARMS	9	0	1	1	0	0	0	1	2	5	1	1	0	0	0	0	0	0
	Houghton Conference	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Semester Program	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r '15	Workshop 1	24	8	22	0	0	1	0	17	2	6	0	4	0	0	0	10	1	1
estei	Workshop 2	20	3	16	0	0	1	0	8	2	6	1	0	0	0	2	7	1	1
em	Workshop 3	27	5	21	0	0	4	0	18	4	5	2	2	0	1	5	6	0	0
all S	Total	71	16	59	0	0	6	0	43	8	17	3	6	0	1	7	23	2	2
ц	% of # Reporting		27%		0%	0%	3%	0%		3%	6%	1%	2%	0%	0%	2%	8%	1%	1%
	Workshop A	22	2	12	0	0	2	1	10	1	5	2	2	0	1	1	8	2	0
	Workshop B	19	5	14	0	0	5	0	14	3	3	2	2	0	2	1	6	0	0
15	Workshop C	23	6	13	0	0	1	0	12	1	5	3	4	0	0	0	10	0	0
cal '	Workshop D	18	4	8	0	0	1	0	6	0	6	1	10	0	0	0	1	0	0
opic	Workshop E	26	1	12	0	0	2	0	10	2	4	3	12	0	1	0	4	0	0
Τ	Total	108	18	59	0	0	11	1	52	7	23	11	30	0	4	2	29	2	0
	% of # Reporting		31%		0%	0%	8%	1%		3%	11%	5%	14%	0%	2%	1%	13%	1%	0%

	A				Gen	der and Ethni	city			Geographical Point of Origin		
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based	
Sur	nmer@ICERM 2015	3	0	0	0	0	0	0	0	3	0	
	IdeaLab	0	0	0	0	0	0	0	0	0	0	
	CAARMS	12	0	2	2	0	0	0	2	12	0	
Но	oughton Conference	16	0	1	0	0	0	0	0	10	5	
	Semester Program	0	0	0	0	0	0	0	0	0	0	
- 15	Workshop 1	25	8	21	0	0	1	0	17	12	13	
ester	Workshop 2	20	3	16	0	0	1	0	8	9	11	
Semes	Workshop 3	31	5	23	0	0	4	0	19	16	14	
all S	Total	76	16	60	0	0	6	0	44	37	38	
Ц	% of # Reporting		27%		0%	0%	3%	0%		11%	11%	
	Workshop A	22	2	12	0	0	2	1	10	10	12	
	Workshop B	19	5	14	0	0	5	0	14	10	9	
'15	Workshop C	24	6	14	0	0	1	0	13	14	10	
ical	Workshop D	20	4	9	0	0	2	0	7	19	1	
[opica	Workshop E	26	1	12	0	0	2	0	10	21	5	
	Total	111	18	61	0	0	12	1	54	74	37	
	% of # Reporting		30%		0%	0%	6%	0%		23%	12%	

All Speakers ICERM funded and Non-ICERM funded

					Gender	and Ethr	nicity			Geographical Point of Origin									
	Program Type	Total Participants	Female	# Reporting Gender	A frican American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
5	Summer@ICERM 2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IdeaLab	7	1	7	0	0	3	0	6	1	2	0	3	0	0	0	1	0	0
	CAARMS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Но	oughton Conference	5	0	5	0	0	2	0	4	0	3	0	0	0	0	0	2	0	0
5	Semester Program	14	6	13	0	0	2	0	10	0	2	1	1	0	1	1	8	0	0
er '1	Workshop 1	18	7	17	0	0	0	0	12	0	3	0	1	0	1	1	11	0	0
neste	Workshop 2	11	3	10	0	0	1	0	8	0	3	0	1	0	1	1	5	0	0
Sen	Workshop 3	16	5	16	0	0	3	0	13	2	2	3	1	0	1	1	7	0	0
Fall	Total	59	21	56	0	0	6	0	43	2	10	4	4	0	4	4	31	0	0
	% of # Reporting		38%		0%	0%	3%	0%		1%	3%	1%	1%	0%	1%	1%	10%	0%	0%
	Workshop A	4	0	4	0	0	0	0	4	0	0	1	0	0	0	1	2	0	0
	Workshop B	4	2	4	0	2	0	0	4	0	1	0	0	0	1	0	2	0	0
15	Workshop C	4	2	4	0	0	1	0	4	0	0	0	1	0	0	0	3	0	0
ical	Workshop D	14	3	13	2	0	5	0	12	1	3	3	5	0	0	1	1	0	0
Top	Workshop E	3	0	3	0	0	3	0	3	1	2	0	0	0	0	0	0	0	0
	Total	28	7	27	2	2	8	0	26	2	6	4	5	0	1	2	8	0	0
	% of # Reporting		26%		1%	1%	6%	0%		1%	3%	2%	2%	0%	0%	1%	4%	0%	0%

ICERM Funded Postdoctoral Fellows and Postdoctoral visitors

5 postdocs received a stipend from ICERM during this reporting period: 2 males, 3 Females.

					Gen	der and Ethni	city			Geographical Point of Origin		
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based	
Sur	nmer@ICERM 2015	0	0	0	0	0	0	0	0	0	0	
	IdeaLab	7	1	7	0	0	3	0	6	6	1	
	CAARMS	6	0	3	3	0	0	1	3	6	0	
H	oughton Conference	14	0	12	0	0	5	0	10	10	4	
	Semester Program	17	8	15	0	0	3	0	12	5	11	
- 15	Workshop 1	19	7	17	0	0	1	0	12	5	14	
estei	Workshop 2	13	3	10	0	0	1	0	8	6	7	
Sem	Workshop 3	19	7	18	0	0	4	0	15	9	10	
all S	Total	68	25	60	0	0	9	0	47	25	42	
щ	% of # Reporting		42%		0%	0%	4%	0%		7%	12%	
	Workshop A	4	0	4	0	0	0	0	4	1	3	
	Workshop B	4	2	4	0	2	0	0	4	1	3	
'15	Workshop C	9	2	8	0	0	3	0	7	3	6	
ical	Workshop D	23	4	19	3	0	5	2	18	18	5	
Top	Workshop E	6	0	6	0	0	4	2	6	5	1	
	Total	45	8	40	3	2	11	4	38	27	18	
	% of # Reporting		20%		1%	1%	5%	2%		9%	6%	

All Postdocs ICERM funded and Non-ICERM funded

5 postdocs received a stipend from ICERM during this reporting period: 2 males, 3 Females.

				Gender	and Eth	nicity			Geographical Point of Origin										
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Summer@ICERM 0 2015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IdeaLab	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAARMS 8		3	7	7	0	0	0	7	1	0	4	0	0	0	0	0	0	0	
Houghton Conference 5		0	5	0	0	2	0	5	0	3	0	0	0	0	0	2	0	0	
	Semester Program	11	2	10	0	0	3	0	10	1	4	2	1	0	0	0	2	1	0
r 15	Workshop 1	21	5	20	0	0	7	0	17	1	7	3	3	0	0	0	6	1	0
ester	Workshop 2	11	1	10	0	0	3	0	10	1	4	2	1	0	0	0	2	1	0
Sem	Workshop 3	14	1	12	0	0	5	0	9	1	8	2	1	0	0	0	2	0	0
all 9	Total	57	9	52	0	0	18	0	46	4	23	9	6	0	0	0	12	3	0
Ц	% of # Reporting		17%		0%	0%	9%	0%		1%	8%	3%	2%	0%	0%	0%	4%	1%	0%
	Workshop A	5	1	5	0	0	1	0	4	1	1	0	1	0	0	0	2	0	0
	Workshop B	7	1	7	0	0	5	0	7	4	1	1	0	0	1	0	0	0	0
15	Workshop C	4	1	4	0	0	2	0	4	0	3	0	0	0	1	0	0	0	0
cal '	Workshop D	10	5	10	0	0	1	1	9	0	3	4	2	0	0	1	0	0	0
opie	Workshop E	5	1	5	0	0	1	0	5	0	2	2	0	0	0	0	1	0	0
	Total	31	9	31	0	0	10	1	29	5	10	7	3	0	2	1	3	0	0
	% of # Reporting		29%		0%	0%	7%	1%		2%	5%	3%	1%	0%	1%	0%	1%	0%	0%

				Geographical Point of Origin							
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Sur	nmer@ICERM 2015	0	0	0	0	0	0	0	0	0	0
	IdeaLab	0	0	0	0	0	0	0	0	0	0
	CAARMS	35	9	23	23	1	0	1	23	21	0
Houghton Conference 15		0	10	0	0	3	0	8	11	4	
	Semester Program	13	3	11	0	0	4	0	11	9	4
- 15	Workshop 1	22	6	20	0	0	7	0	17	15	7
estei	Workshop 2	13	2	12	0	0	4	0	12	10	3
Sem	Workshop 3	15	2	10	0	0	6	0	10	13	2
all :	Total	63	13	53	0	0	21	0	50	47	16
Ц	% of # Reporting		25%		0%	0%	9%	0%		14%	5%
	Workshop A	9	1	7	1	0	1	0	6	7	2
	Workshop B	10	1	9	0	0	5	0	9	9	1
'15	Workshop C	11	3	11	0	1	3	0	11	6	5
ical	Workshop D	15	5	13	0	0	1	2	12	13	2
Top	Workshop E	10	2	9	0	0	3	0	9	7	3
	Total	55	12	49	1	1	13	2	47	42	13
	% of # Reporting		24%		0%	0%	6%	1%		13%	4%

All Graduate Students ICERM funded and Non-ICERM funded

courden und workshops.																		
		Gender and Ethnicity							Geographical Point of Origin									
Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Kobe	2	0	2	0	0	1	0	2	0	0	0	1	0	1	0	0	0	0
Tel Aviv	12	0	8	0	0	1	1	6	0	2	4	4	0	0	1	1	0	0
% of # Reporting		0%		0%	0%	17%	17%		0%	17%	33%	33%	0%	0%	8%	8%	0%	0%

ICERM Funded VI-MSS Attendees - Data below indicates ICERM funded participants who traveled to within the VI-MSS program for research and workshops.

Additional Participant Data

The charts below display breakdowns of ICERM's confirmed participants including organizers by category during the reporting period for all funded programs. Note that VI-MSS program data is not included.





Figure 1





Academic Breakdown



















Semester Programs

Since its inaugural semester program in September 2011, a large portion of the Institute's activity has taken place in the context of semester long thematic programs together with their associated workshops.

Semester Program Process

ICERM's Scientific Advisory Board SAB meets annually in November, and schedules conference calls as needed throughout the year. The 2015 annual meeting and a subsequent conference call in June resulted in the selection of semester programs and topical workshops through Fall 2018.

The semester program selection process follows these steps:

1. Solicitation of Proposals

ICERM hosts two semester programs per year. Each has 5-10 organizers and typically incorporates three week-long associated workshops. Semester program proposers are asked to contact the ICERM Director to discuss program ideas prior to starting a pre-proposal.

Pre-Proposal Requirements

A 2-3 page document which describes the scientific goals, lists the organizers of the program, and identifies the key participants.

Pre-Proposal Target Deadline

All pre-proposals should be submitted to the ICERM Director. Target deadlines are early September and mid-April. The ICERM directors and a subcommittee of the Scientific Advisory Board SAB review all pre-proposals. Proposers receive feedback within a few weeks of their submission.

Semester Program Full Proposal Requirements

Full Proposals for semester programs consist of 6-10 pages containing:

- A description of the program area/theme written with a general mathematical audience in mind,
- A description of the central scientific challenges to be addressed by the program,
- A list of organizers normally around 5-10, most of whom will be in residence for the semester program,
- A list of 8-10 high priority senior scientists who are likely to visit ICERM as long-term participants for a month or more,
- An additional ranked list of up to 20 or more potential long-term participants the organizing committee feels will help form a critical mass for the scientific program,
- A main contact chair of organizing committee,
- A description of the three proposed workshops including potential organizers if possible,
- A discussion of the experimental and computational aspects of the program,
- Concrete plans for involving and mentoring graduate students, postdocs, and early-career mathematicians in the program tutorials at the beginning of the program and/or before workshops, weekly student/postdoc seminars, advising and other structured mentoring activities from the senior participants,
- An assigned organizer responsible for coordination of mentoring,
- Plans for ensuring the participation of underrepresented groups organizers are expected to work with ICERM directors on diversity issues.

Semester Program Full Proposal Deadline

All full proposals should be submitted to the ICERM Director. Target deadlines are October 1st and May 1st. The ICERM directors and the Scientific Advisory Board SAB review all proposals. Proposers receive feedback within a few weeks of their submission.

2. Proposal Selection

The Science Advisory Board SAB approves the semester programs. The deadline for proposals is at least a week prior to the annual November SAB meeting typically the end of the month. Proposals are usually sent out for review. Once a proposal is accepted, an ICERM Director and members of a SAB subcommittee are assigned to assist the organizers and the organizers are provided with a semester program planning timeline. The "high priority" list of senior scientists are contacted and invited to participate immediately upon approval of the program and this list by the SAB. Program dates are scheduled with details posted on the ICERM website and various on-line math organization calendars SIAM, AMS, European Mathematical Society, National Math Institutes, and Conference Service Mandl. Program and/or workshop ads are placed in appropriate publications if recommended by the organizers and directors. In addition, ICERM reserves some funds for applicants to the program.

From this point on, organizers are involved in making decisions on the following: ICERM postdoc selection; applications for long-term visitors, graduate students, and workshop participants; mentoring of students and postdocs an institute Director assists organizers with mentor coordination. The Directors make the final decision on all invitations. The chair of the organizing committee or other designated organizer assists ICERM staff by providing appropriate program images for web and print ads, and may be asked to review marketing materials.

3. Selection of Long-term Visitors/Research Fellows

The organizers propose a ranked list of 15 to 20 research fellows. ICERM Directors approve and/or suggest additions or re-rankings in consultation with assigned SAB members. The standard model for long-term participation for senior faculty is through paid leaves such as sabbatical.

4. Offers to Research Fellows

Once the list of research fellows has been finalized and funding determined, an invitation is sent to each. The invitation describes the program and outlines the support to be provided. Using its Discovery database, ICERM tracks demographic information about, and all interactions with, research fellows.

5. Semester Workshops

The semester program proposal should include a list of organizers for each of its three workshops. The organizers propose an initial ranked list of 20-25 possible speakers and a list of 10 alternates. The ICERM Directors approve and/or suggest additions or re-rankings in consultation with assigned SAB members. Formal invitations are sent by ICERM staff describing the program and outlining the support to be provided to those who indicate an interest.

The chair of each workshop's organizing committee or other designated organizer assists ICERM staff by providing appropriate program images for the workshop's web and print ads, and may be asked to review marketing materials.

6. Application Process

Once the organizers and Directors agree there is enough critical mass in terms of confirmed long-term visitors and/or workshop speakers, the on-line application for that particular program is opened on the ICERM website. All applications are stored in the institute's Application database. The ICERM postdoctoral fellow applicants who were not hired are either automatically entered into the online applicant pool, or they are alerted that these positions have closed and that they should apply online for partial support to attend if they are still interested.

7. Applicant Selection

The Application database allows program organizers, ICERM Directors and staff to view each candidate's application. Every two weeks or so, the organizers are asked to recommend a ranking of

applicants for their program graduate students, participants. ICERM Directors review the ranked list, re-rank as appropriate and make the final selections, taking into consideration the remaining budget for the program, diversity, participant support requested, and whether or not the applicant if a young researcher has an advisor already participating in the program. ICERM staff then updates the applicant about their status, and any support they are eligible for, as appropriate. This process continues until funds for the program run out.

Financial Decisions for Semester Programs

Financial decisions are made by ICERM Directors based on discussions with organizers. On average, the institute provides stipends for 5 semester postdoctoral fellows for each program, and one 9-month fellowship for each program, as well as support for travel and shared housing for 12-15 graduate students per program. There is support for housing and travel for around 15-20 long-term visitors including organizers who stay for 4 months, and up to 60 additional shorter term visitors who stay for 1-4 weeks. In addition, there is support for workshop attendees. The institute has very limited funds for stipends and buyout of teaching for key participants. Some funds are reserved for support for applicants to the program. In general, ICERM will aim to help participants negotiate sabbatical leaves and teaching release from their departments to participate in institute programs.

Opening, "Middle" and Closing Events

Semester program opening and closing events are tailored to each program. Here are some examples of planned events during semester programs.

Opening event

Lasts about 1-2 days, beginning on first day of program and includes:

- 10-15 minute introductory presentations by the postdocs and grad students, designed to get everyone acquainted
- Opening reception on first day of program
- Talks related to upcoming workshops
- IT tutorial led by ICERM's IT staff

Weekly Seminar non workshop weeks

• The weekly seminar includes talks by visitors in residence at ICERM. Program organizers are provided with names and dates to facilitate scheduling.

Mini-Series Optional

• Mini-courses or other multi-session events are encouraged.

Research Clusters Optional

A Research Cluster takes place during a semester program and is an independently organized research group activity in a focused subfield of that semester program.

A typical Research Cluster lasts at least 10 days, and as long as 4-6 weeks, and focuses on immediate progress on a major problem or on several problems of significance in the field of the program. In addition to the invited participants, interested faculty, postdocs or graduate students in residence at ICERM may participate in the research cluster.

The activity period begins with a collection of tutorials or a short possibly two day workshop. The research activities, planned by the organizers, may consist of teamwork, daily/weekly seminars, and closing presentations. In collaboration with an ICERM director, Research Cluster organizers develop a list of 6-15 key scientists to form the core cohort of the cluster.

Prior to each of semester workshops

- Full-day tutorials the Thursday and Friday the week before each workshop.
- Tutorials are given by long term visitors to the program

During Semester Workshops

- Workshops last 1 week and consist of 50-minute talks with 10 minutes of Q&A.
- Typically one afternoon is left "open" for collaborations and small groups
- A poster session is scheduled midweek, usually in the early evening with refreshments
- Workshops include a "wrap-up" session to discuss ideas and new directions among all of the workshop participants together

Non-workshop weeks

- Lectures occur through either mini courses, research seminars, special talks, and/or computational working group meetings
- Young Researcher Seminar, where graduate students and postdocs meet sans faculty and discuss scientific questions
- Postdocs and grad students are mentored throughout the program, both informally and with formal professional development seminars and meetings

Final Event

During the first week of the program a 1-day closing event is planned with input from the organizing committee. Some possible models include:

- Short talks from all long term visitors who are still in residence
- Special Colloquium to close out the event on the last day of the program
- Time set aside for takeaways
- Closing reception

Note: Sample schedules and organizer timeline can be found in Appendix A

Fall 2015 Semester Program

Fall Semester 2015: Computational Aspects of the Langlands Program September 9, 2015 - December 4, 2015

Organizing Committee

Alina Bucur, UCSD Brian Conrey, AIM and University of Bristol David Farmer, AIM John Jones, Arizona State University Kiran Kedlaya, UCSD Michael Rubinstein, University of Waterloo Holly Swisher, Oregon State University John Voight, Dartmouth College

Program Description

In the late 1960s, Robert Langlands discovered a unifying principle in number theory providing a vast generalization of class field theory to include nonabelian extensions of number fields. This principle gives rise to a web of conjectures called the Langlands program which continues to guide research in number theory to the present day. For example, an important first instance of the Langlands program is the

modularity theorem for elliptic curves over the rational numbers, an essential ingredient in the proof of Fermat's last theorem.

