Institute for Computational and Experimental Research in Mathematics

Annual Report
August 1, 2014 – July 31, 2015

Jill Pipher, Director
Jeffrey Hoffstein, Consulting Associate Director
Bjorn Sandstede, Associate Director
Sergei Tabachnikov, Deputy Director
Homer Walker, Deputy Director
Ulrica Wilson, Associate Director for Diversity and Outreach

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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

ICERM's scheduled programs and events from June 2014 through July 2015

TYPE	TITLE	DATE	# ATTENDED
Undergrad Research	Summer@ICERM 2014: Polygons and Polynomials	June 16 – August 8, 2014	18
Early Career Research	Careers in Academia	June 25-27, 2014	Estimated: 20
K-12 Outreach	GirlsGetMath@ICERM (Funded by MAA grant and Phoebe Snow Foundation)	Jul14-18, 2014	29
Topical Workshop	Challenges in 21st Century Experimental Mathematical Computation	July 21-25, 2014	46
Topical Workshop	Combinatorial Link Homology Theories, Braids, And Contact Geometry (This workshop was partially funded by NSF CAREER award DMS-1151671)	August 4-8, 2014	82
Early Career Research	IdeaLab 2014: Topics: Toward a more realistic model of ciliated and agellated organisms and High frequency vibrations and Riemannian geometry	August 11-15, 2014	20
Topical Research/Mini Workshop	Integrability and Cluster Algebras: Geometry and Combinatorics	August 25-29, 2014	49
VI-MSS International Program	Brown - Kobe Joint Simulation School 2014	August 23-September 5, 2014	2
Semester Program	High-dimensional Approximation	September 8 – December 5, 2014	87
Semester Workshop	Information-Based Complexity and Stochastic Computation	September 15-19, 2014	76
Semester Workshop	Approximation, Integration, and Optimization	September 29 – October 3, 2014	127
Topical Workshop	Mathematics of Data Analysis in Cybersecurity (This workshop was fully funded by SaTC award CNS-1354474)	October 22-24, 2014	53

Semester Workshop	Discrepancy Theory	October 27-31, 2014	59
Research Cluster	Research Cluster: Computational Challenges in Sparse and Redundant Representations	November 3-21, 2014	25
Public Lecture	Mathematics of Crime	November 20, 2015	70
Special Event/Workshop	11th DIMACS Implementation Challenge, in collaboration with ICERM (This workshop was partially funded by DIMACS/Rutgers)	December 4-5, 2014	27
Semester Program	Phase Transitions and Emergent Properties	February 2 – May 8, 2015	80
Semester Workshop	Crystals, Quasicrystals and Random Networks	February 9-13, 2015	76
Special Event (co-hosted with Brown Mathematics)	Brown University Symposium for Undergraduates in the Mathematical Sciences (SUMS): "A Celebration of Symmetry"	March 14, 2015	124
Semester Workshop	Small Clusters, Polymer Vesicles and Unusual Minima	March 16-20, 2015	77
Public Lecture	Mathematics of Cooking (co-hosted with Johnson & Wales Culinary Institute)	March 17, 2015	450
Semester Workshop	Limit Shapes	April 13-17, 2015	77
Clay Senior Fellow Colloquium/Lecture	Packing Space with Regular Tetrahedra	April 20, 2015	45
Topical Workshop	Mathematics of Lattices and Cybersecurity (This workshop was fully funded by SaTC award CNS-1354474)	April 21-24, 2015	86
Special Event/Workshop	Houghton Conference on Non-Equilibrium Statistical Mechanics (This workshop was partially funded by Brown University Department of Physics)	May 4-5, 2015	46
VI-MSS International Program	Graduate Student Team-Based Research: Computational Symplectic Topology (@Tel Aviv)	May 17-26, 2015	11
Topical Workshop	Integrability in mechanics and geometry: theory and	June 1-5, 2015	To date: 36

	computations		
Undergraduate Program	S@I 2015: Computational Dynamics and Topology	June 15 – August 7, 2015	19
Special Event	Conference for African-American Researchers in the Mathematical Sciences (CAARMS); primarily externally funded	June 24-27, 2015	Estimated: 70

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 2015, which allowed the program to expand. 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 India

- Chennai Mathematical Institute (CMI), Chennai
- Indian Institute of Science (IISc), Bangalore
- Indian Institute of Science Education and Research (IISER), Pune
- Institute of Mathematical Sciences (IMSc), Chennai
- Indian Statistical Institute (ISI), Kolkata, Delhi, Bangalore
- Tata Institute of Fundamental Research (TIFR), Mumbai
- University of Delhi (DU), Delhi

ICERM is also collaborating with ICTS.