Despite its many successes, the Langlands program remains vague in many of its predictions, due in part to an absence of data to guide a precise formulation away from a few special cases. In this thematic program, we will experiment with and articulate refined conjectures relating arithmetic-geometric objects to automorphic forms, improve the computational infrastructure underpinning the Langlands program, and assemble additional supporting data. Such data has proven valuable for researchers in number theory, and it will continue to be made available at the L-Functions and Modular Forms Database.

During the semester we will focus on three specific aspects of the Langlands program. First, we will look at elliptic curves over number fields and genus 2 curves over the rationals and will consider their relationship to modular forms. Second, we will consider computational aspects of modular forms in higher rank. Specifically, we will examine K3 surfaces and their connections to modular forms on orthogonal groups. Our third topic concerns analytic aspects of L-functions, building upon and complementing the algebraic, arithmetic, and geometric data.

Note: see Appendix B for an article about the L-functions and Modular Forms Database (LMFDB).

Workshop 1: Modular Forms and Curves of Low Genus: Computational Aspects September 28-October 2, 2015

Organizing Committee

John Cremona, University of Warwick Kiran Kedlaya, University of California, San Diego Kristin Lauter, Microsoft Research Ralf Schmidt, University of Oklahoma Joseph Silverman, Brown University

Program Description

One of the crowning achievements of number theory in the 20th century is the construction of the modularity correspondence between elliptic curves with rational coefficients and modular forms of weight 2. The consequences of this result resound throughout number theory; for instance, it enables the resolution of certain problems of diophantine equations e.g., Fermat's last theorem as well as the systematic tabulation of elliptic curves, which in turn provides the basis for many new conjectures and results.

The aim of this workshop is to lay the groundwork for extending this correspondence to curves of small genus over number fields. The general framework for this correspondence is predicted by the Langlands program, but much remains to be made explicit. We will explore theoretical, algorithmic, computational, and experimental questions on both sides of the correspondence, with an eye towards tabulation of numerical data and formulation of precise conjectures.

Speakers

Samuele Anni, University of Warwick Irene Bouw, Universität Ulm Reinier Bröker, Brown University Armand Brumer, Fordham University Alyson Deines, Center for Communications Research Kirsten Eisentraeger, Pennsylvania State University David Harvey, University of New South Wales Sorina Ionica, University of Bordeaux Jennifer Johnson-Leung, University of Idaho Angelos Koutsianas, University of Warwick Elisa Lorenzo, Garcia Universiteit Leiden Marc Masdeu, University of Warwick Rachel Newton, Institut Des Hautes Études Scientifiques IHÉS Ariel Pacetti, University of Buenos Aires Cris Poor, Fordham University Brooks Roberts, University of Idaho Nathan Ryan, Bucknell University Nils Skoruppa, Universität Siegen Andrew Sutherland, Massachusetts Institute of Technology Christelle Vincent, Stanford University Tonghai Yang, University of Wisconsin David Zywina, Cornell University

Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field":

- "The mere fact of talking with other researcher with similar interests is a big benefit. ICERM is a wonderful place to work collaboratively."
- "I have learned many new techniques and problems in the area of computational number theory during my stay at ICERM."
- "I learned of the work of experts who are implementing advanced methods to count points on curves, determine local L-functions, find the sign of functional equation of the L-function and many other computational procedures that may prove useful in my own theoretical work. Being able to speak with these experts in person is the most efficient way to understand these new methods. At the same time, many of the theory talks put the computational methods in the kind of broad theoretical context that stimulates the development of new abstract ideas."

A Workshop Organizer Comment for "Briefly describe workshop highlights":

• "The mix of theoretical and computational talks."

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *"I gave a talk that was well received. I advanced projects significantly because my collaborators were also present at this workshop."*
- "Being able to interact with researchers directly in my area."

Workshop 2: Explicit Methods for Modularity of K3 Surfaces and Other Higher Weight Motives October 19-23, 2015

Organizing Committee

Matthias Schütt, Gottfried Wilhelm Leibniz Universität Hannover Fernando Rodriguez-Villegas, University of Texas at Austin Bianca Viray, University of Washington Holly Swisher, Oregon State University Yuri Tschinkel, New York University John Voight, Dartmouth College

Workshop Description

Only recently has it become feasible to do large scale verification of the predictions of the Langlands program in higher rank cases and to present the results in a way that is accessible widely to mathematicians. Moving from the understanding of Galois representations attached to elliptic curves to those attached to surfaces and other higher-dimensional varieties poses interesting problems in both arithmetic, algebra, geometry, and analysis.

In this workshop, we will consider computational and other explicit aspects of modular forms in higher rank. Topics covered will include: K3 surfaces and their connections to modular forms on orthogonal groups, algebraic modular forms associated to classical groups and their computation, and motives arising from general Calabi-Yau varieties accessible to explicit methods, including hypergeometric motives. This workshop will bring together researchers who approach the Langlands program from a number of different perspectives, and our goal is to work in developing both the theoretical and computational aspects in tandem.

Speakers

Adrian Clingher, University of Missouri, St. Louis Slawomir Cynk, Jagiellonian University Noam Elkies, Harvard University Benedict Gross, Harvard University David Harvey, University of New South Wales Joerg Jahnel, University of Siegen Remke Kloosterman, Humboldt Universitaet zu Berlin Abhinav Kumar, Stony Brook University Edgar Martins, Dias Costa ICERM/Dartmouth College Hossein Movasati, IMPA David Roberts, University of Minnesota, Morris Adriana Salerno, Bates College Matthias Schuett, Gottfried Wilhelm Leibniz Universität Hannover Anthony Varilly-Alvarado, Rice University Ursula Whitcher, University of Wisconsin-Eau Claire Noriko Yui, Queen's University

Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field":

- "This workshop gave me a nice picture of what the Langlands philosophy predicts in higher weight. I was also able to get a great overview of lots of different computational perspectives. It also broadened my perspective in algebraic geometry. In particular, seeing how elliptic curves, K3 surfaces, and Calabi-Yau's play a special role in geometry and arithmetic."
- "Several main talks in the workshop were devoted to the above topics, talks presented expertise and up-to-date knowledge and new developments."
- "An important approach to study Shimura curves and abelian surfaces with QM is via K3 surfaces. During the workshop, I had the opportunity to talk to experts in this area. Also, there was a talk specifically on this subject. This added to my knowledge of computational methodology for Shimura curves and abelian surfaces with QM."

Some Workshop Organizer Comments for "Briefly describe workshop highlights":

• "I really appreciated the slower pace compared with the first workshop, it really allowed for time to digest the talks."

• "Amazing diversity of talks in an very stimulating atmosphere."

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- "I was able to initiate scientific collaborations."
- "Very pleased to have detailed & excited feedback on my talk."
- "Having a chance to work with my collaborators while at the same time meeting new people and learning new things. So many good things!"

Workshop 3: Computational Aspects of L-functions November 9-13, 2015

Organizing Committee

Valentin Blomer, Universität Göttingen Brian Conrey, American Institute of Mathematics Chantal David, Concordia University David Farmer, AIM Michael Rubinstein, University of Waterloo Peter Sarnak, Princeton University

Workshop Description

This conference will revolve around several themes: the computational complexity of L-functions; statistical problems concerning L-functions, such as the distribution of their values, and zeros, moments of L-functions, statistics and size of ranks in families of elliptic curves; practical implementations of algorithms and their applications to testing various conjectures about L-functions; rigorous and certifiable computations of L-functions. One goal is to stimulate dialogue between theoreticians and computationally minded researchers regarding problems to which computation might provide insight or important confirmation of conjectures. In the other direction, we hope that discussions will lead to new ideas concerning algorithms for L-functions.

Speakers

Zin Arai Hokkaido, University Jeremy Avigad, Carnegie Mellon University Wael Bahsoun, Loughborough University Ilia Binder, University of Toronto Sarah Day, College of William and Mary Rafael de la Llave, Georgia Tech Artem Dudko, Stony Brook University Jordi-Lluís Figueras, University of Uppsala Gary Froyland, University of New South Wales Denis Gaidashev, Uppsala University Stefano Galatolo, University of Pisa Zbigniew Galias, AGH University of Science & Technology Vadim Kaloshin, University of Maryland Hans Koch, University of Texas at Austin Jean-Philippe Lessard, Université Laval Suzanne Lynch Boyd, University of Wisconsin-Milwaukee Giorgio Mantica, Universita' dell'Insubria Konstantin Mischaikow, Rutgers University Irina Mitrea, Temple University

Maurizio Monge, Federal University of Rio de Janeiro UFRJ Isaia Nisoli, Federal University of Rio de Janeiro UFRJ Kathrin Padberg-Gehle, Technische Universitat Dresden Pawel Pilarczyk, IST Austria Cristóbel Rojas, Universidad Andrés Bello Santiago Pablo Roldán González, Instituto Tecnológico Autónomo de México Dalia Terhesiu, University of Exeter Daniel Wilczak, Jagiellonian University Piotr Zgliczynski, Jagiellonian University

Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field":

- "I discovered many interesting questions and results in computational number theory, arithmetical statistics, related to the modular forms and L-functions associated to GL2, that I was not aware of."
- "It allowed me to discover interesting ideas about optimizing certain algorithms in number theory in particular on L-functions."
- "A number of talks were on analytic number theory but were not so closely related to computational issues on L-functions. I wish the 15-minute talk on L-functions in PARI had been expanded to a 50-minute talk."
- "A talk can give a good overview of a computational strategy, but the details of implementation require smaller groups. The time spent in smaller groups was very beneficial for the understanding and transmission of the details of implementation."

Some Workshop Organizer Comments for "Briefly describe workshop highlights":

• None

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *"The highlight was a very nice two-person talk by Chris Poor and David Yuen."*
- "I was amazed by the number of bright women, by the people working on the L-functions and modular forms data bases, meeting every week for a whole afternoon, there were also a course and seminars, by the fact that that there was so much collaboration in computational number theory, as this is not the case for more abstract mathematics, and by the interesting results that they get. I think that in the future there will be more and more computational number theory."
- "I loved the 15-minute highlights and the broad-vision talks of Sarnak and Conrey."
- "Many brilliant number theorist from every part of the world. Very interesting talks."

Name	Organization	Time Spent at ICERM in days
Abramovich, Dan	Brown University	46
Anni, Samuele	University of Warwick	57
Arora, Sonny	Pennsylvania State University	4
Asgarli, Shamil	Brown University	4
Atkas, Kevser	Queen's University	4

All Visitors to Fall 2015 Semester Program

Gray highlight represents anyone staying over 9 days

Balakrishnan, Jennifer	Oxford University	27
Balkanova, Olga	ICERM	121
Ballantine, Cristina	College of the Holy Cross	86
Baluyot, Siegfred	University of Rochester	4
Bao, Dianbin	Temple University	4
Beineke, Jennifer	Western New England University	4
Bejleri, Dori	Brown University	4
Bell, Renee	MIT	3
Bennett, Michael	University of British Columbia	4
Bettin, Sandro	ICERM	121
Blomer, Valentin	Universität Göttingen	4
Bober, Jonathan	Heilbronn Institute	34
Booker, Andrew	University of Bristol	4
Borges, Herivelto Martins	Universidade de São Paulo	4
Bouw, Irene	Ulm Germany	22
Brandhorst, Simon	Leibniz University Hanover GRK	4
Breen, Benjamin	Dartmouth College	86
Broggi, Francesco	University of Warwick	4
Broker, Reinier	Brown University	4
Brumer, Armand	Fordham University	25
Bucur, Alina	(UCSD)	101
Börner, Michel	Ulm University	4
Call, Gregory	Amherst College	92
Canadell, Marta	ICERM	121
Candelori, Luca	LSU	4
Caselli, Marco	University of Warwick	4
Chen, Hao	University of Washington	4
Chen, William	Penn State	90
Choi, Suh Hyun	KAIST	4
Choie, YoungJu	POSTECH	6
Cohen, Henri	University of Bordeaux	55
Conrey, Brian	AIM and University of Bristol	73
Consani, Caterina	Johns Hopkins University	4
Costa, Edgar	ICERM	121
Cremona, John	University of Warwick	77
Cullinan, John	Bard College	4
Cunningham, Clifton	University of Calgary	4
Slawomir Cynk	Jagiellonian University	4
Davidoff, Giuliana	Mount Holyoke	4
Deines, Alyson	CCR - La Jolla	4
Dembele, Lassina	Warwick UK	32
Dokchitser, Tim	University of Bristol	7
Dose, Valerio	Istituto Nazionale di Alta Matematica	4
Dupuy, Taylor	The Hebrew University	67
Eischen, Ellen	UNC	8
Eisentraeger, Kirsten	Penn State	4
Ejder, Ozlem	University of Southern California	4
Elkies, Noam	Harvard University	25
Elsenhans, Andreas-Stephan	University of Sydney	5

Emerton, Matthew	University of Chicago	4
Farmer, David	AIM	86
Finotti, Luis	University of Tennessee	4
Fite, Francesc	Universität Duisburg-Essen	4
Frechette, Sharon	College of the Holy Cross	86
Freitas, Nuno	Max Planck Institute	35
Ghosh, Amit	Oklahoma State University	4
Goins, Edray	Purdue University	97
Gonek, Steve	University of Rochester	4
Gross, Benedict	Harvard University	86
Guerberoff, Lucio	University College London	4
Guerreiro, Joao	Columbia University	4
Haensch, Anna	Dequesne University	4
Haghighat, Babak	Harvard University	3
Harvey, David	University of New South Wales	86
Hassett, Brendan	Brown	25
Hein, Jeffery	Dartmouth College	86
Hiary, Ghaith	Ohio State University	86
Huang, Bingrong	Columbia University	4
Ionica, Sorina	University of Bordeaux	13
Jahnel, Joerg	University of Siegen	9
Jennings-Shaffer, Christopher	Oregon State	4
Johnson-Leung, Jennifer	University of Idaho	4
Jones, John	Arizona State University	86
Kadiri, Habiba	University of Lethbridge	4
Kazalicki, Matija	University of Zagrab	4
Keating, Jon	University of Bristol	4
Kedlaya, Kiran	UCSD	101
Khuri-Makdisi, Kamal	American University of Beirut	11
Kilicer, Pinar	Leiden University	4
Kim, Seoyoung	Brown University	92
Kim, Yeansu	University of Iowa	4
Kiral, Eran	Texas A&M	4
Klinger-Logan, Kim	University of Minnesota	4
Kloosterman, Remke	Humboldt University of Berlin	4
Kohen, Daniel	University of Buenos Aires	31
Koutsianas, Angelos	University of Warwick	14
Koutsoliotas, Sally	Bucknell University	86
Kramer, Kenneth	CUNY	4
Kumar, Abhinav	Stony Brook University	4
Ladd , Watson	UC Berkeley	86
Lalin, Matilde	University of Montreal	4
Lauter, Kristin	Microsoft Research	4
Lee, Min	University of Bristol	29
Lee, TingFang	Brown University	92
Lemurell, Stefan	University of Gothenburg	19
Li, Wenching	Pennsylvania State University	86
Li, Chao	Columbia University	4
Liu, Sheng-Chi	Washington State University	4

Lomeli, Luis	Max-Planck Institute for Mathematics	4
Long, Ling	Louisiana State University	73
Lorenzo Garcia, Elisa	Universiteit Leiden	4
Martin, Kimball	University of Oklahoma	4
Martindale, Chloe	Leiden University	6
Marzec, Jolanta	University of Bristol	31
Mascot, Nicholas	University of Warwick	71
Masdeu, Marc	University of Warwick	4
Massierer, Maike	University of Lorraine / Inria / CNRS	13
Maurischat, Kathrin	Heidelberg University	4
Medvedovsky, Anna	ICERM	121
Milinovich, Micah	University of Mississippi	4
Miller, Steven J.	Williams College	4
Molin, Pascal	Université Paris Diderot	4
Mossinghoff, Michael	Davidson College	4
Movasati, Hossein	IMPA	4
Neururer, Michael	University of Nottingham	56
Newton, Rachel	IHÉS	4
Ng, Nathan	University of Lethbridge	4
Omar, Sami	American University Kuwait	4
Pacetti, Ariel	University of Buenos Aires	5
Page, Aurel	University of Warwick	71
Papikian, Mihran	Penn State	4
Peters, Tom	University of Connecticut	4
Pitale, Ameya	University of Oklahoma	4
Platt, David	University of Bristol	4
Poonen, Bjorn	MIT	46
Poor, Cris	Fordham University	51
Radziwill, Maksym	Rutgers University	4
Reznikov, Andre	Bar-Ilan University	4
Robert, Damien	Ecole Normale Superieure	4
Roberts, David	University of Minnesota - Morris	86
Roberts, Brooks	University of Idaho	4
Roditty-Gershon, Edva	Tel Aviv University	4
Rodriguez-Villegas, Fernando	University of Texas, Austin	??
Rubinstein, Michael	University of Waterloo	86
Rudnick, Zeev	Tel Aviv University	4
Rupert, Malcolm	University of Idaho	4
Ryan, Nathan	Bucknell University	46
Salerno, Adriana	Bates College	4
Schein, Michael	Bar-Ilan University	4
Schiavone, Samuel	Dartmouth College	89
Schilly, Harald	University of Vienna	20
Schmidt, Ralf	University of Oklahoma	86
Schuett, Matthias	University of Copenhagen and University of	4
	Hannover	
Shahidi, Freydoon	Purdue University	27
She, Yiwei	Columbia University	4
Shukla, Alok	University of Oklahoma	86

Shurman, Jerry	Reed College	51
Sijsling, Jeroen	Dartmouth College	4
Silverman, Joe	Brown University	86
Skoruppa, Nils	Universität Siegen	4
Snaith, Nina	University of Bristol	11
Soto Ballesteros, Eduardo	University of Barcelona	4
Soundararajan, Kannan	Stanford University	4
Streng, Marco	Universiteit Leiden	4
Stromberg, Fredrik	Technische Universität Darmstadt	4
Sun, Peng	Central University of Finance and Economics	4
Sutherland, Andrew	MIT	86
Swisher, Holly	Oregon State University	86
Taelman, Lenny	University of Amsterdam	4
Tanimoto, Sho	Rice University	4
Thorne, Frank	University of South Carolina	4
Tran, Long	University of Oklahoma	92
Triantafillou, Nicholas	MIT	25
Tschinkel, Yuri	New York University	4
Tu, Fang Ting	National Chiao Tung University	37
Turnage-Butterbaugh, Caroline	North Dakota State University	4
Ulmer, Douglas	Georgia Institute of Technology	2
Varilly-Alvarado, Anthony	Rice University	4
Vigneras, Marie-France	Jussieu	29
Vincent, Christelle	Stanford University	86
Voight, John	Dartmouth College	90
Wagh, Siddhesh	University of Oklahoma	4
Weigandt, James	ICERM	121
Wewers, Stefan	Ulm Germany	20
Whitcher, Ursula	University of Wisconsin- Eau Claire	4
Wong, Tian An	City University of New York (CUNY)	4
Yang, Tonghai	University of Wisconsin	4
Yang, Yifan	National Chiao Tung University	13
Young, Matthew	Texas A&M University	4
Yuen, David	Lake Forest College	46
Yui, Noriko	Queen's University	4
Zhou, Fan	Ohio State University	4
Zhu, Hui	SUNY at Buffalo	92
Zywina, David	Cornell University	4

Here follows a sample of the most substantive comments from our long-term visitors:

Some Semester Program Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field":

- "I learned a lot about the latest theoretical developments, as well as about the state of art in computational number theory."
- "As far as the theoretical developments are concerned, I don't think the meeting at ICERM added that much to my knowledge. However, I did learn a lot from other participants who had more experience on the computational side."