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 funded two programs involving international institutions (Johannesburg, Africa and Tel Aviv, Israel). In addition, 14 researchers were funded by VI-MSS funding to travel abroad. See the VI-MSS section later in this report for more details.

Participant Summaries by Program Type

For this reporting term (**May 1, 2014 to May 1, 2015**) 897 unique participants were enrolled in two semester long programs and/or ten workshops, Summer@ICERM, IdeaLab, and REUF. Of the 897, 568 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, 2015. For example Summer@ICERM funded 12 students of 18 participating, and 6 faculty leaders and TA's.

ICERM Funded Participants

			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
Summer@ICERM 2014		22	5	12	0	0	1	0	11	2	8	5	4	0	1	0	1	0	1
IdeaLab		26	6	15	0	0	2	4	13	5	7	7	2	0	0	1	3	1	0
Fall Semester '14	Semester Program	81	9	53	0	0	9	1	53	9	9	13	6	0	4	2	31	0	7
	Workshop 1	71	8	56	0	0	14	2	55	7	10	10	4	0	1	1	33	0	5
	Workshop 2	86	15	63	0	0	18	2	61	7	12	18	12	0	5	1	27	0	4
	Workshop 3	52	10	36	0	0	10	0	36	4	7	11	7	0	1	1	16	0	5
	Research Cluster 1	23	2	13	0	0	0	1	13	4	3	4	2	0	2	1	7	0	0
	Total	313	44	221	0	0	51	6	218	31	41	56	31	0	13	6	114	0	21
	% of # Reporting		20%		0%	0%	23%	3%		10%	13%	18%	10%	0%	4%	2%	36%	0%	7%
Spring Semester '15	Semester Program	75	10	36	0	0	6	0	31	3	29	5	5	0	7	1	24	1	0
	Workshop 1	65	9	40	0	0	8	1	36	5	27	7	8	0	1	1	15	1	0
	Workshop 2	68	13	41	0	0	10	2	35	4	30	8	3	0	4	1	16	2	0
	Workshop 3	67	10	39	0	0	8	1	33	6	22	4	8	0	4	1	21	1	0
	Total	275	42	156	0	0	32	4	135	18	108	24	24	0	16	4	76	5	0
	% of # Reporting		27%		0%	0%	24%	3%		7%	39%	9%	9%	0%	6%	1%	28%	2%	0%
Topical '14 - '15	Workshop A	38	6	27	0	0	5	3	26	7	7	10	5	0	0	0	9	0	0
	Workshop B	37	3	18	2	0	2	0	15	3	0	14	8	0	1	1	7	0	3
	Workshop C	61	23	53	2	0	17	2	51	6	15	21	2	3	5	1	8	0	0
	Workshop D	32	6	22	0	0	1	0	18	6	5	0	2	0	1	2	16	0	0
	Total	168	38	120	4	0	25	5	110	22	27	45	17	3	7	4	40	0	3

All Participants (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2014		30	5	14	0	0	2	0	13	25	5
IdeaLab		28	6	17	0	0	2	4	15	23	5
Fall Semester '14	Semester Program	87	9	56	0	0	11	1	56	42	45
	Workshop 1	76	8	57	0	0	15	2	56	36	40
	Workshop 2	127	19	98	0	0	37	3	93	85	42
	Workshop 3	59	10	40	0	0	12	0	28	35	24
	Research Cluster 1	24	2	14	0	0	1	1	14	14	10
	Total	373	48	265	0	0	76	7	247	212	161
	% of # Reporting		18%		0%	0%	31%	3%		57%	43%
Spring Semester '15	Semester Program	79	10	37	0	0	6	0	31	45	34
	Workshop 1	76	9	45	0	0	8	1	40	58	18
	Workshop 2	77	14	44	0	0	10	2	36	54	23
	Workshop 3	77	11	45	0	0	10	1	38	50	27
	Total	309	44	171	0	0	34	4	145	207	102
	% of # Reporting		26%		0%	0%	23%	3%		67%	33%
Topical '14 - '15	Workshop A	43	7	31	0	0	6	3	30	34	9
	Workshop B	45	4	26	2	0	6	0	23	28	17
	Workshop C	82	28	67	2	0	22	2	63	60	22
	Workshop D	49	8	34	0	0	4	0	28	30	19
	Total	219	47	158	4	0	38	5	144	152	67
	% of # Reporting		30%		3%	0%	26%	3%		69%	31%

ICERM Funded Speakers

			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
Summer@ICERM 2014		4	1	1	0	0	0	0	1	0	1	0	2	0	0	0	0	0	1
IdeaLab		4	1	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Fall Semester '14	Semester Program	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Workshop 1	26	2	22	0	0	2	0	21	2	2	1	1	0	1	1	17	0	1
	Workshop 2	23	3	14	0	0	2	0	12	2	4	3	7	0	0	0	5	0	2
	Workshop 3	20	5	13	0	0	3	0	13	2	3	3	1	0	0	1	9	0	1
	Research Cluster 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	70	10	49	0	0	7	0	46	6	10	7	9	0	1	2	31	0	4
	% of # Reporting		20%		0%	0%	3%	0%		2%	3%	2%	3%	0%	0%	1%	10%	0%	1%
Spring Semester '15	Semester Program	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Workshop 1	21	3	9	0	0	2	0	8	1	7	1	6	0	0	0	6	0	0
	Workshop 2	22	3	12	0	0	2	0	9	1	9	2	1	0	2	0	6	1	0
	Workshop 3	19	3	11	0	0	0	0	10	0	5	1	2	0	1	0	10	0	0
	Total	63	9	32	0	0	4	0	27	2	22	4	9	0	3	0	22	1	0
	% of # Reporting		28%		0%	0%	3%	0%		1%	8%	1%	3%	0%	1%	0%	8%	0%	0%
Topical '14 - '15	Workshop A	21	3	13	0	0	1	1	12	4	3	6	1	0	0	0	7	0	0
	Workshop B	22	0	7	1	0	0	0	6	2	0	6	6	0	1	1	5	0	1
	Workshop C	14	3	6	0	0	3	0	6	1	2	7	0	0	1	0	3	0	0
	Workshop D	17	2	11	0	0	1	0	7	4	3	0	0	0	1	2	7	0	0
	Total	74	8	37	1	0	5	1	31	11	8	19	7	0	3	3	22	0	1
	% of # Reporting		22%		1%	0%	5%	1%		7%	5%	11%	4%	0%	2%	2%	13%	0%	1%

All Speakers (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2014		6	1	3	0	0	0	0	2	5	1
IdeaLab		4	1	2	0	0	0	0	0	4	0
Fall Semester '14	Semester Program	2	0	0	0	0	0	0	0	2	0
	Workshop 1	26	2	22	0	0	2	0	21	6	20
	Workshop 2	25	3	14	0	0	2	0	12	17	8
	Workshop 3	20	5	13	0	0	3	0	13	9	11
	Research Cluster 1	0	0	0	0	0	0	0	0	0	0
	Total	73	10	49	0	0	7	0	46	34	39
	% of # Reporting		20%		0%	0%	3%	0%		9%	10%
Spring Semester '15	Semester Program	2	0	0	0	0	0	0	0	1	1
	Workshop 1	22	3	10	0	0	2	0	8	16	6
	Workshop 2	22	3	12	0	0	2	0	9	13	9
	Workshop 3	19	3	11	0	0	0	0	10	8	11
	Total	65	9	33	0	0	4	0	27	38	27
	% of # Reporting		27%		0%	0%	3%	0%		12%	9%
Topical '14 - '15	Workshop A	21	3	13	0	0	1	1	12	14	7
	Workshop B	22	0	7	1	0	0	0	6	14	8
	Workshop C	15	3	8	0	0	3	0	7	11	4
	Workshop D	21	2	13	0	0	2	0	8	11	10
	Total	79	8	41	1	0	6	1	33	50	29
	% of # Reporting		20%		1%	0%	4%	1%		23%	13%