• "It was very beneficial for me to attend lectures, seminars and a workshop related to my area. It definitely broaden my knowledge on this topic. I found particularly useful a course on quaternion algebras. This is one of those topics with which one should have at least basic familiarity, and because my research haven't used yet any of its tools, my knowledge was very limited on this subject. I also become more aware of computational methods."

Some Semester Organizer Comments for "Briefly describe program highlights":

- "Numerous participants reported new interactions and collaborations."
- "I was able to work on several projects, learn from other participants, participate in LMFDB development, and invigorate my research program while connecting it more deeply to broader mathematical goals."
- I think that a lot of great work on the LMFDB happened. I was extremely pleased to see such a broad range of number theorists working together. I think this project has a great unifying force."
- "I liked Sally K's talk during workshop 3 where she presented a table of L-functions of degree 4 all with the same Gamma factors in their functional equation but arising from multiple sources; with the open question of where the level 550 one came from!"

Some Semester Organizers Comments for "What, if any, specific projects or collaborations did you pursue during this program?":

- "I started looking at effective constants in Chebotarev-like results, as well as in Sato-Tate results. I finished a paper started last year on one level density for L-functions of cyclic p-covers over finite fields. I have started a couple of projects computing databases of L-functions of elliptic curves over Q and quadratic real fields."
- "Computing complete lists of artin representations and computing minimal examples of psl2,7 fields."
- "I continued a project with Ling Long and Fang-Ting Tu on hypergeometric series over finite fields, and started a new project on Appell series over finite fields with Sharon Frechette, Ling Long, and Fang-Ting Tu. I also continued a project on mock and quantum modular forms with collaborators who were not at ICERM, although one collaborator from this project visited me at ICERM Amanda Folsom."
- "I worked on a theoretical basis for understanding higher moments of modular L-functions; this was new. And I continued a project on gaps between zeros of zeta that had already started."

Some Long-Term Participant Comments for "Briefly describe program highlights":

- "I learnt about quaternion algebras."
- The environment as well as the staff at ICERM were very welcoming and conducive to learning. I enjoyed very much the first two workshops, which I attended. I also enjoyed talking to other participants, although this has not yet led to any scientific collaboration."
- "I have already alluded to contacts made and process on projects, both of which are definitely highlights for me. Other highlights included 1 extensive discussions with David Farmer et al. on L-functions not coming from motives, i.e. those coming from Maass wave forms and the like; I now understand better how they fit into the larger picture. 2 hearing from various other people working on hypergeometric motives in some way; this will help with my own projects; 3 A whole huge list of useful conversations: Andy Booker and Mike Rubinstein on the explicit formula, Winnie Lie on motives with Hodge vector 2,0,0,2, Andrew Sutherland on modular polynomials, Nathan Ryan on Siegel modular forms,... 4 Many particularly useful talks in the workshops and local seminars, too numerous to even begin to list!"

Some Long-term Visitor Comments for "What, if any, specific projects or collaborations did you pursue during this program?":

- "I started looking at effective constants in Chebotarev-like results, as well as in Sato-Tate results. I finished a paper started last year on one level density for L-functions of cyclic p-covers over finite fields. I have started a couple of projects computing databases of L-functions of elliptic curves over Q and quadratic real fields."
- "Cris Poor and David S. Yuen and I are working together on a paper and also on a book."
- "I have been discussing with Noriko Yui about arithmeticity of monodromy groups of Calabi-Yau threefolds."
- "I continued number-theoretic projects with John Jones. I initiated number-theoretic projects with John Jones, one of which may involve Andy Booker, Jonathan Bober, and Min Lee. I moved a number field/modular form project substantially forward with Lassina Dembele and Fred Diamond. I talked extensively on my hypergeometric motive project with Fernando Rodriguez Villegas and Mark Watkins, making progress in the process. I related some of my number fields with Siegel modular forms by interacting with Ralf Schmidt et al on the one hand, and Watson Ladd on the other. This should related to a paper somehow, but it is too early to say exactly I received good guidance from Stefan Wewers on an old project involving three-point covers, which I hope to be able to complete now. I deepened contact with John Voight and his group, who are able to compute some three-point covers that fit into a paper I am writing but are beyond my computational range."

Some Postdoc Comments for "Briefly describe program highlights":

- "For me, the highlight was sitting in offices listening to experts like David Farmer and Mike Rubinstein talk about tools for computing with L-functions, struggling to keep up, but having followed the discussion well enough to suggest problems these tools would make tractable."
- "Meeting others. Initiating the next publication."
- "The discussion/working section is relatively important to me, since I am not familiar with the "analytic part" of L-series. I learned much from the discussions."

Some Postdoc Comments for "What, if any, specific projects or collaborations did you pursue during this program?":

- "David Farmer, Sally Koutsoilotas, Mike Rubinstein and I started a project whose initial goal was to find an elliptic curve over the rationals with Mordell-Weil rank at least 29 if such a curve exists. This is a lofty goal, but one that Mike Rubinstein has had for several years. A more reasonable goal we have set is to verify conditional on standard conjectures that the smallest conductor of an elliptic curve over the rationals with Mordell-Weil rank 5 is 19047851. The corresponding conductor for rank 4 was proven by Cremona by enumerating all the elliptic curves with conductor at most 234446. Using the same approach for rank 5 would probably take at least decades, but the Farmer-Koutsoliotas machinery for "Computing L-functions from nothing" seems to offer more tractable approach. We're also trying to find the smallest conductors of elliptic curves with specific Mordell-Weil groups, since having a particular torsion subgroup already determines a great deal about the L-funtion of an elliptic curve. In preparation to give a poster at the 3rd workshop, I finished a draft of a joint paper with Zev Klagsbrun and Travis Sherman. In this project we proved conditional only on GRH that a certain elliptic curve discovered by Noam Elkies has Mordell-Weil rank 28. We are currently trying to compute the Mordell-Weil rank of the jacobian of a certain hyperelliptic curve which Elkies has shown to be at least 29. We have computed, conditional on GRH, the the 2-rank of the class group of the sextic 2-division field of this jacobian is 23. It remains to generalize a result of Brumer and Kramer to translate this into an upper bound on the Mordell-Weil rank."
- "Computing the endomorphism ring of a Jacobian of a curve over a number field A census of zeta functions of quartic K3 surfaces over F3 On the distribution of the Picard ranks of the reductions of a K3 surfaces The Galois structure of the Picard lattice of a family of K3 surfaces

Effective computations of Bernoulli numbers Counting points on singular plane curves Traces, High powers and One level density for families of curves over finite fields Computation of zeta functions of projective hypersurfaces via controlled reduction in p-adic cohomology Computation of zeta functions of nondegenerate toric hypersurfaces via controlled reduction in p-adic cohomology Computation of zeta functions of K3 surfaces on average polynomial time Computation of zeta functions of K3 surfaces in sublinear time."

- "Computing L-functions / automorphic forms with the trace formula."
- *"About the Appell hypergeometric funciotns over finite field. A finite field analogue of the classical Appell hypergeometric series. ."*

Some Graduate Student Comments for "Briefly describe program highlights":

- "I especially enjoyed the program on Wednesday and Thursday, where most of the talks were related to paramodular conjecture, and some to Fourier coefficients. They were very much related to my research and gave light on how one may attack paramodular conjecture.
- "The entirety of the third workshop, in particular, was astoundingly interesting to me. It was well-run and very open to researchers at all levels, including we graduate students."
- "Ralf Schmidt told me a vast amount about GSp4 that I didn't previously know. I also learned a good deal about candidate varieties to try to hunt down in my tables, and the algorithms to do this with."
- "I especially liked the first workshop. Although, the schedule was really packed but it was the closest to my area of interest so I liked it. I also liked the mini course run by Dr. John Voight. Most importantly, the semester program provided an excellent opportunity to meet and learn from so many experts from all over the world. So, overall It was a great learning experience."
- "Getting a chance to present my work at the poster session. It was a great experience to speak with senior mathematicians about my research and hear their questions, comments, and suggestions."

Some Graduate Student Comments for "What, if any, specific projects or collaborations did you pursue during this program?":

- "Moduli interpretations for noncongruence modular curves."
- "I continued working on a project concerning arithmetic statistics of L functions over function fields that originated at the 2014 Arizona Winter School. [We finished this project at ICERM] I began two interrelated projects concerning moments of L functions with some of the participants here. We are continuing to work on them even as ICERM draws to a close. I began to collaborate on a project about finding isomorphism classes of zeta functions over varieties over F2."
- "I continued working on inner forms of O3,2 and improved variants of Faltings-Serre to deal with previously unknown cases. Currently computation is ongoing to use these improved variants to prove cases of modularity arising from these inner forms."
- "I presented poster in all the poster sessions. I gave a talk in the peer to peer seminar. I also participated in LMFDB workshop and contributed in bug fixing. I worked on a research problem and discussions with fellow participants helped me in that."
- *"A project on multiplying Hilbert modular forms and computing equations for Hilbert modular varieties. 2 Computations of Belyi maps connected to motives."*

Note: for upcoming programs from February 1, 2016, please see Appendix C.
Topical Workshops

ICERM hosts several topical workshops each year. These workshops typically last 5 days and focus on a timely and exciting theme of interest that aligns with ICERM's mission of supporting and broadening the relationship between mathematics and computation.

Pre-Proposal Requirements

A 1-2 page pre-proposal document which describes the scientific goals, lists the organizers of the program, and identifies the key participants.

Pre-Proposal Deadline

All pre-proposals should be submitted to the ICERM Director. The target deadlines for submissions are early September and mid-April. The ICERM directors and a subcommittee of the Scientific Advisory Board SAB will review all pre-proposals. Proposers will receive feedback within a few weeks of their submission.

Topical Workshop Full Proposal Deadline

All full proposals should be submitted to the ICERM Director. Target deadlines are October 1st and May 1st. All full proposals are considered by the Scientific Advisory Board SAB potentially after an external review. Decisions are typically reached within one-to-two months of the target deadlines.

1. Solicitation of Topical Workshop Proposals

A topical workshop proposal should be of 2-4 pages length and contain the following:

- A description of the program area/theme written with a general mathematical audience in mind,
- A list of organizers normally around 3-6,
- The main contact chair of the organizing committee,
- A discussion of the experimental and computational aspects of the program,
- Plans for ensuring the participation of underrepresented groups organizers are expected to work with ICERM directors on diversity issues.

2. Proposal Selection

The Science Advisory Board SAB approves the topical workshops. The deadlines for proposals is mid-October, prior to the annual November SAB meeting, and mi May, prior to an annual conference call. Approved program dates will be scheduled with details posted on the ICERM website and various on-line math organization calendars SIAM, AMS, European Mathematical Society, National Math Institutes.

From this point on, applications for graduate students and workshop participants will be considered; the chair of the workshop organizing committee or other designated organizer will assist ICERM staff by providing appropriate program images for web and print ads, and may be asked to review marketing materials.

3. Recommendation of Speakers

The organizers will propose a ranked list of 20-25 speakers, which the ICERM Directors will approve and/or suggest additions or re-rankings in consultation with SAB members.

4. Invitations to Speakers

Once the list of workshop speakers has been finalized and funding determined, an invitation will be sent to each. The invitation will describe the workshop and outline the support to be provided. Using its Discovery database, ICERM will track demographic information about, and all interactions with, speakers.

5. Application Process

Once the organizers and Directors agree there is enough critical mass in terms of confirmed speakers, the on-line application for that particular workshop will be opened on the ICERM website. All applications will automatically be synced with ICERM's Discovery database.

6. Applicant Selection

The Discovery database allows workshop organizers, ICERM Directors and staff to view each candidate's application. Every two weeks or so, the organizers will be asked to recommend a ranking of applicants for their program graduate students, participants. ICERM Directors will review the ranked list, re-rank as appropriate and make the final selections, taking into consideration the remaining budget for the program, diversity, participant support requested. ICERM staff will then update the applicant about their status, and any support they are eligible for, as appropriate. This process continues until funds for the program run out.

Financial Decisions for Topical Workshops

Financial decisions are made by ICERM Directors based on discussions with organizers. There is support for housing and travel support for around 20-25 speakers including organizers, who stay for 1 week. The institute reserves some funds to support uninvited applicants.

Topical and Special Workshops, May 1, 2015 through January 31, 2016

ICERM has hosted 7 topical and special workshops from May 1 2015 to January 31, 2016. These workshops focus on topics of current interest in the mathematical sciences.

Topical Workshop 1: Integrability in Mechanics and Geometry: Theory and Computations June 1-5, 2015

Organizing Committee

Annalisa Calini, College of Charleston Boris Khesin, University of Toronto Gloria Mari-Beffa, University of Wisconsin Vadim Zharnitsky, University of Illinois at Urbana-Champaign

Workshop Description

This workshop focuses on topics at the interface of classical mechanics, differential geometry, and computer experiments. The directions of current research to be explored at the workshop include the study of invariants and complete integrability of geometrically motivated differential equations in particular, vehicle motion, tire track geometry, and smoke ring equations, sub-Riemannian geometry, geometric control, nonholonomic systems such as e.g. bicycle stability and nonholonomic methods in billiard problems, computational methods in mechanics and dynamics including geometric integrators, biological applications, etc..

The goal of the workshop is to explore broad applications of the mechanical approach to geometry and geometric one to classical mechanics, to foster interaction between researchers in the above areas, with a view of finding new domains for applications of these fertile ideas.

workshop I I articipants integrability in viechances and Geometry. Theory and Computa	worksnop i Participa	Participants Integrability in	a Mechanics and	Geometry: I	i neory and Com	putations
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Name	Organization
Simonetta Abenda*	Università di Bologna
Anani Komla Adabrah	University of Texas at Dallas

Maxim Arnold*	University of Texas at Dallas
Kenneth Ball	University of Texas
Yuliy Baryshnikov*	University of Illinois at Urbana-Champaign
Yakov Berchenko-Kogan	Massachusetts Institute of Technology
Raphael Boll	Technische Universität Berlin
Gil Bor*	Center of Investigations in Mathematics
Annalisa Calini	College of Charleston
Alessandra Celletti*	University of Rome Tor Vergata
Gabor Domokos*	Budapest University of Technology and Economics
Yuri Fedorov*	Universitat Politecnica de Catalunya
Oscar Fernandez*	Wellesley College
Luis Garcia-Naranjo*	National Autonomous University of Mexico
Eriko Hironaka	Florida State University
Thomas Ivey*	College of Charleston
Anton Izosimov*	University of Toronto
Boris Khesin	University of Toronto
Ki Yeun Kim	University of Illinois at Urbana-Champaign
Madison Krieger	Brown University
Joel Langer*	Case Western Reserve University
Melvin Leok*	University of California, San Diego
Mark Levi*	Pennsylvania State University
L. Mahadevan*	Harvard University
Gloria Mari-Beffa	University of Wisconsin
James Mathews	Stony Brook University
Vladimir Matveev*	Friedrich-Schiller-Universität
Tom Mestdag	University of Ghent
Richard Montgomery*	University of California, Santa Cruz
Joseph Palmer	University of California, San Diego
Ron Perline*	Drexel University
Manuele Santoprete	Wilfrid Laurier University
Richard Schwartz	Brown University
Jonah Smith	Drexel University
Chong Song*	Xiamen University
Yuri Suris*	Technische Universität Berlin
Sergei Tabachnikov*	ICERM
Tadashi Tokieda*	University of Cambridge
Mats Vermeeren	Technische Universität Berlin
Alexander Veselov*	Loughborough University
Andreas Vollmer	University of Jena
Dmitry Zenkov*	North Carolina State University
Vadim Zharnitsky	University of Illinois at Urbana-Champaign
*Speaker	

Some Workshop Organizer Comments for "Describe the highlight of this workshop":

• *"Talk by R.Montgomery on dances of 3 bodies. Also talk by A.Izosimov on stability of rotations of n-dim rigid body."*

Some Workshop Participant Comments for "Describe the highlight of this workshop":

• "The workshop gave me the opportunity to meet and talk with experts in areas of my current

research. I gave an invited talk that is probably the most important one in my resume. I presented my work in a research area that I am starting to investigate and involves numerics and computations together with deep methods from the theory of integrable systems. The audience was very receptive of my work and I gained motivation and insights into new problems."

- "I felt like the conversations that were induced by the question/answer sessions after talks were really valuable; I learned a lot about how more experienced researchers in this field think about problems and interpret them in geometric language. I also had a couple of great conversations with folks that I hadn't met before about some future collaborative work."
- "This workshop consisted of the absolute top people in this area. As much as it was important to see what they did and what they knew, it was maybe even more important to learn what they did not know and were trying to understand. Very well organized workshop."

NOTE: The following question (which will appear later in this report) had not been added to ICERM's exit surveys at the time of this program: "Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field."

Topical Workshop 2: Computational Geometric Topology in Arrangement Theory July 6-10, 2015

Organizing Committee

Nero Budur, KU Leuven and University of Notre Dame Graham Denham, Univ. Western Ontario Anca Daniela Macinic, IMAR, Bucharest Daniel Matei, IMAR, Bucharest Laurentiu Maxim, UW-Madison Hal Schenck, UIUC Max Wakefield, US Naval Academy

Workshop Description

This workshop will bring together mathematicians working on combinatorial, geometric and topological properties of arrangements. In addition to fundamental open problems in the area, we will emphasize connections to tropical geometry, configuration spaces, and applications coding theory, statistical economics, topological robotics, building bridges between those working on different aspects of the area. The main aim of the workshop is to discuss computational issues that arise in studying topological and combinatorial invariants of arrangements.

The workshop will be comprised of two main activities: A series of short courses by leading experts and research or expository talks. The short courses will be aimed at a broad audience; in particular they will be appropriate for advanced graduate students and early career mathematicians. In addition to theory, talks will highlight computational aspects of the problems, and the state of the art on the main open conjectures in the field. We will also have a pair of research talks each afternoon.

Name	Organization
Nancy Abdallah*	Université de Nice Sophia Antipolis
Takuro Abe	Kyoto University
Paolo Aluffi*	Florida State University
Enrique Artal Bartolo*	Universidad de Zaragoza

Workshop 2 Participants Computational Geometric Topology in Arrangement Theory

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Pauline Bailet*	Université de Nice Sophia Antipolis
Jeremiah Bartz	Francis Marion College
Christin Bibby*	University of Western Ontario
Pavle Blagojevic *	Freie Universität Berlin
Nero Budur	KU Leuven
Kevin Casto	University of Chicago
Weiyan Chen	University of Chicago
Jose Cogolludo	University of Zaragoza
Daniel Cohen*	Louisiana State University
Emanuele Delucchi	University of Fribourg
Graham Denham*	University of Western Ontario
Alperen Ergur	Texas A & M University
Michael Falk*	Northern Arizona University
Eva Feichtner*	Universität Bremen
Nathan Fieldsteel	University of Illinois at Urbana-Champaign
Nir Gadish	University of Chicago
June Huh*	Institute for Advanced Study
Rita Jimenez Rolland	National Autonomous University of Mexico UNAM
Thomas Koberda*	Yale University
Yongqiang Liu*	University of Science and Technology of China
Diane Maclagan*	University of Warwick
Daniel Matei*	Institute of Mathematics "Simion Stoilow" of the
	Romanian Academy
Laurentiu Maxim	University of Wisconsin
Mario Salvetti*	Università di Pisa
Hal Schenck*	University of Illinois at Urbana-Champaign
Yun Su*	University of Wisconsin
Alexander Suciu*	Northeastern University
Max Wakefield	U.S. Naval Academy
Uli Walther*	Purdue University
He Wang	Northeastern University
KaiHo Wong*	University of Wisconsin
Arnold Yim	Purdue University
Youngho Yoon	Institute for Basic Science, Center for Geometry and
-	Physics
Masahiko Yoshinaga*	Hokkaido University
Sergey Yuzvinsky*	University of Oregon
*Speaker	

Some Workshop Organizer Comments for "Describe the highlight of this workshop":

- "Plenty of interesting young people came; a couple of the speakers announced major results; there was time for some informal discussions with past and future collaborators."
- "There were excellent talks and posters presented at this conference, but, In my opinion, the talk by June Huh, describing the algebraic geometric proof of a prominent conjecture in combinatorics due to G-C. Rota, with important theoretical and experimental ramifications."
- "Excellent slate of speakers, nice blend of research talks and "mini courses", good mix of established/young researchers."