ICERM Funded Postdocs

			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
Summer@ICERM 2014		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IdeaLab		9	4	9	0	0	1	2	9	2	4	0	0	0	0	0	2	1	0
Fall Semester '14	Semester Program	9	0	5	0	0	0	0	5	0	0	2	1	0	0	0	5	0	1
	Workshop 1	10	0	6	0	0	1	0	6	0	1	2	1	0	0	0	5	0	1
	Workshop 2	11	0	7	0	0	0	0	6	0	1	3	1	0	0	0	6	0	0
	Workshop 3	7	0	3	0	0	0	0	3	0	0	2	2	0	0	0	3	0	0
	Research Cluster 1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Total	37	0	21	0	0	1	0	20	0	2	9	5	0	0	0	19	0	2
	% of # Reporting		0%		0%	0%	0%	0%		0%	1%	3%	2%	0%	0%	0%	6%	0%	1%
Spring Semester '15	Semester Program	9	2	6	0	0	0	0	3	0	3	2	0	0	1	1	2	0	0
	Workshop 1	13	1	9	0	0	1	0	7	1	4	2	0	0	0	1	5	0	0
	Workshop 2	10	3	7	0	0	2	0	5	0	4	1	1	0	1	1	2	0	0
	Workshop 3	13	1	9	0	0	2	1	5	1	3	1	2	0	1	1	4	0	0
	Total	45	7	31	0	0	5	1	20	2	14	6	3	0	3	4	13	0	0
	% of # Reporting		23%		0%	0%	4%	1%		1%	5%	2%	1%	0%	1%	1%	5%	0%	0%
Topical '14 - '15	Workshop A	2	1	2	0	0	1	0	2	2	0	0	0	0	0	0	0	0	0
	Workshop B	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
	Workshop C	11	6	11	0	0	3	0	11	1	1	6	1	0	2	0	0	0	0
	Workshop D	5	2	5	0	0	0	0	5	1	0	0	1	0	0	1	2	0	0
	Total	19	9	19	0	0	4	0	19	4	1	6	3	0	2	1	2	0	0
	% of # Reporting		47%		0%	0%	4%	0%		2%	1%	4%	2%	0%	1%	1%	1%	0%	0%

10 postdocs received a stipend from ICERM during 2014-2015: 7 males, 3 Females.

All Postdocs (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2014		0	0	0	0	0	0	0	0	0	0
IdeaLab		12	4	10	0	0	1	2	10	7	3
Fall Semester '14	Semester Program	9	0	5	0	0	0	0	5	3	6
	Workshop 1	11	0	7	0	0	1	0	7	4	7
	Workshop 2	15	0	11	0	0	2	0	9	9	6
	Workshop 3	7	0	3	0	0	0	0	3	4	3
	Research Cluster 1	1	0	0	0	0	0	0	0	1	0
	Total	42	0	26	0	0	3	0	24	20	22
	% of # Reporting		0%		0%	0%	1%	0%		5%	6%
Spring Semester '15	Semester Program	9	2	6	0	0	0	0	3	5	4
	Workshop 1	14	1	10	0	0	1	0	8	8	6
	Workshop 2	10	3	7	0	0	2	0	5	6	4
	Workshop 3	14	1	9	0	0	2	1	5	8	6
	Total	47	7	32	0	0	5	1	21	27	20
	% of # Reporting		22%		0%	0%	3%	1%		9%	6%
Topical '14 - '15	Workshop A	3	1	3	0	0	2	0	3	3	0
	Workshop B	2	0	2	0	0	1	0	2	2	0
	Workshop C	16	9	16	0	0	7	0	16	11	5
	Workshop D	6	2	6	0	0	0	0	6	3	3
	Total	27	12	27	0	0	10	0	27	19	8
	% of # Reporting		44%		0%	0%	7%	0%		9%	4%

10 postdocs received a stipend from ICERM during 2014-2015: 7 males, 3 Females.

ICERM Funded Graduate Students

			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
Summer@ICERM 2014		3	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0
IdeaLab		1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Fall Semester '14	Semester Program	12	4	12	0	0	4	0	12	1	1	0	1	0	0	0	7	0	2
	Workshop 1	13	4	13	0	0	6	1	13	4	0	0	1	0	0	0	6	0	2
	Workshop 2	17	7	17	0	0	9	1	17	2	4	1	2	0	1	0	5	0	2
	Workshop 3	9	3	8	0	0	4	0	8	1	1	0	3	0	0	0	2	0	2
	Research Cluster 1	3	1	3	0	0	0	0	3	0	1	0	0	0	0	0	2	0	0
	Total	51	18	50	0	0	23	2	50	8	6	1	7	0	1	0	20	0	8
	% of # Reporting		36%		0%	0%	11%	1%		3%	2%	0%	2%	0%	0%	0%	6%	0%	3%
Spring Semester '15	Semester Program	7	3	7	0	0	3	0	7	0	4	0	0	0	1	0	2	0	0
	Workshop 1	8	2	8	0	0	2	1	8	0	5	0	1	0	1	0	0	1	0
	Workshop 2	12	4	12	0	0	6	1	12	2	7	0	2	0	1	0	0	0	0
	Workshop 3	8	3	8	0	0	3	0	8	0	5	0	1	0	0	0	2	0	0
	Total	35	12	35	0	0	14	2	35	2	21	0	4	0	3	0	4	1	0
	% of # Reporting		34%		0%	0%	10%	1%		1%	8%	0%	1%	0%	1%	0%	1%	0%	0%
Topical '14 - '15	Workshop A	9	1	9	0	0	2	1	9	0	3	3	2	0	0	0	1	0	0
	Workshop B	4	0	4	1	0	2	0	4	0	0	2	1	0	0	0	0	0	1
	Workshop C	34	13	34	0	0	11	2	32	4	12	8	1	0	2	1	6	0	0
	Workshop D	7	2	7	0	0	0	0	7	1	2	0	1	0	0	0	3	0	0
	Total	54	16	54	1	0	15	3	52	5	17	13	5	0	0	0	10	0	1
	% of # Reporting		30%		1%	0%	14%	3%		3%	10%	8%	3%	0%	0%	0%	6%	0%	1%