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *"Talking with Thomas Koberda about pure braid groups and fundamental groups of arrangements."*
- "Seeing the latest discoveries on arrangements, especially new interesting examples of their behavior."

NOTE: The following question (which will appear later in this report) had not been added to ICERM's exit surveys at the time of this program: "Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field."

Topical Workshop 3: Computational and Analytical Aspects of Image Reconstruction July 13-17, 2015

Organizing Committee

Gaik Ambartsoumian, University of Texas at Arlington Vladimir Druskin, Schlumberger-Doll Esther Klann, Johannes Kepler University Venkateswaran P. Krishnan, TIFR Centre for Applicable Mathematics Alfred Louis, Universität des Saarlandes Eric Todd Quinto, Tufts University

Workshop Description

The mathematical study of image reconstruction problems can have a huge impact on human life. More efficient mathematical algorithms for X-ray tomography and more accurate mathematical models in seismic or hybrid imaging can lead to better imaging devices in fields such as medicine and remote sensing. Developing the underlying mathematics, including the analysis of reconstruction stability, regularization, singularity characterization, and efficient algorithms, may lead to fewer false positives in fields such as medical, seismic and radar imaging.

This topical workshop will bring together international experts working in computational and analytical aspects of image reconstruction (including but not limited to electron-microscope tomography, hybrid imaging, radar and sonar, full waveform inversion of seismic imaging and X-ray CT) as well as postdoctoral fellows and graduate students. There will be multiple introductory-level talks for early-career researchers and non-specialists in the area on both the mathematics involved and the scientific and industrial applications. Speakers and participants from industry will be included to strengthen the practical aspects of the workshop.

Name	Organization
Anuj Abhishek	Tufts University
Roza Aceska	Ball State University
Gaik Ambartsoumian	University of Texas
Matthias Beckmann	University of Hamburg
Carlos Borges	New York University
Jim Byrnes	Prometheus Inc.
Margaret Cheney*	Colorado State University
Ricardo Diaz	University of Northern Colorado
Diego Domenzain	Boise State University
Yiqiu Dong	Technical University of Denmark

Workshop 3 Participants Computational and Analytical Aspects of Image Reconstruction

Vladimir Druskin	Schlumberger-Doll
Raluca Felea*	Rochester Institute of Technology
Jeffrey Fessler*	University of Michigan
David Finch	Oregon State University
Jürgen Frikel	Technical University of Denmark
Denitza Gintcheva	University of Rochester
Rim Gouia-Zarrad*	American University of Sharjah
Allan Greenleaf*	University of Rochester
Eric Grinberg	University of Massachusetts
Bernadette Hahn*	Universität des Saarlandes
Ralf Hielscher	TU Chemnitz
Yulia Hristova	University of Michigan
Mark Hubenthal	University of Houston
David Isaacson*	RPI
Mirza Karamehmedovic	Technical University of Denmark
Alexander Katsevich*	University of Central Florida
Esther Klann	Technische Universität Berlin
Andrew Knyazev	MERL
Holger Kohr	KTH Royal Institute of Technology
Venkateswaran Krishnan	Centre for Applicable Mathematics
Leonid Kunyansky*	University of Arizona
Oleg Kuybeda*	National Institutes of Health
Youzuo Lin	Los Alamos National Laboratory
Alexander Mamonov*	University of Houston
Rohit Mishraq	Tata Institute of Fundamental Research
Shari Moskow*	Drexel University
Jennifer Mueller*	Colorado State University
Frank Natterer*	Westfälische Wilhelms-Universität Münster
Linh Nguyen*	University of Idaho
Cliff Nolan*	University of Limerick
Sarah Patch*	University of Wisconsin
Olga Podgornova*	Schlumberger
Zenith Purisha	University of Helsinki, Finland
Michael Quellmalz	TU Chemnitz
Todd Quinto	Tufts University
Rakesh*	University of Delaware
Ronny Ramlau*	Johannes Kepler Universität Linz
Rasmus Rasmussen	Technical University of Denmark
Joel Rosiene	Eastern Connecticut State University
Kamran Sadiq	Johann Radon Institute for Computational and
	Applied Mathematics
Otmar Scherzer*	Johann Radon Institute for Computational and Applied Mathematics
Remco Schoenmakers*	FEI Netherlands
Thomas Schuster*	Universität des Saarlandes
Brian Sherson	Oregon State University
Eric Stachura	Temple University
Andrew Thaler	Institute for Mathematics and its Applications
Bastian von Harrach*	Universität Stuttgart

Henning Voss	Weill Cornell Medical College
Ming Yan	University of California, Los Angeles
He Yang	Stanford University
Mikhail Zaslavsky*	Schlumberger Cambridge Research
Jian-Zhou Zhang	Sichuan University
Ting Zhou*	Massachusetts Institute of Technology
Speaker*	

Some Workshop Organizer Comments for "Briefly describe workshop highlights":

- "I was a collaborator to a presentation on seismic imaging for oiul exploration, given by Mikhail Zaslavsky. After his talk Margaret Cheney approach me with questions about applicability of our approach to radar imaging. Apparently our technology can be of intertest of the Air Foorce. We had lenghtly discussion, and result of this discussion we plan to work on this new application on radars with possible funding from the Air Force. We also established possible new collaboration with Bastian von Barrach on model reduction to EIT inversion and Shari Moskow on reduced order inversion of frequency-domain problems. So this workshop was a very efficient instrument in faciliating new interdisciplinary connections."
- "The fact that most speakers took seriously my request to speak to a broad audience the informal time to talk with colleagues in engineering and math as well as colleagues in industry."
- "The workshop had the right blend of theory and computational aspects of imaging. Coming from a theoretical background, I wanted to know, apart from the latest advances in theory, the major computational challenges in implementing the theoretical inversion formulas. To me this was partially accomplished and I am happy getting to know some of the challenges."

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- "Learning about new developments in colleagues' research from lectures, and having intensive small group discussions."
- "The talks on inverse problems for Maxwell's and acoustic equations as well as Fessler's talk on CT."
- "Talking with the group from Schlumberger about their work on suppressing multiple scattering."

NOTE: The following question(which will appear later in this report) had not been added to ICERM's exit surveys at the time of this program: "Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field."

Topical Workshop 4: Mathematics in Data Science July 28-30, 2015

-

Organizing Committee

Philip Kegelmeyer, Sandia National Laboratories Tamara Kolda, Sandia National Laboratories Randall LeVeque, University of Washington Aleksandra Mojsilovic, IBM T. J. Watson Research Center Linda Ness, Applied Communication Sciences Alyson Wilson, North Carolina State University

Workshop Description

The goal of this workshop is to bring together mathematicians and data scientists to participate in a discussion of current methods and outstanding problems in data science. The workshop is particularly aimed at mathematicians interested in pursuing research or a career in data science who wish to gain an understanding of this rapidly evolving field and the ways in which mathematics can contribute. Researchers currently working in data science are also encouraged to attend, to share ideas about mathematical methodologies and challenges. A number of experienced data scientists with a variety of backgrounds from academics, national laboratories, and industry (including startups) will be invited. The program will include overview and technical talks, several panels consisting of practitioners with different experience levels, and one or more poster sessions.

Career Panelists	Math in Data Science Panel	
 June Andrews (LinkedIn) Justin Basilico (Netflix) Tom LaGatta (Splunk) Randall LeVeque (University of Washington) *Chair Jake VanderPlas (University of Washington) Bobbie-Jo Webb- Robertson (Pacific-Northwest National Laboratory) 	 Justin Basilico (Netflix) Susan Holmes (Stanford University) Xiaoming Huo (National Science Foundation/Georgia Tech) Peter Jones (Yale University) *Chair Tamara Kolda (Sandia National Laboratories) Linda Ness (Applied Communications Sciences) 	 Randall LeVeque (University of Washington) Amit Singer (Princeton University) Yi-Qiao Song (Schlumberger-Doll Research Center)

Workshop 4 Participants Mathematics in Data Science

Name	Organization
Mahesh Agarwal	University of Michigan
Ronay Ak	Supélec
Montaz Ali	University of the Witwatersrand
Javier Amezcua Espinosa	University of Reading
June Andrews*	LinkedIn
Salman Asif	Rice University
Paul Atzberger	UC Santa Barbara
Bubacarr Bah	University of Texas at Austin
Anthony Bak*	Ayasdi, Inc.
Jon Bannon	Siena College
Justin Basilico*	Netflix
Janine Bennett*	Sandia National Laboratories
Ghanshyam Bhatt	Tennessee State University
Henry Boateng	STFC Daresbury Laboratory
Jeffrey Brock	ICERM

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Hilla Brot	Northwestern University
Rajmonda Caceres	MIT Lincoln Laboratory
Qianyong Chen	UMass Amherst
Xiongzhi Chen	Princeton University
Haiyan Cheng	Willamette University
Eric Chi	Rice University
Andra Constantinescu	TripAdvisor
Gary Davis	University of Massachusetts Dartmouth
Jacqueline Davis	Arizona State University
Persi Diaconis	Stanford University
David Dunson*	Duke University
Ellen Eischen	University of Oregon
Fariba Fahroo	DARPA
Ya Ju Fan	Lawrence Livermore National Laboratory
Kathleen Finlinson	University of Colorado at Boulder
Ramesh Garimella	University of Central Arkansas
Timothy Goodrich	North Carolina State University
David Guarrera	DARPA
Andrea Hairston	The Laboratory for Analytic Sciences
John Harer*	Duke University
Emilie Hogan	Pacific Northwest National Laboratory
Susan Holmes*	Stanford University
Mayer Humi	WPI
Xiaoming Huo	National Science Foundation/ Georgia Tech
YunKyong Hyon	National Institute for Mathematical Sciences
Jiahua Jiang	University of Massachusetts Dartmouth
Qingtang Jiang	University of Missouri - St. Louis
Christopher Johnson*	University of Utah
Matthew Johnson	City University of New York
Peter Jones*	Yale University
Sunnie Joshi	Temple University
Mahta Khosravi	University of British Columbia
Saeja Kim	University of Massachusetts Dartmouth
Christine Klymko	Lawrence Livermore National Laboratory
Andrew Knyazev	Mitsubishi Electric Research Laboratories
Tammy Kolda*	Sandia National Laboratories
Jey Kottalam	University of California, Berkeley
Bala Krishnamoorthy	Washington State University
Yu-Ju Kuo	Indiana University of Pennsylvania
Tom LaGatta	Splunk
Jingguo Lai	Brown University
Roy Lederman	Yale
Benedict Leimkuhler*	University of Edinburgh
Randall LeVeque	University of Washington
Sivan Levivang	Georgetown University
Edo Liberty*	Yahoo! Inc.
Mark Lyon	University of New Hampshire
Kevin Matulef	Sandia National Labs
Timothy McDevitt	Elizabethtown College

Yevhen Mohylevskyy	York University
Elizabeth Munch	University at Albany - SUNY
Carmeliza Navasca	University of Alabama at Birmingham
Linda Ness	Applied Communication Sciences
Zoran Obradovic*	Temple University
Michael O'Brien	North Carolina State University
Omayra Ortega	Arizona State University
Randy Paffenroth	Worcester Polytechnic Institute
Thomas Peters	University of Connecticut
Vincent Quenneville-Belair	Columbia University
John Ringland	University at Buffalo
Henry Romero	University of Colorado at Boulder
Michael Salpukas	Raytheon
Lixin Shen	Syracuse University
Jennifer Shin	8 Path Solutions LLC
Olivia Simpson	UC San Diego
Amit Singer*	Princeton University
Yi-Qiao Song*	Schlumberger-Doll Research Center
Ravi Srinivasan	The University of Texas at Austin
Blair Sullivan*	North Carolina State University
Minh Tang	Johns Hopkins University
Gabriel Terejanu	University of South Carolina
Charalampos Tsourakakis	Harvard University
Konstantinos Vamvourellis	ACS
Jake VanderPlas	University of Washington
Andrew Van Der Poel	North Carolina State University
Oleksiy Varfolomiyev	NJIT
Eugene Vecharynski	Lawrence Berkeley National Laboratory
Daniele Venturi	University of California Santa Cruz
Graziano Vernizzi	Siena College
Soledad Villar	University of Texas at Austin
Bobbie-Jo Webb-Robertson	Pacific Northwest National Laboratory
Chris Wiggins*	Columbia University
Alyson Wilson	North Carolina State University
Manda Winlaw	University of Waterloo
Yu-Jiang Wu	Columbia University
Karamatou Yacoubou Djima	University of Maryland
Ming Yan	University of California, Los Angeles
Ramesh Yapalparvi	Dartmouth College
Ping Ye	Quincy University
Izzet Yildiz	Brown University
Bin Yu*	University of California, Berkeley
Jane Zhao*	New York University
*Speaker	

Some Workshop Organizer Comments for "Describe the highlight of this workshop":

• "The highlights of the workshop were: -the opportunity to working with leading members in the Applied Mathematics field to organize the workshop to bring mathematicians together with a broad spectrum of people conducting research and applying. This enable us to bring together

experts from statistics, applied mathematics, and mathematics. The experts were from academia (including centers devoted to research in data), government labs and industry. Industrial participants were from research labs, Consumer web companies and other companies. -the opportunity to present our work on data analysis exploiting mathematical theorems and to discuss the results with leading statisticians and other participants

• Open discussion period the first day was both good discussion and ice breaker.."

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- "This is the best and most exciting workshop I have been to in twenty years. The combination of speakers and topics was amazing."
- "1. Get some hot research topics of image analysis related to big data. 2. Get many recent progress and popular mathematical methods in big data. 3. Get a few connections with some outstanding imaging machine learning groups in US. 4. Get useful tips for job application from the career panel."
- "The workshop had a great balance of participants from Industry and Academia. This was especially helpful in gaining insights into important technical problems of relevance. Overall, the workshop was very professionally run and administered."
- "I really liked the workshop, it was my first. I come from a pure mathematics background, so it was interesting to attend an applied math/statistics/computer science focus conference. I made a few connections and get to know about the new trends in big data. I wasn't sure going in what to expect. So I liked the informal setting and would have appreciated an opportunity to work in groups to kick start on new projects/ collaboration. But I guess it would be a different kind of conference."
- "Good mix of mathematics and applications. I would have liked a little more of a bridge between the edge of theory and applications, especially where the biggest data sets were concerned. A few survey presentations would have been nice to start, as well."
- 1. It greatly helps the exchange of ideas from different fields/professions, such as mathematics, statistics, physicist, computer scientists, etc., 2. It provides a good opportunity to make new connections 3. Good arrangement of talks in different fields/professions 4. The organizers are very helpful and kind!

NOTE: The following question (which will appear later in this report) had not been added to ICERM's exit surveys at the time of this program: "Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field."

Topical Workshop 5: Numerical Methods for Large-Scale Nonlinear Problems and Their Applications August 31 - September 4, 2015

Organizing Committee

Tim Kelley, North Carolina State University Homer Walker, Worcester Polytechnic Institute and ICERM Carol Woodward, Lawrence Livermore National Lab

Workshop Description

Over the last 20 years or so, Newton-Krylov methods have developed to maturity, allowing effective fully-coupled treatment of a broad range of large-scale nonlinear problems. This development has set the stage for addressing more difficult problems with more challenging features. Additionally, applications

for which state-of-the-art Newton-Krylov approaches are inapplicable have recently exposed several basic research questions. At the same time, there remain many problem-specific methods and legacy codes that are still useful and can be regarded as a resource for further development.

This workshop will include mathematicians and computer scientists who work on algorithm design, implementation, and analysis, together with disciplinary scientists and engineers who use the algorithms in applications and have a working knowledge of their capabilities, weaknesses, and limitations. The major foci of the workshop will be acceleration methods, in particular Anderson acceleration; methods for nonlinear problems that have significant stochastic aspects; methods for nonsmooth problems; and various techniques for improving robustness, such as nonlinear

Name	Organization
James Adler	Tufts University
Shahriar Afkhami	New Jersey Institute of Technology
Steven Allmaras	MIT
Hengbin An	Worcester Polytechnic Institute
Donald Anderson*	Harvard University
Paul Barton *	Massachusetts Institute of Technology
Stefania Bellavia*	Università di Firenze
Troy Butler*	University of Colorado Denver
Xiao-Chuan Cai*	University of Colorado
Carlos Cardoso Borges	Courant Institute of Mathematical Sciences
Marco Ceze	NASA Ames Research Center
Luis Chacon*	Los Alamos National Laboratory
Minseok Choi	Brown University
Geoffrey Dillon	Virginia Tech
Jon Erwin	University of Tennessee
Katherine Evans*	Oak Ridge National Laboratory
Marshall Galbraith	MIT
David Gardner*	Lawrence Livermore National Laboratory
Ryan Glasby	University of Tennessee
Christian Glusa	Brown University
Andreas Griewank*	Humboldt-Universität
Rob Haelterman*	Royal Military Academy
Jeff Hittinger*	Lawrence Livermore National Laboratory
Xiaozhe Hu	Tufts University
Tim Kelley*	North Carolina State University
Yannis Kevrekidis*	Princeton University
David Keyes*	King Abdullah University of Science & Technology
Abdul Qayyum Khaliq	Middle Tennessee State University
Arkadz Kirshtein	Penn State
Axel Klawonn*	University of Cologne Mathematical Institute
Matt Knepley*	University of Chicago
Andrew Knyazev	Mitsubishi Electric Research Laboratories
Antony Liakopoulos	University of Thessaly
Lulu Liu	King Abdullah University of Science and Technology
Yicong Ma	Pennsylvania State University
Vijay Mahadevan	Argonne National Laboratory

Workshop 5 Participants Numerical Methods for Large-Scale Nonlinear Problems and...

Matthias Mayr	Technische Universität München
Razvan Mezei	Lenoir-Rhyne University
HyeongKae Park*	Los Alamos National Laboratory
Kailash C. Patidar	University of the Western Cape
Roger Pawlowski*	Sandia National Laboratories
Eric Phipps*	Sandia National Laboratories
Sara Pollock	Texas A&M University
Viktor Reshniak	Middle Tennessee State University
Daniel Reynolds*	Southern Methodist University
Yousef Saad*	University of Minnesota
Anju Saini	Indian Institute of Technology
John Shadid*	Sandia National Laboratories
Ramjee Sharma	University of North Georgia
Bedrich Sousedik	University of Maryland, Baltimore County
Alex Toth*	North Carolina State University
Benjamin Uekermann	Technische Universitaet Muenchen
Panayot Vassilevski*	Lawrence Livermore National Laboratory
Homer Walker*	ICERM
Mary Wheeler*	University of Texas at Austin
Tim Wildey*	Sandia National Laboratories
Carol Woodward*	Lawrence Livermore National Laboratory
Shuonan Wu	Pennsylvania State University
Yuanzhe Xi	University of Minnesota
Jinchao Xu*	Pennsylvania State University
Hongquan Zhang	Pennsylvania State University
Lei Zhang	Shanghai Jiao Tong University
Zhongqiang Zhang	Brown University
*Speaker	

Some Workshop Participant Comments for "Please describe how ICERM has or has not added to your knowledge of experimental/computational methodologies and/or theoretical developments within this field":

"This workshop featured the 50th anniversary of Anderson Acceleration, a nonlinear solution algorithm which was published by Donald Anderson of Harvard in 1965, and subsequently known only the chemistry and statistical physics communities for most of the last five decades. In 2009, the equivalence of a specialized version of Anderson in the linear case with the popular GMRES linear solver was published. In the past few years, other connections have been made of specializations of Anderson to various limited memory Newton methods. For this ICERM workshop, Donald Anderson came out of retirement to address the bolus of papers that revived "his" method in the past six years, and he recommended broadening in some respects and narrowing in other respects of a method attributed to him, while many authors made connections back to Anderson of a number of other historically important or currently contemporarily relevant nonlinear solution methods that do not require the full Jacobian matrix to be rapidly asymptotically rapidly convergent. Connections were made to many industrial and government laboratory problems, to multiphysics simulations throughout science and engineering, to various matrix completion methods or optimization problems, such as recommender systems or maximum likelihood, and to the new Exascale Computing Initiatve recently announced by Barack Obama, which requires a fundamental reworking and rethinking of algorithms. Theoretical holes were

exposed, and heuristics in setting various tuning parameters of the nonlinear solutions algorithms were shared. Impressive large-scale simulations accelerated by the new methods were presented. In short, the meeting was perfectly timed to bring together the "classical" nonlinear solvers community of Newton-Krylov-Schwarz and Newton-Krylov-Multigrid users and software developers for large scale simulations, and a younger generation of computational mathematicians. Attendees were primarily from government labs and academia. Industrial users and developers seem either to be unaware of a recent revolution of relevance to their codes, or unsuccessful in their applications, or too secretive to reveal their own successes. For a follow-on workshop in a few years, effort should be made to attract industrial visitors, for at least a one-day minisymposium as part of an overall meeting. I did not miss one minute of the up front proceedings, and only a few minutes of networking opportunity."

- "I especially appreciated the mix of people from universities and US national laboratories. The latter bring first-hand experience with computational methods on many of the most challenging problems solved on the largest scales and the largest computational platforms."
- "The topic was narrow enough so that people working in the field could mostly understand the work of others, but at the same time broad enough so that new insights from other domains could be absorbed. The slightly longer breaks than usual (between each talk) allowed for immediate networking related to the last talk given. The people present were mostly highly skilled and highly experienced but at the same time very open to discussing ideas and to collaboration. It is rare to encounter such a concentration of people working on the same topic as I do. The only regret is that it only lasted 5 days as I personally would have liked to discuss even much more with the people that were present."
- "I learned enough about nonlinear preconditioning to start thinking of how to implement these strategies in my work. I learned a lot about Anderson Acceleration, particularly with respect to the current state of the art for implementation and analysis, and this gave me ideas of how to proceed in my related work, and how it fits in to the bigger picture."
- "I think it was very useful to hear from people at the National Laboratories which are using this nonlinear solver technology to solve large, complex, multiphysics systems. We also heard from the leading groups in implementation and convergence theory. The discussions focusing on the interaction between them were fruitful."
- "This workshop provided numerous opportunities to hear leading researchers speak about new developments in both theory and practice for simulating large scale scientific problems. The amount of technical experience represented at this meeting was astounding. I learned more about approaches I currently use and was exposed to new problems and techniques to overcome these issues I had yet to encounter or had not considered."

Some Workshop Organizer Comments for "Describe the highlight of this workshop":

- "Seeing Don Anderson present his method and the session on semi-smooth analysis."
- "I knew many of the participants beforehand. Becoming acquainted with the rest and their work was the highlight of the workshop for me."

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *"The organization and format was exceptional. There was a significant amount of time to develop new connections. This works much better that most conferences."*
- "Listening for five days to people broadly working in the same field as myself (and being able to present my own work) with both experience and refreshing ideas, which furthermore were open to collaboration, was for me a highlight in my academic career. I must thank Brown University (and ICERM in particular) for the invitation."

• "I really enjoyed the triumvirate of nonlinear preconditioning. Xiao-Chuan Cai describing his understanding of nonlinear preconditioning, David Keyes comparing the ASPIN and MSPIN styles, and Axel Klawonn showing the largest nonlinear DD solutions in the world."

Note: for upcoming programs from February 1, 2016, please see Appendix C.

Special Workshop/Event 1: The Tony and Pat Houghton Conference on Non-Equilibrium Statistical Mechanics May 4-5, 2015

Organizing Committee

Dima Feldman, Brown University Brad Marston, Brown University

Workshop Description

The conference will promote a broad discussion of current topics in Non-Equilibrium Statistical Mechanics. Talks will focus on theoretical frameworks (or the desire for such) and on specific systems from wide-ranging fields such as astrophysics, atomic physics, biology, chemistry, climate physics, condensed matter, fluid mechanics, geophysics, and high-energy physics. There will be a mix of experimental, computational, and theoretical perspectives.

This is the second in a series of Conferences made possible by a generous bequest from the estate of Tony and Pat Houghton. Tony, who was a theoretical condensed matter physicist, chaired the Brown University Department of Physics from 1992 to 1998.

Note: this event was hosted by ICERM and co-sponsored with the Brown University Department of Physics.

Name	Organization
Tapio Ala-Nissilä	Aalto University and Brown University
Altan Allawala	Brown University
Dilum Aluthge	Brown University
James Baird	Brown University
Xin Bian	Brown University
Freddy Bouchet	École Normale Supérieure de Lyon
Manis Chaudhuri	Harvard University
Gregory Chini	University of New Hampshire
Thiparat Chotibut	Harvard University
Matthew Dobson	University of Massachusetts Amherst
Maxence Ernoult	Harvard University
Dima Feldman	Brown University
Raffaele Ferrari	Massachusetts Institute of Technology
Baylor Fox-Kemper	Brown University
Mara Freilich	Brown University
Enzo Granato	Brown University
Moty Heiblum	Weizmann Institute of Science
Christopher Jarzynski	University of Maryland
Changho Kim	Brown University
Oleg Kogan	Cornell University

Special Event 1 Participants Houghton Conference

Michael Kolodrubetz	Boston University
Alexandre Krajenbrink	Ecole Polytechnique
Aki Kutvonen	Aalto University
Xuejin Li	Brown University
Zhen Li	Brown University
Cristina Marchetti	Syracuse University
Brad Marston	Brown University
Andy Millis	Columbia University
Aditi Mitra	New York University
David Nelson	Harvard University
Andrew Noble	University of California, Davis
Jason Olejarz	Harvard University
Hans Ottinger	ETH
Jukka Pekola	Aalto University
Robert Pelcovits	Brown University
Abigail Plummer	Brown University
Alexander Plyukhin	Saint Anselm College
Anatoly Polkovnikov	Boston University
Sanjay Ramassamy	Brown University
Kabir Ramola	Brandeis University
Gil Refael	California Institute of Technology
Marcos Rigol	Pennsylvania State University
Lea Santos	Yeshiva University
Ivan Savenko	Aalto University
Michael Scheer	Brown University
Krishna Shrinivas	Massachusetts Institute of Technology
Joe Skitka	Brown University
Richard Stratt	Brown University
Samu Suomela	Aalto University
Vaibhav Thakore	Aalto University
Simon Thalabard	UMASS Amherst
Steve Tobias	University of Leeds
Sophie Trastour	Harvard SEAS
Mark Tuominen	University of Massachusetts
Bruce Turkington	Univ. of Massachusetts Amherst
James Valles	Brown University
Daniele Venturi	Brown University
Jin Wang	Stony Brook University
Peter Weichman	BAE Systems
Dazhi Xu	Massachusetts Institute of Technology
Alireza Yazdani	Brown University
SeeChen Ying	Brown University
Zekun Zhuang	Brown University
Royce Zia	Virginia Polytechnic Institute and State University
Philip Zucker	Brown University

No surveys were distributed for this program.

Special Workshop/Event 2: Conference for African American Researchers in the Mathematical Sciences 21 (CAARMS) June 24-27, 2015

Organizing Committee

William Massey, Princeton University Ulrica Wilson, Morehouse College

Description

In the early 1990s, William Massey of Bell Laboratories (then AT&T, now Lucent Technologies) had an idea for an organization devoted mainly to addressing critical issues involving African-American researchers and graduate students in the mathematical sciences. It was envisioned that this organization would highlight current research by African-American researchers and graduate students in mathematics, strengthen the mathematical sciences by encouraging increased participation of African-Americans and members of other underrepresented groups, facilitate working relations among them, and provide assistance to them in cultivating their careers. This organization became known as the Conference for African-American Researchers in the Mathematical Sciences (CAARMS). For the past twenty years this conference has been held at various institutions and institutes across the U.S. (see <u>caarms.net</u>). The CAARMS 21 program will include invited speakers, tutorials, and a graduate students poster session. While this conference is open to all, it will provide a forum where minority researchers in the mathematical fields.

Special Event 2 Participants CAARMS	
Name	Organization
Henok Abraham	The Franklin Institute
Opeyemi Akinbola	University of Michigan
John Belcher	WORASI
Bekele Berhanu	Addis Ababa University
Terrence Blackman	Massachusetts Institute of Technology
Naiomi Cameron	Lewis and Clark College
Shamaera Campbell	Morgan State University
Lincoln Chandler	Chandler Decision Services
Chae Clark	University of Maryland
Melvin Currie	National Security Agency
Dennis Dean	Harvard Medical School
Gelonia Dent	City University of New York
Jonathan Esole	Harvard University
Christina Glenn	University of Alabama at Birmingham
Edinah Gnang	Purdue University
Edray Goins	Purdue University
Jean Guillaume	Brooklyn College, CUNY
Johnny Guzman	Brown University
Joshua Hale	Georgia Institute of Technology
Robert Hampshire	Carnegie Mellon University
Shannon Harris	University of Pittsburgh
Rudy Horne	Morehouse College
Chelsea Huston	Morgan State University

Note: ICERM hosted this event and covered lodging. The remaining expenses were funded by the CAARMS NSF grant awarded to William Massey (Princeton).

Henry Ibekwe	University of Houston
Kamal Ibrahim	NetApp Inc.
Kingsley Iyawe	SPIRAL
Monica Jackson	American University
Kai James	Columbia University
Daniel Jordon	University of Michigan
Donald King	Northeastern University
Samory Kpotufe	Princeton University
William Massey	Princeton University
Paul Millington	Okemos Applied Systems Research
Marquise Mitchell	The Franklin Institute
Calandra Moore	College of Staten Island, CUNY
Jelani Nelson	Harvard University
Asamoah Nkwanta	Morgan State University
Alfred Noel	University of Massachusetts
Elliot Outland	University of Georgia
Terrence Pendleton	Iowa State University
Cristian Potter	Purdue University
Haleigh Redmon	Morgan State University
Keanu Richardson	University of Michigan
Aquia Richburg	University of Maryland at Baltimore
Ahmad Ridley	Department of Defense
Laura Roberts	Princeton University
Philippe Saint-Juste	City College, CUNY
Bolanle Salaam	University of Georgia
Thomas Shepard	The Franklin Institute
Idris Stovall	Pennsylvania State University
Octavious Talbot	Harvard University
Karen Taylor	Bronx Community College, CUNY
Alain Togbe	Purdue University
Rachel Vincent-Finley	Southern University
Wilton Virgo	Texas A&M International University
Cleveland Waddell	North Carolina State University
Jonathan Welburn	University of Wisconsin
Nathaniel Whitaker	University of Massachusetts
Alexis White	American University
Bobby Wilson	University of Chicago
Ulrica Wilson	Morehouse College
William Wilson	Harvard University
Zerotti Woods	University of Georgia
Asia Wyatt	University of Maryland
Karamatou Yacoubou-Djima	University of Maryland
Michael Young	Iowa State University

No surveys were distributed for this program.

VI-MSS International Programs

VI-MSS has sponsored joint workshops, research visits and graduate educational activities with support from the US National Science Foundation, the Indo-US Science and Technology Forum, and the Indian Department of Science and Technology. VI-MSS presently includes jointly funded international collaborations with institutes and institutions in Brazil, Israel, Japan, and South Africa.

Graduate Student Team Based Research

ICERM's international VI-MSS research training program provides graduate students with the opportunity to work in small teams on research projects, while also engaging with a diverse group of graduate students from different countries with different cultural backgrounds. Each program is held in collaboration with a foreign university or institution, typically involving six students from US universities and six students from the international partner institution. Students work in small teams of 3-4 participants on different research projects. Each team is be led by an advanced graduate student; two faculty mentors supply the projects, provide general guidance, and facilitate the research work. Each research program lasts for 3 weeks with half of the time being spent at ICERM and the other half at the international partner institution: this ensures that students are exposed not only to research collaborations within an international group of students but also experience the cultural differences of working in different countries.

ICERM held two research schools this year, jointly with Kobe University in Japan, and Tel-Aviv University in Israel. There are plans to hold three in each of the following years (2-5). Other partner institutions who have expressed interest in these International Graduate student Team-Based Projects are EPFL (Switzerland), IMPA (Brazil), and HKUST, Hong Kong.

Computational Symplectic Topology (team based research)

May 17 - May 26, 2015 in Tel-Aviv, and July 27 - August, 5, 2015 at ICERM

Organizing Committee

Richard Hind, Department of Mathematics, University of Notre Dame Yaron Ostrover, School of Mathematical Sciences at Tel Aviv University Leonid Polterovich, School of Mathematical Sciences at Tel Aviv University Michael Usher, Department of Mathematics, University of Georgia

Description

Symplectic and contact geometry and topology, which provide a natural setting for Hamiltonian dynamics, comprise a broad spectrum of interrelated disciplines in the mainstream of modern mathematics. The past two decades gave rise to several exciting developments in these fields: on one hand, powerful new mathematical tools and concepts were introduced, solving long-standing problems that were previously unattainable; and on the other hand, challenging and exciting new questions arose for future research. Presently, symplectic and contact geometry have connections with an amazingly wide range of areas in mathematics and physics: differential and algebraic geometry, complex analysis, dynamical systems, low-dimensional topology, quantum mechanics, and string theory.

The research program will address a number of cutting-edge research topics within symplectic and Hamiltonian dynamics, with a special focus on computational and experimental aspects.

Program Structure

Several projects will be developed by the faculty organizers. Graduate students will be collaborating in teams formed around each project. All graduate students will participate in both sessions of the program:

05/17/2015 - 05/26/2015 in Tel-Aviv, and 07/27/2015 - 08/05/2015 at ICERM. Between the site visits, the teams will continue collaborating remotely via email and video-conferencing.

Name	Organization
Daniel Alvarez-Gavela	Stanford University
Gautam Banhatti	University of Muenster
Matthew Strom Borman	IAS, Princeton and Stanford University
Robert Castellano	Columbia University
Yaniv Ganor	Tel-Aviv University
Richard Hind	Notre Dame
Victoria Kaminker	Tel-Aviv University
Michael Khanevsky	University of Chicago
Asaf Kislev	Tel-Aviv University
Konstantin Kliakhandler	Tel-Aviv University
Jeremy Lane	University of Toronto
Andrei Pavlichenko	University of Missouri - Columbia
Christopher Policastro	University of California, Berkeley
Leonid Polterovich	Tel-Aviv University
Itamar Rauch	Tel-Aviv University
Lorenzo Rigolli	Ruhr-Universitat Bochum
Daniel Rosen	Tel Aviv University
Karina Samvelyan	Tel-Aviv University
Ood Shabtai	Tel-Aviv University
Kyler Bryce Siegel	Stanford University
Richard (Bret) Stevenson	University of Georgia
Emmanuel Tsukerman	University of California, Berkeley
Shira Tanny	Tel-Aviv University
Jun Zhang	University of Georgia

VIMSS Participants Tel Aviv/ICERM

12 participants were funded by ICERM for this program.

Note: No exit surveys were collected for this program, but participants were asked if they established any on-going collaborations as a result of participation in this program, and did they have any works in progress influenced by their participation in the program. Some responses below:

- *"We completed the paper "Embeddings of free groups into asymptotics cones of Hamiltonian diffeomorphisms". The paper was recently submitted for publication."*
- "I have tried to stay in contact with the organizers in Israel. I would like to continue work on the project from a different angle. I believe that remaining questions from our project could be fodder for the summer REU at UC Berkeley."

Brown-ICERM-Kobe Simulation Summer School (Team Based Research) August 17 - 31, 2015 split between Providence, RI, USA and Kobe, Japan

Organizing Committee

Jill Pipher, ICERM, Brown University Nobuyuki Kaya, Kobe University Bjorn Sandstede, ICERM, Brown University

Description

This program has three objectives. First, it provides graduate students with opportunities to acquire fundamental knowledge and skills in high performance computing, including parallel computing and visualization in 3D caves, and to expose them to the research carried out in these areas at Brown and Kobe Universities. Second, graduate students will learn how to work collaboratively in teams, thus preparing them for the changing nature of research. Finally, the program will provide students with opportunities to develop a global perspective and mindset through participation in a culturally rich and diverse program.

Format

The summer school will take place during 17-31 August 2015 (not counting travel before and after the program). During the first week in Providence, students will attend mini-courses that provide an introduction to numerical algorithms, parallel computing, training on the FX-10 supercomputer in Kobe, and application areas. Simultaneously, student teams, led by advanced graduate students, postdocs, and faculty, will begin to work on their projects. During the second week in Kobe, the student teams will continue to work on their projects, run simulation on Kobe's FX-10 (which has the same architecture as RIKEN's K computer), and visualize results and data on Kobe's 3D visualization system. Teams present their results on the last day to an audience of administrators and research faculty at Kobe University.

Distinctive Features

The program is distinguished by (i) the small number of participants and their teams, which allows for individual instruction, mentoring, and support, (ii) a two-week intensive research summer school which enhances multi-cultural competencies among students, and (iii) the participation of distinctive researchers from Brown, Kobe, and the RIKEN Advanced Institute for Computational Science as guest lecturers.

Prerequisites

This program is open to MSc and first- to second-year graduate students. Prior exposure to scientific computing and programming is useful but not required. Online resources and lectures will be offered during July 2015 prior to the program.

Group Projects:

Project 1: Fracture mechanics of brittle materials using peridynamics

Project 2: Self-assembly of micelles using dissipative particle dynamics

Project 3: Vortex dynamics of turbulent channel flow using pseudospectral methods

History

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The first two Brown-ICERM-Kobe Simulation Schools ran in August 2013 and 2014, each time with 3 research teams, consisting of one team leader and 4-5 team members. In 2014, the projects were

- Peridynamic Theory of Solid Mechanics
- Dissipative Particle Dynamics Simulation
- Direct Numerical Simulation of Turbulent Channel Flow

Schedule	
Location	Date
Providence, RI, USA	17-21 August 2015
Travel	22-24 August 2015
Excursion	25 August 2015
Kobe, Japan	26-30 August 2015
Kobe, Japan	31 August 2015 (Final Presentations)

Name	Organization
Clark Bowman*	Brown University
Tianheng Chen	Brown University
Alexis Cook	Brown University
Stephanie Dodson	Brown University
William Everett	ICERM
Yuji Funaki	Kobe
Amanda Howard*	Brown University
Ryoji Jinushi	Kobe
Taewoo Kim	ICERM
Karen Larson	Brown University
Takuya Makimura	Kobe
Elizabeth Makrides*	Brown University
Akira Matsui	Kobe
Colin McSwiggen	Brown University
Yohei Miyake*	Kobe
Shu Oogawara	Kobe
Daiki Ooyagi	Kobe
Ross Parker	Brown University
Zheng Sun	Brown University
Yoshiyuki Takahashi*	Kobe
Yu-Hang Tang*	Brown University
Hirokazu Uede	Kobe
Hideyuki Usui*	Kobe
Kunrui Wang	Brown University
Ben Whitney	Brown University
Jianfei Xue	Kobe
*Leader	

VIMSS Participants Kobe/ICERM Simulation Summer School

2 participants were funded by ICERM for this program.