All Graduate Students (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2014		3	0	1	0	0	0	0	1	3	0
IdeaLab		1	0	0	0	0	0	0	0	1	0
Fall Semester '14	Semester Program	12	4	12	0	0	4	0	12	3	9
	Workshop 1	16	4	15	0	0	7	1	15	7	9
	Workshop 2	33	8	30	0	0	12	1	30	24	9
	Workshop 3	11	3	8	0	0	4	0	8	7	4
	Research Cluster 1	3	1	3	0	0	0	0	3	1	2
	Total	72	19	65	0	0	27	2	65	41	31
	% of # Reporting		29%		0%	0%	11%	1%		11%	8%
Spring Semester '15	Semester Program	9	3	7	0	0	3	0	7	3	6
	Workshop 1	12	2	9	0	0	2	1	9	2	10
	Workshop 2	16	4	12	0	0	6	1	12	15	1
	Workshop 3	11	4	9	0	0	3	0	9	9	2
	Total	48	13	37	0	0	14	2	37	29	19
	% of # Reporting		35%		0%	0%	10%	1%		9%	6%
Topical '14 - '15	Workshop A	11	1	11	0	0	2	1	11	10	1
	Workshop B	4	0	4	1	0	2	0	4	3	1
	Workshop C	37	13	36	0	0	12	2	34	28	9
	Workshop D	14	3	13	0	0	2	0	13	11	3
	Total	66	17	64	1	0	18	3	62	52	14
	% of # Reporting		27%		1%	0%	13%	2%		24%	6%

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

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 2014	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
% of # Reporting		0%		0%	0%	0%	0%	0	0%	9%	0%	0%	0%	0%	0%	0%	0%	0%
Fall Semester '14	11	1	7	1	0	1	0	5	0	3	5	3	0	0	0	0	0	0
% of # Reporting		14%		20%	0%	20%	0%	5	0%	27%	45%	27%	0%	0%	0%	0%	0%	0%
Spring Semester '15	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
% of # Reporting		100%		0%	0%	0%	0%		0%	100%	0%	0%	0%	0%	0%	0%	0%	0%

During this time, 1 postdoctoral fellow was sent to ICERM from India's Department of Science and Technology to participate in the Fall Semester program 2014.

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.