Note: No exit surveys were collected for this program,

Note: for upcoming programs from February 1, 2016, please see Appendix C.

Program Promotions

ICERM programs and events are marketed through a variety of outlets: its website, dedicated Facebook page and Twitter account, targeted blast emails, posters mailed to purchased targeted university and college lists, placement of advertisements in mathematical journals and newsletters, Director participation in conferences and exhibits, upcoming program fliers and announcements provided to all ICERM participants, and various on-line math organization calendars SIAM, AMS, European Mathematical Society, National Math Institutes, and Conference Service Mandl, etc.

ICERM's email database is made up of former and future participants, ICERM board members, academic and corporate sponsors, and the department managers from higher education math departments in both the US and overseas. It currently has over 4,000 contact emails. Posters for ICERM's summer undergraduate research program Summer@ICERM are target mailed to institutions known to have undergraduate programs in mathematics, applied math, and computer science.

During this reporting cycle, ICERM has had a speaker, a booth and/or joint representation with other institutions at the following locations and national events:

- MAA MathFest, Summer 2015, Washington DC
- Mathematical Field of Dreams Conference, Fall 2015 Birmingham, AL
- Modern Math Workshop at SACNAS, Fall 2015 Washington, DC
- JMM, Winter 2016 Seattle, Washington
- Nebraska Conference for Undergraduate Women in Mathematics, Winter 2016

All program advertising emphasizes diverse participation and uses language encouraging minority and under-represented students to apply. More details about this can be found in the "Outreach/Diversity" section of this report.

Organization/Infrastructure

ICERM's governing body is a Board of Trustees BOT. The Scientific Advisory Board SAB oversees all scientific activities of the Institute and selects the scientific programs. The Education Advisory Board, or EAB coordinates the oversight of educational activities at all levels at ICERM.

Board of Trustees (BOT)

The Board of Trustees (BOT) oversees all institute activities. This includes being responsible for reviewing the budget for the coming year, developing policies and procedures, approving the appointment of the Director, and taking a leadership role in fundraising and public awareness. The Board of Trustees has a face-to-face meeting at ICERM for one day each year usually in late spring, and one or two conference-call meetings if needed.

Board member appointments are for four years. Chairs from the Scientific Advisory Board SAB and the Education Advisory Board EAB, as well as the ICERM Directors, act as ex officio members. The board meets in person once a year. There may be additional conferences and consultation.

Name	Institution
Douglas Arnold	University of Minnesota
Sir John Ball	University of Oxford
Jennifer Chayes	Microsoft Research
Peter Jones (interim Chair)	Yale University
David Keyes	Columbia University/KAUST
Barbara Keyfitz	Ohio State University
Yann LeCun	NYU and Director of Research, Facebook
Yvon Maday	Université Pierre et Marie Curie
Bin Yu	University of California at Berkeley

ICERM Board of Trustees

Note: See Appendix D for the minutes of the June 5, 2015 annual Board of Trustees meeting.

Scientific Advisory Board (SAB)

The Scientific Advisory Board (SAB) is responsible for approving the programs and scientific activities of the Institute. In addition, through direct communication with the Directors, Science Board members will be involved in shaping the direction of the scientific enterprise through specific suggestions of thematic programs, program organizers and participants.

Terms are three years. Three of the seats on this Board are reserved for senior representatives of Google Research, IBM, and Microsoft Research. The ICERM Directors act as ex officio members of this committee.

Name	Institution
Henry Cohn	Microsoft Research
Qiang Du (new member)	Columbia University
Charles Epstein	University of Pennsylvania
Anna Gilbert, Chair	University of Michigan
Sally Goldman	Google
Ricardo Nochetto (new member)	University of Maryland
Guillermo Sapiro	Duke University
Anne Schilling	University of California, Davis
Richard Schwartz	Brown University
Cosma Shalizi	Carnegie Mellon University
Robert S. Sutor	IBM

ICERM Scientific Advisory Board

Quang Du and Ricardo Nochetto joined the SAB in 2015. Cynthia Philips, Yuri Tschinkel, and Peter Winkler rotated off in late 2015

Note: see Appendix E for the minutes of the November 2015 annual Scientific Advisory Board meeting.

Education Advisory Board (EAB)

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The Education Advisory Board (EAB) is charged with 1) oversight of the mentoring mechanisms and professional development of both graduate students and postdoctoral candidates, 2) oversight of undergraduate research programs, and helping to develop and identify successful proposals, and 3) developing proposals for K-12 outreach programs, including student internships and teacher education, and identifying alternative sources of funding.

Principally, the focus of the EAB will be the educational activities pertaining to Undergraduates, Secondary and Primary school students, Teachers in STEM fields, and the community at large. Subcommittees will have oversight over the following activities:

- **Summer Undergraduate Research Programs**: Oversight includes the task of reviewing and rank-ordering proposals for summer undergraduate research programs from faculty.
- **Outreach Activities:** Oversight includes proposing and reviewing all projects and programs involving the interaction between ICERM and the communities listed above. Review of such programs will include advice on assessment and evaluation.
- **External Funding:** The EAB will explore opportunities for external funding for outreach activities, and, where possible, facilitate and pursue such funding opportunities.
 - **Public Outreach:** The EAB will identify potential speakers and topics for public lectures to the community at large.
- **Dissemination and Evaluation:** This subcommittee will recommend external evaluators and review evaluation processes.

Terms are three years. The ICERM Directors act as ex officio members of this committee.

Name	Institution
John Ewing (new member)	Math for America
Karen Haberstroh	Brown University
Irina Mitrea	Institute for Mathematics and its Applications
Katharine Ott	Bates College
Allison Pacelli	Williams College
Lynn Rakatansky	RI Math Teachers Association Executive Board
Tatiana Shubin	San Jose University
Sergei Tabachnikov, Chair	Brown University
Ulrica Wilson	Morehouse College

ICERM Education Advisory Board

Note: see Appendix F or the minutes of the September 11, 2015 annual Education Advisory Board meeting.

Mathematics Institute Directors Meeting MIDs

See Appendix G for the May 2015 MIDs meeting minutes.

ICERM's Early Career Training and Mentorship

A special focus of the operations of the institute is the training and mentorship of younger and early career mathematicians, through specific outreach programs and directed opportunities for connections between mathematicians at different stages in their career. This includes ICERM's postdoctoral program, integration and support of graduate students in the context of semester programs, and our summer research programs for undergraduates (Summer@ICERM).

Caroline Klivans, a Lecturer for Brown University's Applied Mathematics and Computer Science Departments, is also ICERM's newest Associate Director. Carly provides leadership for the institute's graduate student and postdoc mentoring program, including the Professional Development seminar series.

Postdoctoral Program

ICERM's postdoctoral program brings early career mathematicians to the institute in order to support and expand their research and to create lasting career collaborations and connections. ICERM supports postdoctoral researchers in two different ways: postdoctoral fellows, who participate in a single semester program and are supported by a stipend plus health insurance benefits and a \$750 travel stipend, and a smaller number of institute fellows, who stay at ICERM for 9 months and who receive a salary plus health insurance benefit with the possibility of summer support. In addition, \$1,500 in research travel funding is made available with pre-approval from ICERM. All ICERM postdocs are matched with a faculty mentor for the duration of their institute appointment.

Recruiting and Selection of ICERM-Funded Postdocs

ICERM's postdoctoral positions are widely advertised using MathJobs.org, print and online publications of the Society for Industrial and Applied Mathematics News, Notices of the American Mathematical Society, the Association of Women in Mathematics, the Society for the Advancement of Chicanos and Native Americans in Science, and on the ICERM website. These positions are also advertised at the NSF Institute Reception at the joint meetings of the AMS/MAA. ICERM collects applications via Mathjobs.org, an online job application service provided by the American Mathematical Society.

In all written material sent out, it is emphasized that Brown is an EEO/AA Employer and that ICERM encourages applications from women and minority candidates.

ICERM sets a mid-January deadline for postdoctoral applications. Application review begins immediately and continues until the positions are filled.

The Postdoctoral Fellow Search Committee consists of the ICERM Semester Program organizers for the upcoming programs and the ICERM Director and Deputy Directors.

The program organizers review all of the applications and provide a rank-ordered list to the ICERM Directors for each of the two types of positions (Institute and Semester postdocs). Directors review the total applicant pool and the ranked lists, and may suggest changes. The directors approve all offers, and Brown University's Dean of the Faculty generates the appointment paperwork.

Typically, ICERM postdoctoral fellows come to ICERM after taking a leave from, or have deferred the start of, another position.

Fall 2015 ICERM Postdoctoral Cohort

ICERM Postdoctoral Semester Fellows: 4 months w/funds for travel to and from institute

Name	Previous Institution	Semester
Olga Balkanova	University of Bordeaux	Fall 2015 CALP
Sandro Bettin	CRM, Universit de Montreal	Fall 2015 CALP
Edgar Costa	Courant Institute of	Fall 2015 CALP
-	Mathematical Sciences	

ICERM Postdoctoral Institute Fellows*: 9 months w/funds for travel to and from institute

Name	Previous Institution	Semester
Anna	Brandeis University	2015-16: focus Fall
Medvedovsky		CALP
James Weingandt	Purdue University	2015-16: focus Fall
		CALP

ICERM funded 2 ICERM Institute Postdocs in 2015.

Based on available information, the ICERM supported postdocs for Fall 2015 break down as follows:

	Male	Female
Black	0	0
Hispanic	0	0
American Indian/Alaskan Native	0	0
Asian/Pacific Islands	0	0
White	2	3
Other specify	0 -	+ <u>0</u>
	$\overline{2}$	3 = 5 Total

Keeping Track of Former Postdocs Institute and Semester

The institute makes every effort to keep in touch with its postdoctoral alums in order to track their professional growth.

ICERM-funded postdocs to date	Period of Stay	Current Position
Emre Esenturk	Fall 2011	Warwick Mathematics

		Institute
Jeffrey Haack	Fall 2011	RTG Instructor, University of
		Texas/Austin
Andong He	Fall 2011- Spring 2012	Passed Away in 2016
Ahmed Kaffel	Fall 2011	Research Associate University of WI
Daniela Tonon	Fall 2011	Maître de Conférence, Université Paris Dauphine
Dongming Wei	Fall 2011	Associate Dir at RBC Capital Markets
Cecile Armana	Spring 2012	Maître de Conférence, University of Franche-Comté
Anupam Bhatnagar	Spring 2012	Data Scientist at Chartboost
Alon Levy	Fall 2011 – Spring 2012	Postdoc at KTH
Bianca Viray	Spring 2012	University of Washington
Xiaoguang Wang	Spring 2012	Tenure track at Zhejiang University
Daniel Cargill	Fall 2012	Visiting Assistant Professor, Southern Methodist University
Arnab Ganguly	Fall 2012	Tenure track at University of Louisville
Peng Hu	Fall 2012	Oxford-Man University
Hao Ni	Fall 2012	Oxford-Man University
Aaron Smith	Fall 2012 - Spring 2013	Tenure Track at University of Waterloo
Julio Andrade	Fall 2012 - Spring 2013	Senior Researcher at Oxford
Kwangho Choiy	Spring 2013	Tenure track at Southern Illinois University
Zajj Daugherty	Spring 2013	Tenure track CCNY
Martina Lanini	Spring 2013	Tenure track University of Edinburgh
Ben Salisbury	Spring 2013	Tenure track Central Michigan University
BoGwang Jeon	Fall 2013	Tenure track at Columbia University
Rodolfo Rios-Zertuche	Fall 2013	Max Planck Institute
Ryan Greene	Fall 2013	Lecturer at Ohio State
Giulio Tiozzo	<i>Fall 2013</i> – Spring 2014	Tenure track at Yale University
Anastasiia Tsvietkova	Fall 2013	Tenure track at UC-Davis
Danupon Nanongkai	Spring 2014	Tenure track KTH Royal Institute of Technology
Amanda Redlich	Spring 2014	Tenure track at Bowdoin College
Kyle Fox	Spring 2014	Duke University
Charalampos Tsourakakis	Spring 2014	Harvard School of Engineering and Applied Sciences
Grigory Yaroslavtsev	Fall 2013 - Spring 2014	University of Pennsylvania

Ali Ahmed	Fall 2014	MIT
Ulas Ayaz	Fall 2014 – Spring 2015	MIT
Jacqueline Davis	Fall 2014	Arizona State University
Pawel Siedlecki	Fall 2014	University of Warsaw, Faculty
Li Wang	Fall 2014	University of Illinois,
		Research Asst. Prof non tenure
		track
Tyler Helmuth	Spring 2015	UC Berkeley
Marcin Lis	Spring 2015	University of Gothenburg
Xuan Wang	Spring 2015	Georgia Institute of
		Technology, Visiting Assistant
		Professor
Emily Russell	Fall 2014 – <i>Spring 2015</i>	Google Software Engineer
Samuel Watson	Spring 2015	Brown University
Olga Balkanova	Fall 2015	University of Turku, Finland
Sandro Bettin	Fall 2015	University of Genova
Edgar Costa	Fall 2015	Instructor, Dartmouth College
Anna Medvedovsky	Fall 2015- Spring 16	Max Planck Institute
James Weingandt	Fall 2015 – Spring 16	Purdue University
Marta Canadell	Fall 2015- Spring 16	UAB, Barcelona

Graduate Students

Support for Graduate Students

The research semester program budget includes partial support for a cohort of graduate students. A housing allowance \$750/month and travel to the institute is provided to about 10-14 graduate students each of whom applies to be in residence for the entire semester. Applicants include graduate students working with visitors to the program, as well as students who intend to come without an advisor. Graduate students must arrange for a letter of recommendation from their advisor to be sent separately. The graduate student applications are rank-ordered by the semester program organizing committee, and subsequently reviewed by the Deputy Director overseeing the development of that particular program. Final decisions are made by the directors. The ability to provide a mentor for each graduate student in residence is a factor in the decision.

Training and Mentoring Programs

Before an ICERM semester program starts, all postdocs and graduate students are assigned a mentor. The institute provides all senior mentors with written guidelines that spell out their responsibilities and the responsibilities of mentees. The institute also provided mentors and mentees with the AAMC Compact and the FASEB Individual Development Plan IDP to help them clarify mutual expectation and guide them in developing and setting goals for the mentees. Currently, Associate Director Caroline Klivans coordinates these efforts and works with the members of the Program Organizing Committee assigned to be responsible for mentorship.

In addition, at the beginning of each semester program, directors hold mentor/mentee introductory meetings. These meetings emphasize that mentors should help mentees start to build a research cohort, and help them create contacts and resources which will persist beyond the program.

The mentoring program for the Institute Postdoctoral Fellows necessarily includes a plan for the "off semester" when these postdocs are in residence at ICERM while there is no active research program in

their area. So far, all such postdocs have been matched with mentors at Brown in Math, Applied Math, or Computer Science. However, we envision the possibility of different arrangements, including mentorship from faculty at local institutions or even arranging travel or extended visits to more distant locations.

Postdoc	Mentor	Program
Samuele Anni	Andrew Sutherland	Fall 2015 ICERM/Independent
Olga Balkanova	Jeff Hoffstein	Fall 2015 ICERM Postdoctoral Fellow
Sandro Bettin	Ghaith Hiary	Fall 2015 ICERM Postdoctoral Fellow
Edgar Costa	David Harvey	Fall 2015 ICERM Postdoctoral Fellow
TingFang Lee	Jeff Hoffstein	Fall 2015 ICERM/Independent
Anna Medvedovsky	Holly Swisher	Fall 2015 ICERM Institute Postdoc
Nicolas Mascot	John Cremona	Fall 2015 ICERM/Independent
Aurel Page	Kiran Kedlaya	Fall 2015 ICERM/Independent
Christelle Vincent	Jeff Hoffstein	Fall 2015 ICERM/Independent
James Weigandt	Edray Goins	Fall 2015 ICERM Postdoctoral Fellow

ICERM Postdoctoral Participant and Mentor list, Fall 2015 Semester Program

Graduate Student Mentoring, Fall 2015 Semester Program

Graduate Student	Mentor	Program
Benjamin Breen	John Voight	Fall 2015
William Chen	Winnie Li	Fall 2015
Zhou Fang	Jeff Hoffstein	Fall 2015
Angelos Koutsianas	John Cremona	Fall 2015
Daniel Kohen	Kiran Kedlaya	Fall 2015
Seoyoung Kim	Joe Silverman	Fall 2015
David Lowry-Duda	Jeff Hoffstein	Fall 2015
Watson Ladd	John Voight	Fall 2015
Jolanta Marzec	Lassina Dembele	Fall 2015
Alok Shukla		Fall 2015
Harald Schilly	John Jones	Fall 2015
Samuel Schiavone	John Voight	Fall 2015
Long Tran		Fall 2015
Alexander Walker	Jeff Hoffstein	Fall 2015

Roundtable Discussions

To prepare graduate students and postdocs better for their future careers, the institute also organizes regular roundtable discussions with long-term visitors, Brown faculty, and directors, that in the course of each semester, cover the following topics:

- Preparing job applications
- Writing and submitting papers
- Writing grant proposals
- Ethics in research as required by NSF mandatory, attendance is taken
- Job opportunities in industry and government labs

Peer-to-Peer Discussions

During semester programs, there are regularly scheduled postdoc-graduate student seminars, expressly limited to junior researchers. This gives participating postdocs and graduate students an opportunity to

discuss research topics and any other issues openly, without senior people present. The format is completely flexible. For example, it could feature talks by postdocs or graduate students on their current research, or provide an opportunity to read and report on papers, or give an introduction to upcoming talks in other seminars. The group could even ask a senior participant to give a tutorial lecture and then follow up with a discussion session afterwards.

Integration with Summer@ICERM undergraduate research program.

Ideally, our summer undergraduate research program has scientific connections to the themes of one of the surrounding semester program, and will attract applications from participating postdocs and graduate students to assist the summer faculty leaders.

Graduate Students and Postdocs as Mentors

It is expected that some of the graduate students and postdocs may play an integral part in the Summer Undergraduate programs by supporting faculty in working with the undergraduate participants.

IdeaLab for Early Career Researchers

This program Idea-Lab is a one-week program aimed at early career researchers within five years of their Ph.D. that will focus on two different topics at the frontier of research. Participants will be exposed to problems whose solution may require broad perspectives and multiple areas of expertise. Senior researchers will introduce the topics in tutorials and lead discussions. The participants will break into teams to brainstorm ideas, comprehend the obstacles, and explore possible avenues towards solutions. The teams will be encouraged to develop a research program proposal. On the last day, they will present their ideas to one another and to representatives from funding agencies (NSF's Andrew Pollington and DARPA's Fariba Fahroo) for feedback and advice. *IdeaLab applicants should be at an early stage of their post-Ph.D. career*. A CV, research statement, and two reference letters are required.

This program was retired in favor of the new Collaborate@ICERM program.

IdeaLab 2015: Inverse Problems and Uncertainty Quantification July 6 - July 10, 2015

Organizing Committee

Omar Ghattas, University of Texas at Austin Youssef Marzouk, Massachusetts Institute of Technology Noemi Petra, University of California, Merced

Program Description

Inverse problems arise in an enormous variety of science and engineering applications. Examples range from understanding the dynamics of Antarctic ice sheets to developing predictive models of combustion emissions. In all these applications, model parameters must be estimated from noisy and indirect observational data. Uncertainty is integral to this endeavor: observational errors, model errors, and issues of ill-posedness yield uncertainties in model parameters. More broadly, the solution of inverse problems can be viewed as the interpretation of data through the lens of models that capture key relationships between measured quantities, the state and parameters of a system, and the ultimate quantities of interest to the modeler.

Bayesian statistical approaches to inverse problems offer the ability to endow model parameters and subsequent predictions with quantified uncertainties, reflecting both prior information and the information available in observations. Quantifying uncertainty in predictions of interest in turn enables coherent approaches to model-based decision making. While the past several years have seen significant advances

in both the theoretical formulation of Bayesian inverse problems and the development of effective computational tools for their solution, many important and long-standing challenges remain: methods for efficient posterior exploration in high or infinite-dimensional parameter spaces, algorithms that exploit the structure of expensive PDE-based forward models, algorithms for parsing and reducing "big data" in the context of inversion, the construction of controlled approximations to the posterior distribution and its constituent models, the development of physically meaningful yet mathematically coherent prior distributions, and methods for incorporating model errors into the inverse solution and subsequent predictions.

The goal of this IdeaLab is to lay out the fundamentals of uncertainty quantification for inverse problems in a relatively rapid but hands-on manner, so that participants can understand and fluently discuss the current state of the art. We will also present connections to classical (regularization-based) inverse problems. We will then brainstorm projects focusing on new methodological approaches and new applications. The session will benefit from collaboration among participants with diverse mathematical and computational interests, ranging from statistics and machine learning to optimization and numerical PDE, as well as interests across a broad set of science and engineering application areas.

Name	Organization
Sergios Agapiou	University of Warwick
Ali Ahmed	Massachusetts Institute of Technology
Andrea Arnold	North Carolina State University
Kenny Chowdhary	Sandia National Laboratories
Jerrad Hampton	University of Colorado
Jayanth Jagalur-Mohan	Massachusetts Institute of Technology
Tulin Kaman	ETH
Georgios Karagiannis	Purdue University
Jonghyun Lee	Stanford University
Qin Li	California Institute of Technology
Andreas Mang	University of Texas at Austin
Mahsa Mirzargar	University of Utah
Lars Ruthotto	Emory University
Umberto Villa	University of Texas at Austin
Stephen Wu	ETH

IdeaLab Participants

Here follows a sample of the most substantive comments from our IdeaLab participants.

IdeaLab Participant Comments for "Describe the highlight of this program":

"The good introduction to UQ and inverse problems by the lecturers. That we had to find a good problem, think a direction to solve that problem, and present a mini proposal in front of NSF and DARPA representatives was a very important training and experience. The feedback we got from the NSF and DARPA officers on how to get a grand, and what they mainly expect from a proposal"

"I really enjoyed the lectures but more importantly the time to actually work in small groups. Our group had a great mix of expertise and we applied some methods from the lecture to an application. This was very useful in understanding the material covered in the lectures."

"The opportunity to have in-depth discussion about methods, challenges, and open problems in the field of inverse problems and uncertainty quantification with pioneers and experts, as well as having a hands on experience. In particular I liked the fact that we were a relatively small group which allowed us to really express, understand, and discuss ideas and challenges. From a scientific but also from a personal perspective, this trip stands out as a highlight compared to other workshops and conferences I have visited so far. I learned a lot."

Summer Undergraduate Research Program

Summer Undergraduate Research Program Process

The summer undergraduate research program selection process follows these steps:

1. Solicitation of Proposals

ICERM solicits and recruits proposals from faculty nationwide. Faculty leading the program will spend a period of 8 weeks in Providence during the summer, teaching and supervising the undergraduates, with the assistance of graduate student TAs and/or postdoctoral fellows.

2. Future Proposal Selection

Programs are selected from proposals submitted to ICERM in an open competition. Successful programs typically have a significant computational component. Summer research programs which pair with the semester programs are especially encouraged, but not required. A subcommittee of the EAB and an Associate Director vet proposals. External evaluations of proposals are solicited. Preliminary decisions on summer programs are made by the Directors and must be approved by the Scientific Advisory Board.

3. Application Process

Undergraduates apply to the program through MathPrograms.org and a ranked list of applicants are made by the faculty program leaders and the Directors.

4. Applicant Selection

Undergraduate participants are selected by instructional staff of the summer research program and the selections are finalized by ICERM Directors. At all stages of recruitment, solicitation, and selection, committees are instructed about the diversity goals of the National Science Foundation, and ICERM in particular. To ensure a diverse group of applicants, ICERM advertises and recruits from minority serving organizations.

Financial Decisions for Program

Each faculty member receives either salary or expenses, or some combination of the two. Both regular faculty members and senior postdoctoral researchers are eligible to serve as faculty mentors. An institute postdoc who wishes to participate in the summer program can receive summer support. Each graduate student supporting a program receives a stipend commensurate with a summer teaching stipend. Undergraduate participants funded by ICERM receive a stipend, travel funds within the United States, and meals and accommodation in a Brown dormitory.

Summer 2015: Summer@ICERM – Computational Dynamics and Topology

June 15 - August 7, 2015

Organizing Committee

Y.M. Baryshnikov, University of Illinois at Urbana-Champaign V. Zharnitsky, University of Illinois at Urbana-Champaign

Program Description

The Summer@ICERM: Polygons and Polynomials program is designed for a select group of 18-20 undergraduate scholars. Students will work in small groups of two or three, supervised by a faculty

advisor and aided by a teaching assistant. The faculty advisors will describe a variety of enticing open questions in geometry and in dynamical systems of geometric origin. Topics discussed will include Euclidean, hyperbolic and projective geometry, iteration of geometric constructions, and mathematical billiards. A variety of activities around these research themes will allow participants to engage in collaborative research, communicate and examine their findings in formal and informal settings, and report-out their findings with a finished product.

Summer@ICERM students receive a \$3,000 stipend, support for travel within the U.S., and room and board.

Name	Home Institute	Funding Source
Shuchi Agrawal	Brown University	Outside Funds
Jeremy Ariche	Morehouse College	NSF
Daniel Barg	Columbia	NSF
Emily Black	Wesleyan University	NSF
Juan Claramunt	Universidad de Cantabria	Outside Funds
Thomas Dauer	Indiana Univ/Bloomington	NSF
Meg Doucette	Univ. of Chicago	NSF
Milana Golich	Perdue University	NSF
Anna Grim	University of St. Thomas	NSF
Chang He	Centre College	Outside Funds
Esther Hunt	George Fox University	NSF
Conrad Kosowsky	Univ. of Pittsburg	NSF
Derek Levinson	Brown University	Outside Funds
Ben Lowe	Univ. of Chicago	NSF
Erin McCloskey	Brown University	Outside Funds
Timothy Valicenti	Brown University	Outside Funds*
Laura Vargas Hernandez	Instituto Tecnológico Autónomo de	NSF
	México	
Shan Wolf	University of Cambridge (UK)	NSF
Frank Yang	Carleton College	Outside Funds

2015 Summer@ICERM Cohort

*UTRA funded with stipend of \$3,500.

In addition to the 19 undergraduate researchers and 2 faculty organizers, 4 teaching assistants were key members of the Summer@ICERM program: Tarik Aougab (Brown University), Stefan Klajbor Goderich (University of Illinois), Maxim Arnold (University of Texas), and Emily Stark (Tufts University).

Here follows a sample of the most substantive comments from our Summer@ICERM participants.

Summer@ICERM Organizer Comments for "Describe the highlight of this program": *No comments were submitted.*

Summer@ICERM Participant Comments for "Describe the highlight of this program": *"The people were all very accessible and having everyone in the same area was very conducive to productive and enjoyable work. The facilities are great too!"*

Summer@ICERM TA Comments for "Describe the highlight of this program":

"Meeting and working closely with great students from around the country and the world. I anticipate maintaining close contact with several of my peers from the program."

"For me, the highlights of the program were getting access to tremendous resources, getting introduced to research, having very helpful TAs, and meeting very interesting faculty (through Summer@ICERM workshops, and through the other workshops/conferences at ICERM)."

"Presenting! It was a great start to my professional experience giving talks as a mathematician. I really enjoyed explaining my research to others and was a great wrap up to what I had worked on all summer. Also the many opportunities we had to learn more about graduate school and what we want out of our careers through networking."

"The highlight of the program was working with very interesting and motivated people from across the country. Our group got along very well and we had a lot of fun together. I also really enjoyed the conferences that were held at ICERM throughout the summer. It was fun to attend the poster sessions and ask the presenters about graduate school and jobs."

Participant Selection Process

The "Summer@ICERM" program ran from June 15, 2015 through August 7, 2015 with a cohort of 19 students. Twelve students were funded through the NSF, one via a Brown University Undergraduate Training and Research Award UTRA, and six via outside funding.

ICERM accepts applications for its Summer@ICERM program via *Mathprograms.org*, an online service provided by the American Mathematical Society. The total number of applicants in the pool for the 2015 Summer@ICERM program 399 included many who were not qualified in the sense that their research interests did not fit within the research parameters of the program, they did not complete the application properly, or they were no longer undergraduate students and thus disqualified.

The selection committee reviewed the list of qualified applicants, and with consideration towards diversity, a rank-ordered list was generated.

Based on available information, the 2015 Summer@ICERM *ICERM funded* cohort broke down as follows:

	Male	Female	
Black	1	0	
Hispanic	1	1	
American Indian/Alaskan Native	0	0	
Asian/Pacific Islands	1	2	
White	7	6	
Other specify	<u>0</u>	<u>0</u>	
	10	+ 9 =	19 Total

The seven externally funded students were made up of 3 Asian/Pacific Islanders (1 male, 2 female), 1 male Hispanic, and 3 white (1 male and 2 female).

Summer@ICERM Scientific Outcomes to Date

Like all ICERM programs, many of the scheduled scientific seminars for this program were announced and open to the Brown community. Throughout the Summer@ICERM program, approximately 25 individuals graduate students, undergraduate students, and Brown visitors came to ICERM in order to participate in the Summer@ICERM mini-courses.

Final Student Presentations

Links to presentation PDFs can be found at: <u>https://icerm.brown.edu/summerug/2015/ - collapseThree</u>

- "The Topology of Configuration Spaces of Coverings" by D. Barg, S. Agrawal, and D. Levinson
- "Configuration Spaces of Hard Disks" by E. Black and E. Hunt
- "Crowd Dynamics" by J. Ariche, T. Valicenti, J. Claramunt
- "Cyclic Pursuit/Evasion Systems" by A. Grim, M. Golich, and L. Vargas Hernandez
- "Discontinuous Standard Map Dynamics" by T. Dauer, M. Doucette, and S. Conrad-Wolf
- "Mixing Time in Robotic Explorations" by C. He and S. Yang
- "Singularities of Hinge Structures" by B. Lowe and C. Kosowsky

Completed Student Projects

"On a very steep version of a standard map" by by T. Dauer, M. Doucette, and S. Conrad-Wolf (to appear in Experimental Mathematics Journal)

Several Summer@ICERM students went on to give poster presentations at MAA and NCUWM based on their work at ICERM. One group, C. He and S. Yang, received the MAA 2016 Outstanding Poster Award for their "Mixing Time in Robotic Explorations" research; a monograph is in preparation.

Expanding Summer@ICERM

ICERM has continued to explore additional sources of funding for the undergraduate program and create relationships with organizations that can help recruit minorities.

Two to four Brown-funded students and two to four self-funded students participate each summer in the program. These students were partially funded by ICERM.

The Evaluation Process: Measure to Evaluate Progress

The overarching goal of ICERM is to promote and facilitate research at the intersection of mathematics and computation/experimentation. This goal is achieved through the planning and execution of numerous scientific programs and events available to participants each year.

Almost since its very first topical workshop in 2011, ICERM has been collecting survey data from its participants to assess the immediate impact of each program and determine participant satisfaction.

Current Program Evaluation

ICERM has expanded its evaluation and measurement efforts to gain a better understanding of program impact on participant research and scholarly success over time. Additionally, ICERM has begun to incorporate more in-depth data analysis procedures in its current evaluation efforts in order to understand the impact of its programs on different subgroups of participants e.g., early career versus tenured faculty. The following is summary of the goals set last year

- 1. Hire an external evaluator (completed)
- 2. Ensure all ICERM surveys are consistent and capture all relevant indicators (completed)
- 3. Transition to a more sophisticated survey tool (completed)
- 4. Embed unique identifiers in every survey (completed)
- 5. Measure impact of programs across subgroups
- 6. Measure long-term outcomes

External evaluator

ICERM continues to work with SRG, an external evaluation company, to improve its survey process.
More consistent surveys

Based on SRG's feedback, the following improvements were made to the surveys in order to streamline the reporting-out and analysis of results:

- all institute surveys are now created and stored securely in the cloud using the Qualtrics Research Suite
- all are similar in length and style
- all include some identical questions and unique identifier markers, all of which were identified as necessary for tracking ICERM's impact on research and career growth over time

The goal in the coming year is to have all survey reports automated to display particular variables of interest across participants and over time. In this way, ICERM can start to more easily recognize a pattern of program strengths in certain areas and may be able to tailor aspects of its programs to successfully equip individuals for a thriving and influential research career.

ICERM now successfully creates surveys that are customized to a single participant instead of distributing a broad and generalized survey to all participants. An example of how customized surveys are being used at the institute is the generation of publication lists for each participant. When the survey is sent, Qualtrics reads the unique identification number of the participant stored in the panel database and generates a list of publications previously collected by ICERM staff and assigned to that specific identification number. Then, the surveyed participant is able to identify the publications that can be attributed to his or her time at ICERM. This novel incorporation of a participant-specific generated publication list has been useful in understanding how influential ICERM programs are to one's research career long-term.

Survey response rates

ICERM strives to get the highest response rate for its surveys. The director informs participants that they will receive a survey during her welcoming remarks. In addition, the institute works to explain how it handles responses confidentially and why it collects gender and ethnicity data. Reminders are sent one or two weeks after each survey is first sent out. This year, ICERM averaged a 65% response rate on all of its exit surveys.

Every survey ICERM sends to participants includes the following statements:

Why ICERM asks for demographic information: ICERM receives support from the National Science Foundation (NSF), which is an agency of the Federal Government. The Federal Government has a continuing commitment to monitor the operation of its grant and award processes to identify and address any inequities based on gender, race, ethnicity or disability.

Your voluntary responses to our demographic questions are made available to ICERM and reported only in aggregate. They are not linked to your other survey responses. This data allows us to measure our objective to ensure the participation of a representative sample of the population, hence it is important to get this information from everyone.

ICERM maintains the strictest standard of confidentiality with all information provided by our participants. Responses are not shared or reported in any way outside of ICERM that is personally identifiable. All results are reported at the aggregate level.

Measure impact across subgroups

Qualtrics not only aids in creating customizable surveys for participants, but also can serve as a platform for analyzing data according to different subgroups of participants e.g., gender, job title, race/ethnicity.

SRG will be assisting ICERM with using the Qualtrics data analysis tools to better understand how the institute's programs impact different subgroups of researchers in both the immediate i.e., program exit

surveys and intermediate-/long-term i.e., two- and five-years after program participation. ICERM is now positioned to conduct appropriate analyses of categorical data i.e., Chi-square analysis and t-tests within the survey website. Qualtrics also provides the opportunity to analyze longitudinal data, which will be helpful in the analysis of certain programs over time. Ultimately, these analyses will provide information as to how ICERM can alter programs to benefit different types of participants who may be at various points in their research career.

Measure long-term outcomes

Since 2014, ICERM has been administering an intermediate - i.e., two-year follow-up survey to past semester program participants. Using the unique identification numbers and in-survey data analyses as outlined above, these surveys measure the attributable impact of participation in ICERM research programs by gathering data on published papers, invited talks, and funded or pending grant proposals. These follow-up surveys will help us understand the far-reaching impact of ICERM's research programs over time. A first five-year follow-up surveys will be administered to program participants during the coming reporting cycle.

ICERM continues to play a large role in gathering and updating participant information for the two year surveys. Specifically, one question provides participants with a list of their papers, pre-prints, or reports published since their participation at ICERM; participants then have the opportunity to include which publications resulted from their participation at an ICERM program or event. ICERM is responsible for finding and compiling these publications for each participant. Additionally, before implementing each survey, ICERM continues to be involved in editing and testing the survey in order to have an end product that will most effectively provide data aligned with its goals.

It is important to note here that although ICERM has hired SRG as its external evaluation company to aid in reaching their evaluation goals, the institute still plays a vital role in the data collection and survey distribution process. In addition, at weekly management meetings, survey results are reviewed and discussed so that improvements can be made as appropriate.

Note: Appendix H shows links to exit survey summaries for programs run during this reporting cycle (May 2015-January 2016).

Reported Scientific Outcomes/Projects Initiated

In the past years, the Director sent a request to all long-term participants asking for updates on their research projects and/or publications that arose during, or were enhanced by, participation in an ICERM program. With the advent of ICERM's 2-year and soon to be added 5-year follow-up survey for each of its semester programs, scientific outcomes have begun to be collected much more systematically and consistently; ICERM can now report scientific outcomes for past programs in a standardized report. For the purposes of this annual report, we have summarized "projects initiated" that were reported on the fall 2015 semester program exit surveys. Participants answered the question, "What, if any, specific projects did you initiate or continue while attending this semester program?" Using unique IDs, ICERM will be able to track the advancement of these initial projects through the subsequent standardized 2-year and 5-year follow-up surveys.

Note: see Appendix I for a list of research projects initiated at ICERM during the fall 2015 semester program.

Corporate and Academic Sponsorship

Several math institutes currently funded by the NSF employ corporate and university sponsored programs with tiered memberships. ICERM launched its own unique corporate and academic sponsorship programs

in 2011.

The Corporate Sponsorship program has a \$5,000 annual membership fee. To date, ICERM has received \$22,500 in corporate sponsorship funds.

Annual Corporate sponsors include:

- Google
- Mathematical Association of America
- Microsoft Research

The Academic Sponsorship has an annual membership fee of \$1,500 for domestic memberships with small graduate student programs, \$3,000 for domestic membership with large graduate student programs, and \$5,000 for international membership. To date, ICERM has received \$54,875 in academic sponsorship funds.

Academic sponsors include:

- Cornell University, Department of Mathematics
- Georgia Tech, School of Mathematics
- Indiana University, Bloomington, Department of Mathematics
- Iowa State University, Department of Mathematics
- Korea University, Department of Mathematics
- Michigan State University, Department of Mathematics
- Michigan Tech, Department of Mathematical Sciences
- Tufts University, Department of Mathematics
- UMASS Amherst, Department of Mathematics and Statistics
- Worcester Polytechnic Institute, Mathematical Sciences Department

External Support

The institute staff will continue to aggressively work to develop new sources of support for its programs. Financial Manager, Juliet Duyster, has duties which include managing both public and private grants, managing the proposal process and ensuring that follow-up reporting is completed. Assistant Director Ruth Crane manages relations with the institute's sponsoring corporations and serves as a liaison to Brown's Division of Advancement, which unites Alumni Relations, Development, and International Advancement in a single, focused organization.