Semester Program Length of Visits

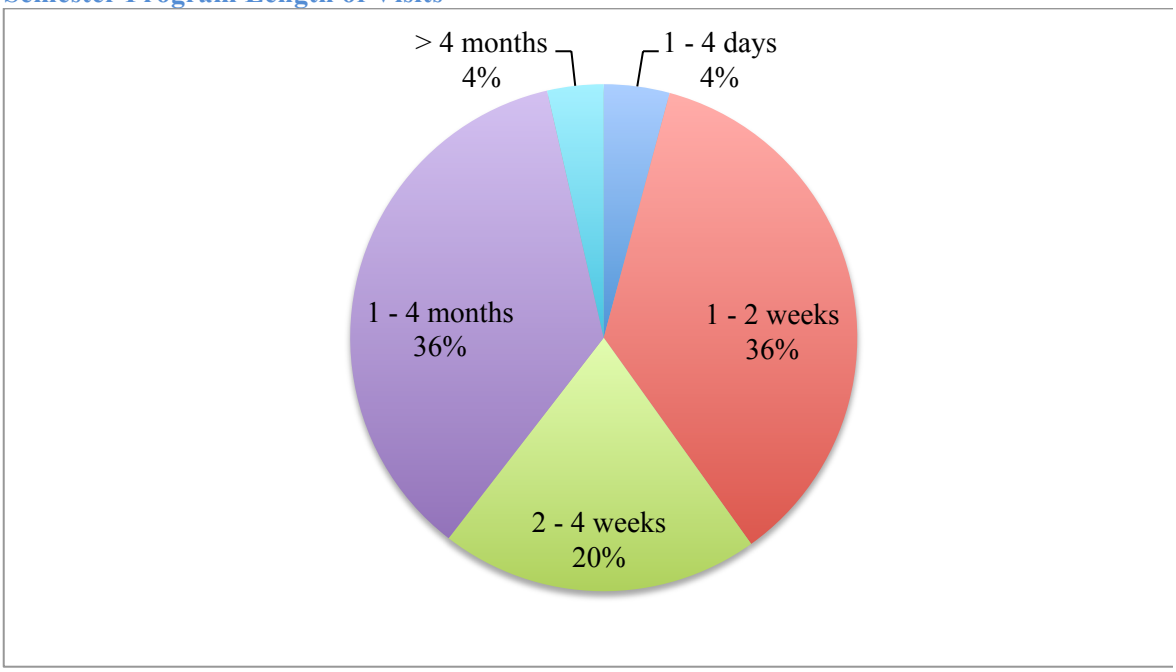

Figure 1

Primary Field of Interest

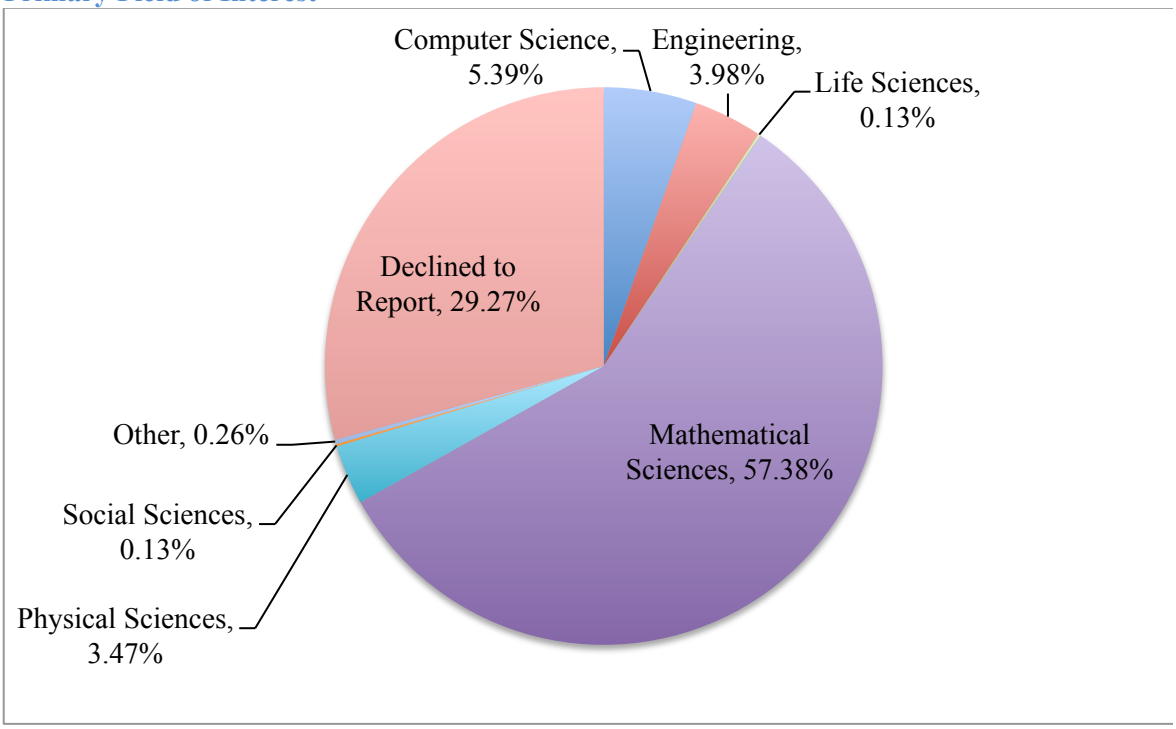

Figure 2

Academic Breakdown

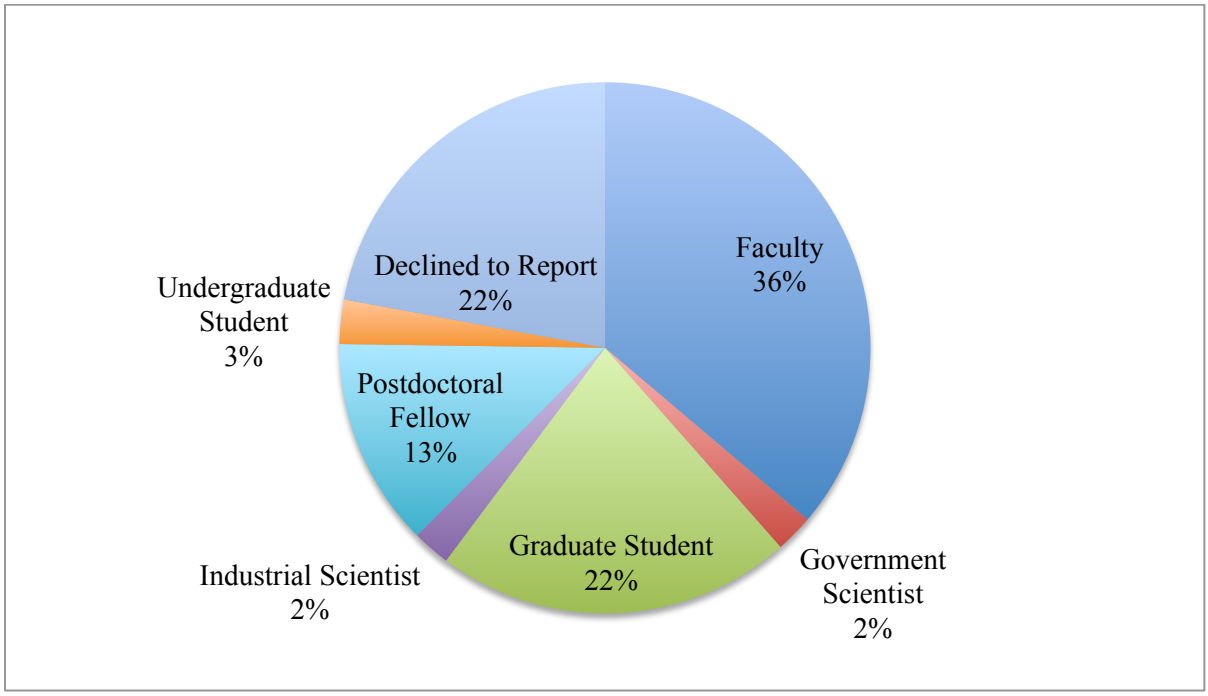

Figure 3

Applied Attendees VS Invited Attendees

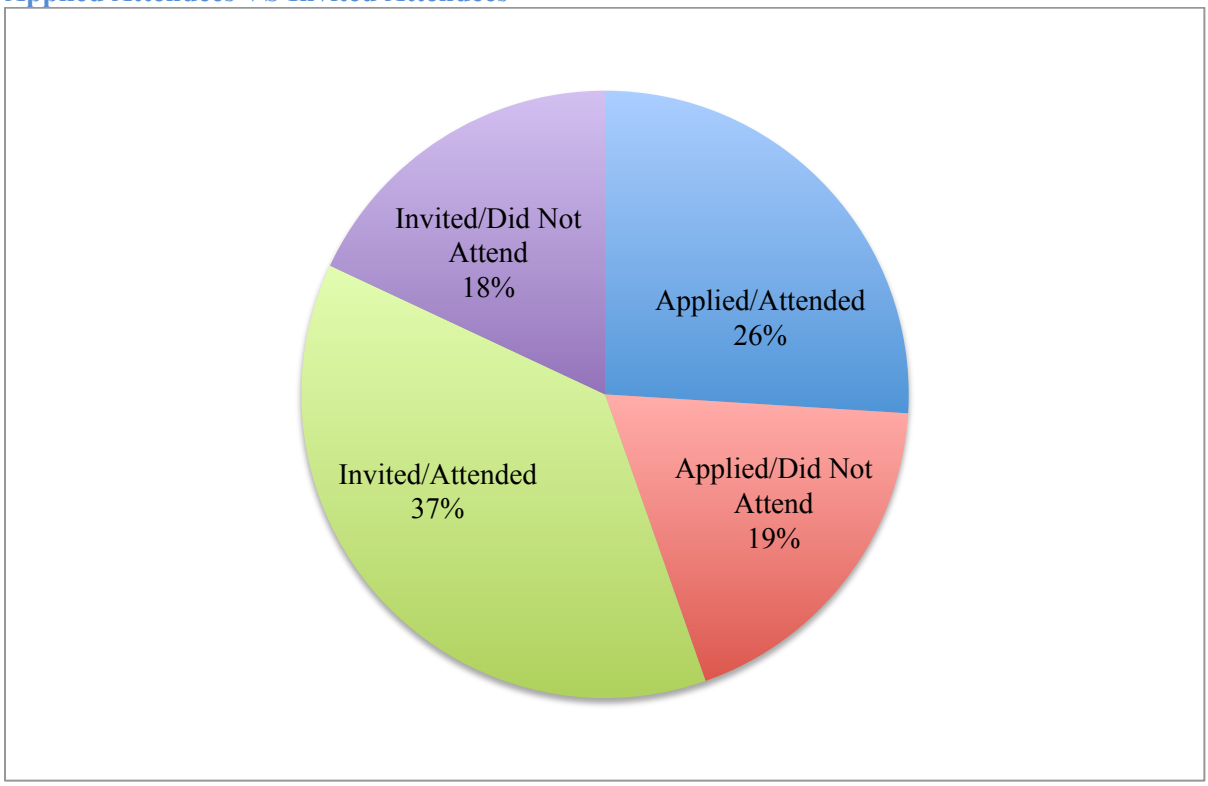

Figure 4: Applied/Did Not Attend includes applicants who were not qualified as well as applicants who were accepted without full funding but