In addition to the funding provided by the NSF, ICERM receives substantial in-kind financial support from Brown University. The Director is released from teaching, and two Deputy Directors are released from half of their teaching responsibilities. In addition, ICERM is not charged for the use of its building or for custodial care which Brown values at \$670,500 annually. During the 2015-2016 academic year Brown gave ICERM over \$80,000 in funding, \$75K of which is the university operating budget.

Other Funding Support received from May 1, 2015 and January 31, 2016

Additional Grants	<u>Amount</u>
Mathematical Association of America for GirlsGetMath@ICERM	\$ 6,000.00
Lawrence Livermore National Laboratory	\$20,000.00
Sub-total	\$26,000.00

University Funding Support	
University Resource Committee	\$56,250.00
Assorted Brown Funding for Summer@ICERM	\$ 9,500.00
Sub-total	\$65,750.00
Sponsor Support	
Academic Sponsors	\$ 3,000.00
Corporate Sponsors	\$.00
Sub-total	\$ 3,000.00
TOTAL	\$94,750.00

Outreach/Diversity

Ulrica Wilson, an Associate Professor of Mathematics at Morehouse College, is also ICERM's Associate Director of Diversity and Outreach. Ulrica continues to provide leadership in meeting institutional diversity goals: ensuring diversity throughout ICERM's programs, assisting in the development of policies and procedures, participating in national meetings and conferences, and helping to identify and obtain funding for programs and activities. Ulrica currently chairs the overarching diversity committee of the Math Institutes Diversity Committee.

ICERM strongly supports the National Science Foundation's goals of expanding the numbers and diversity of individuals engaged in mathematical sciences through increased participation. Through its membership in the Math Institutes Diversity Committee, the institute actively seeks best practices for securing the participation of women and under-represented minorities in ICERM's governing bodies and in all scientific programs, workshops and events. Specifically, ICERM policy includes the following:

ICERM's Board of Trustees and Science Advisory Board work to ensure participation of women and under-represented minorities on all ICERM boards and in all scientific programs, respectively. The Director, Deputy, and Associate Directors are proactive in seeking representation of women and minorities in its undergraduate, graduate and postdoctoral programs and on organizing committees of programs and workshops, and work to liaise closely with organizing committees to increase diversity among funded participants. All past and future activities that support these goals and achievements in this area are documented on this page.

ICERM hosts or co-sponsors special events or conferences that serve women and under-represented minorities in the mathematical sciences, including diversity workshops, Blackwell-Tapia conferences, Society for Advancement of Chicanos and Native Americans in Science SACNAS conferences, Association for Women in Mathematics AWM workshops and events, and is building relationships with academic institutions that serve large minority populations.

ICERM states its commitment to diversity on all informational and promotional materials, and broadly advertises its activities and opportunities for funding.

ICERM sends diversity guides to all semester program and workshop organizers. They are available for review later in this tab section.

Diversity Events (May 2015 to January 2016):

• Hosted CAARMS in June 2015

- Participated in MAA MathFest, Summer 2015, Washington DC
- Participated in Mathematical Field of Dreams Conference, Fall 2015 Birmingham, AL
- Participated in Modern Math Workshop at SACNAS, Fall 2015 Washington, DC
- Organized Institute's Reception at JMM, Winter 2016 Seattle, Washington
- Participated in Nebraska Conference for Undergraduate Women in Mathematics, Winter 2016

Other Activities

- Submitted proposal (on behalf of MIDC) to fund 4 workshops
- Shared funds among NSF Mathematics Institutes available for rotating programs like Modern Math Workshop and Blackwell-Tapia
- ICERM is a member of the NSF Institute-wide diversity committee
- ICERM co-supporter the AWM mentor network

EPSCoR

ICERM supports the National Science Foundation's EPSCoR mission: "to assist the NSF in its statutory function "to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education." EPSCoR goals are:

- 1. to provide strategic programs and opportunities for EPSCoR participants that stimulate sustainable improvements in their R&D capacity and competitiveness;
- 2. to advance science and engineering capabilities in EPSCoR jurisdictions for discovery, innovation and overall knowledge-based prosperity.

Accepted ICERM participants by EPSCoR States for May 2015 to May 2016:

	# of ICERM
EPSCoR State	Participants
Alabama	4
Alaska	0
Arkansas	2
Delaware	2
Guam	0
Hawaii	0
Idaho	5
Iowa	3
Kansas	0
Kentucky	1
Louisiana	7
Maine	1
Mississippi	1
Missouri	2
Montana	0
Nevada	0
New Hampshire	19
New Mexico	11
North Dakota	0
Oklahoma	16
Puerto Rico	0

Rhode Island	64
South Carolina	5
South Dakota	0
Tennessee	14
US Virgin Islands	0
Utah	5
Vermont	0
West Virginia	0
Wyoming	0
TOTAL	162

Administration and Staff

ICERM Directors funded by the grant are: Jeffrey Brock, Jill Pipher, and Bjorn Sandstede (all Brown University). Jeff Brock and Bjorn Sandstede have committed one half summer month of effort to the institute as Associate Directors, Jill Pipher commits 100% time. Jeff Hoffstein (Brown University) is the fourth PI on the grant receives no financial support from the grant and volunteers his time for special projects at ICERM. Homer Walker (WPI) and Sinai Robins (University of Sao Paulo) serve as Deputy Directors, each at 50% time, with appointments starting July 2013 and July 2015, respectively.

ICERM Staff

Mathew Borton, Director of IT hired in December 2011: reports to the Director. Responsible for all daily IT/technology related operational activities in the institute; oversees all technical development and IT related service offerings; oversees IT staff management, ensures operational security and stability, provides service development, and continuity of the institute activities; acts as liaison to the institutional IT community, provides assistance with longer-term planning and resource development, and has continued awareness of external activities and resources of relevance to the mission of ICERM. Besides support of the scientific activities in the institute, the responsibilities include support of administrative IT and A/V equipment, and development and support of web interfaces and databases.

Ruth Crane, Assistant Director hired in November 2010: reports to the Director. Responsibilities include overseeing the coordination and administrative aspects of all research programs of the institute; supervision of institute staff; development and implementation of policies and procedures; external communications with various academic units, companies, and individuals; coordination of fundraising activities and grant proposals including proposal writing; organization of board meetings; assistance with reporting functions; oversight of web content; advertising management; oversight of functional aspects of undergraduate programs; and coordination of community outreach activities.

Juliet Duyster, Financial Manager, hired in August 2011: reports to the Assistant Director. Provides high-level administrative support and financial management; sets policy and creates spending guidelines in accordance with Brown's Office of Sponsored Projects OSP and the Brown Accounting Office; oversees financial processes and administration; Prepares budget for multiple programs and workshops of ICERM; works with Director and Assistant Director to prepare contract and grant proposal budgets; provides data trend analysis for budget projection and prepare monthly and annual financial reports on multiple funding sources; approves high volume of Travel Express vouchers, purchase orders, subcontract agreements, intra-departmental, intercampus fund transfers and other financial transactions endowment, gift funds, etc..; provides financial analyses and various reports on the status of the institute's operating funds required.

Heather Forand, Program Coordinator hired in July 2015: reports to the Program Manager. Major responsibilities include securing housing for all visitors (long and short term), assisting with sending and tracking invitations, and general event/visitor and administrative support.

Brian Lavall, Technical Support Coordinator, hired April 2014: reports to the Director of IT. The Technical Support Coordinator supports and facilitates the technological needs of ICERM staff, visiting researchers, postdocs and guests 50-100 end-users. Responsibilities include support of administrative IT and A/V equipment. Provides A/V support for the institute's workshops and events. Monitors and actively controls the Echo 360 lecture capture system and provides first level support for technical issues such as wireless connectivity and printing.

Danielle Izzi, Administrative Assistant, hired May 2014: reports to the Program Manager. Is the first point of contact for ICERM visitors. Acts as receptionist/concierge. Assists with updating and posting schedules, tracking invitations, visitor data entry, all event prep and set-up. Assists with marketing.

Bernadette McHugh, Web Content Editor, hired in September 2012: reports to the Senior Application Developer. Updates and maintain website content and web-based applications used to support and promote ICERM and its activities, including semester programs, workshops, and special events. Assists with quality assurance testing of web content and data systems and routine maintenance and support as needed.

Jenna Sousa, Program Manager hired May 2014: reports to the Assistant Director. Responsible for the implementation of the entire portfolio of ICERM's scientific research programs; manages a program timeline and program guide for each program, adhering to all programmatic deadlines and budgets. Major responsibilities include coordinating the housing, coordinating all communications regarding the arrival and orientation of long-term and short-term visitors; sending and tracking invitations and applications, assisting with creating a program schedule; assisting with creating materials for distribution; coordinating special events; hiring and training student employees as needed to assist with event prep and administrative support.

Katie Grasso, Financial Office Assistant, hired February 2013: reports to the Financial Manager. Serves as primary point of contact for ICERM staff, program organizers, visitors, postdocs, students, vendors, and sponsor agencies for all financial transactions and related issues; reconciles the day-to-day financial activity for expenses supported by sponsored projects and University appropriated budgets.

Shaun Wallace, Senior Application Developer hired in March 2011: reports to the Director of IT. The Web Application Developer designs, implements and maintains websites, web based applications, and ICERM's proprietary databases used to support and promote ICERM and its activities. The Web Application Developer assists the IT support team in routine maintenance and support as needed.

ICERM PI and Director Biographies



Jill Pipher is the Elisha Benjamin Andrews Professor of Mathematics at Brown University, and founding Director of the Institute for Computational and Experimental Research in Mathematics ICERM. She served as Chair of the Mathematics Department 2005-2008. Pipher received her Ph.D. from UCLA in 1985, and came to Brown as an Associate Professor in 1990 from the University of Chicago. Her research interests include harmonic analysis, partial differential equations and cryptography. She jointly holds four patents for the NTRU encryption and digital signature algorithms and was a co-founder of Ntru Cryptosystems, Inc, now owned by

Security Innovation, Inc. Her awards include an NSF Postdoctoral Fellowship, Presidential Young

Investigator Award, Mathematical Sciences Research Institute Fellowship, and an Alfred P. Sloan Foundation Fellowship. She served as President of the Association for Women in Mathematics in 2011-2013 and was a National Women's History Month 2013 Honoree. She was honored to deliver the 2016 Brown University Presidential Faculty Award lecture. Pipher is a Fellow of the American Mathematical Society and a member of the American Academy of Arts and Sciences.



Jeffrey Brock is Professor and Chair of mathematics at Brown University, and an ICERM Associate Director. Brock's research focuses on low-dimensional geometry and topology, particularly on spaces with hyperbolic geometry. He received his undergraduate degree in mathematics at Yale University and his Ph.D. in mathematics from U.C. Berkeley, where he studied under Curtis McMullen. After holding postdoctoral positions at Stanford University and the University of Chicago, he came to Brown as an Associate Professor. He was awarded the Donald D. Harrington Faculty Fellowship to visit the University of Texas, and has had continuous National

Science Foundation support since receiving his Ph.D. He was recently awarded a John S. Guggenheim Foundation Fellowship. Brock is the incoming Director of Brown University's new Data Science Initiative.



Jeffrey Hoffstein is a Professor at Brown University, and an ICERM Associate Director. He received his PhD in mathematics from MIT in 1978. After holding postdoctoral positions at the Institute for Advanced Study, Cambridge University, and Brown University, Hoffstein was an Assistant and Associate Professor at University of Rochester. He came to Brown as a full professor in 1989. His research interests are number theory, automorphic forms, and cryptography. Hoffstein has written over sixty papers in these fields, co-authored an undergraduate textbook in cryptography, and

jointly holds seven patents for his cryptographic inventions. He was a co-founder of Ntru Cryptosystems, Inc., now merged with Security Innovation, Inc.



Caroline Klivans is the newest ICERM Associate Director. Her focus is on the Institute's mentoring and professional development programs for students and postdoctoral fellows. In particular she leads the Round-Table discussion sessions building community and career foundations. Caroline received a BA degree in mathematics from Cornell University and a PhD in applied mathematics from the Massachusetts Institute of Technology. Currently, she is a Lecturer in the Division of Applied Math and Department of Computer Science at Brown University. Before

coming to Brown she held positions at MSRI and the University of Chicago. Her research is in algebraic, geometric and topological combinatorics.



Sinai Robins is a deputy director at ICERM, and a Professor of computer science at the University of Sao Paulo, Brasil. He enjoys doing research in discrete and computational geometry, combinatorics, and number theory. His work has revealed interactions between polytopes and lattices, and some of his current research focuses on computing various different forms of discrete volumes for polytopes, often using Harmonic analysis. Professor Robins has contributed to the modern field of the geometry of numbers by coauthoring the Springer UTM book "Computing the

continuous discretely: integer point enumeration in polyhedra". His research has been funded by the National Science Foundation, the NSA, the Sloan Foundation, the London Mathematical Society, and the Singapore Ministry of Education. Professor Robins received his PhD from UCLA in 1991, and has had numerous research visiting positions, including the CNRS/LAAS lab for architecture of systems (Toulouse, France), the Alfred Renyi research institute (Budapest, Hungary), the Technion institute (Haifa,

Israel), MSRI (Berkeley, California), the Institute for Defense Analysis (La Jolla, California), and the Distinguished Visiting Professorship at Brown University in 2014.



Bjorn Sandstede is Professor and Chair of applied mathematics at Brown University, and an ICERM Associate Director. He studied mathematics at the University of Heidelberg and received his PhD in 1993 from the University of Stuttgart. After holding postdoctoral positions at the Weierstrass Institute in Berlin and at Brown University, he was a faculty member at the Ohio State University from 1997-2004, before moving in 2004 to the University of Surrey in England. In 2008, he joined the Division of Applied Mathematics at Brown University. Sandstede received an Alfred P Sloan Research Fellowship in 2000, was awarded the first JD Crawford Prize of

the SIAM Activity Group on Dynamical Systems in 2001, and received a Royal Society Wolfson Research Merit Award in 2004. He is currently the editor-in-chief of the SIAM Journal on Applied Dynamical Systems. Sandstede is a Fellow of the Society for Industrial and Applied Mathematics.



Homer Walker joined ICERM as a Deputy Director in July 2013. He has been a professor of mathematics at Worcester Polytechnic Institute since 1997 and previously held faculty appointments at Utah State University, the University of Houston, and Texas Tech University. He has also held visiting appointments at a number of institutions, including Cornell, Yale, and Rice Universities and Lawrence Livermore and Sandia National Laboratories. His previous administrative experience includes service as department head at WPI 1997-2002 and as program manager for the US

Department of Energy Office of Science Applied Mathematics Program 2007-2008. Walker's research interests are in numerical analysis and computational mathematics, especially iterative methods for large-scale linear and nonlinear systems, implementations for high-performance computing, and applications. He has been an associate editor of SIAM Journal on Numerical Analysis and has served as a guest editor for ten special sections in SIAM Journal on Scientific Computing. He has also served on program committees for a number of national and international conferences and workshops, notably the biennial Copper Mountain Conferences on Iterative Methods, as well as on many review panels and site-visit teams for funding agencies in the US and abroad.



Ulrica Wilson is an Associate Professor of Mathematics at Morehouse College. Director of Diversity and Outreach she provides leadership in meeting institutional diversity goals: ensuring diversity throughout ICERM's programs, assisting in the development of policies and procedures, participating in national meetings and conferences, and helping to identify and obtain funding for programs and activities. Ulrica's primary research has been in noncommutative ring theory and combinatorial matrix theory. Throughout her career, she has integrated opportunities to

address diversity issues in the mathematical workforce. A decade of experience includes directing the Enhancing Diversity in Graduate Education EDGE Program and organizing the Research Experience for Undergraduate Faculty REUF workshops at the American Institute of Mathematics AIM.

Facilities

ICERM is located on the 10th and 11th floors of 121 S. Main Street, in a Brown owned building in downtown Providence, RI. Visitors to ICERM are within a 10-minute walking distance of the Brown campus, the train station, major hotels, and a variety of restaurants and historic sites.

The space includes a 100-seat lecture hall, a 20-seat seminar room, a 20-seat conference room, an administrative suite, office space for 40-45 visitors, a kitchen, and three large collaborative areas.

IT Resources

ICERM's information technology group's mission is to provide the necessary tools for research, collaboration, and information dissemination required by the institute's participants and to support the administrative staff. This is accomplished by providing flexible systems that can be quickly reconfigured to meet research needs and efficient administrative tools that allow the institute's staff to maintain operational excellence.

Work Stations

ICERM provides virtual desktop systems to all semester program participants using Virtual Bridges on Redhat Linux systems. The host operating system is Redhat Linux Server, the guests use Redhat Linux workstation or Windows 8, and the client machines are thin clients using a thin version of Linux. Applications are distributed as needed. Application needs differ from program to program and researcher to researcher. Individuals have administrative control over their own virtual desktops. Researchers are also free to provide their own equipment use their own laptop. The majority of the applications provided to users will leverage existing Brown license agreements.

Web Based Tools

ICERM provides web-based tools for collaboration and to assist research. All previous talks and papers generated in the course of semester programs are archived and available for download and review via the website.

Multimedia Resources

ICERM has state of the art audio/visual capabilities. The 120-seat lecture hall features dual projection screens, a centrally controlled AV system capable of displaying multiple media types, and a lecture capture system for recording presentations and streaming to the web. A smaller meeting room is equipped with a video conferencing system and includes a digital media projection system. The video conferencing system can also be leveraged to communicate with the lecture hall. A seminar room on the 10th floor provides basic multimedia presentation capability and contains a smart-board system. Digital signage screens throughout the institute are used to display important information to visitors and can be independently used as a peripheral display from a laptop.

Live Streaming

ICERM provides live, real-time video streaming of all Workshop talks, special events, and tutorial sessions given in the lecture hall.

Video Archives

ICERM digitally records semester and topical workshop talks and special lectures in High Definition using the Panopto lecture capture system. Presentations are then archived and made available for viewing on our website along with a PDF copy of the presenter's slides, when available.

Data Collection and Reporting

ICERM has developed a new database, called CUBE to collect and report on participant data. This system will become a central point of data management for both staff and participants as new feature sets are added.

Brown Computing Resources

ICERM participants are encouraged to use other IT resources available at Brown. Chief among these is the high-performance computing cluster HPC hosted by the Center for Computation and Visualization CCV. ICERM provides premium access accounts upon request to all long-term participants and to

workshop participants on an as needed basis with approval from the Director. To date, thirty researchers from various programs have taken advantage of this resource.

Participants are also welcome to use the Digital Scholarship Lab at the Rockefeller Library. This room incorporates a high-definition video wall for large-scale visualization and collaboration.

CCV makes other services available to ICERM participants, including access to consultants for code creation and optimization and an immersive display environment.

APPENDIX:

Appendix A: Sample Semester Schedule & Organizer Timeline Appendix B: L-functions and Modular Forms Database (LMFDB) article Appendix C: Upcoming Programs and Events (from February 1, 2016) Appendix D: Minutes from 2015 Board of Trustees Meetings Appendix E: Minutes from 2015 Scientific Advisory Board Meetings Appendix F: Minutes from 2015 Education Advisory Board Meeting Appendix G: 2015 MIDs Meeting Minutes Appendix H: Survey Summaries May 2015-January 2016 Appendix I: Research Projects Initiated at ICERM May 2015-January 2016

NSF Required Materials Available in the Appendix

Appendix J: ICERM Participant List and Summary Table (May 1, 2015 to May 10, 2016) Appendix K: ICERM Financial Support List (May 1, 2015 to May 10, 2016) Appendix L: ICERM Income and Expenditure Report (May 1, 2015 to May 10, 2016) Appendix M: VI-MSS Income and Expenditure Report (May 1, 2015 to May 10, 2016)