could not attend, or who declined without a reason given.

All Semester Attendees US Based VS Foreign Based

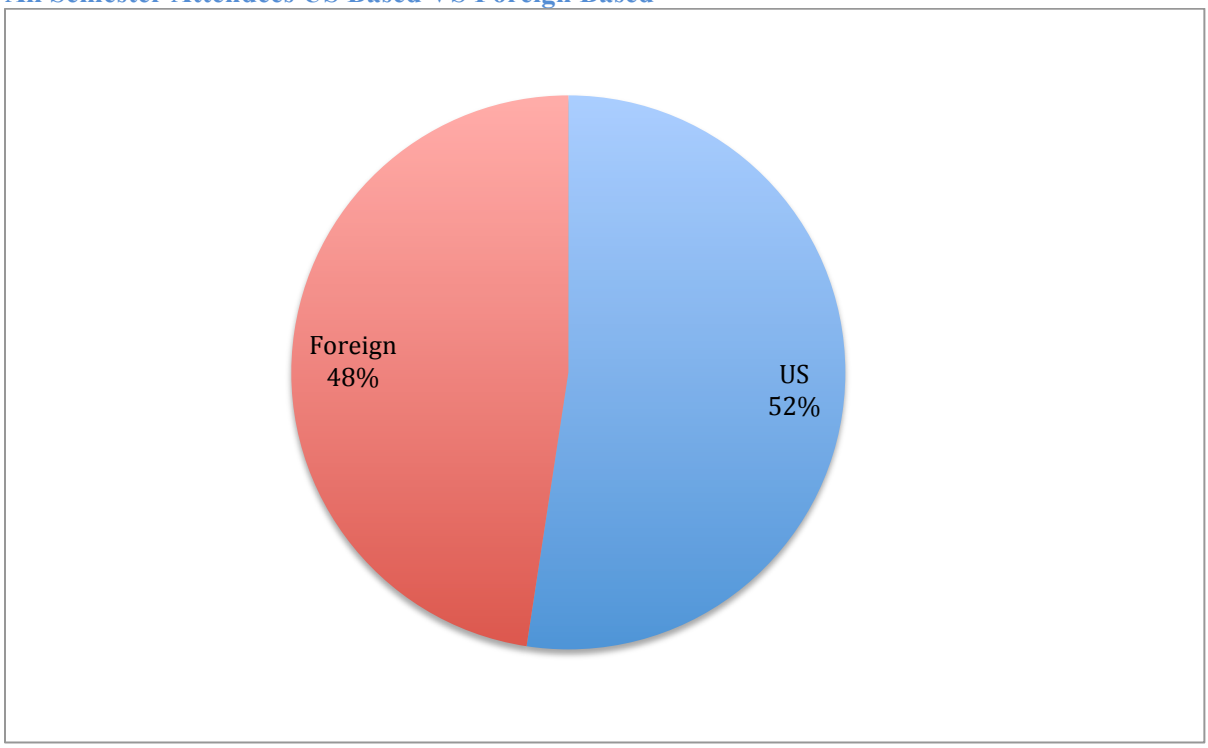

Figure 5

All Semester Program Workshop Attendees US Based VS Foreign Based

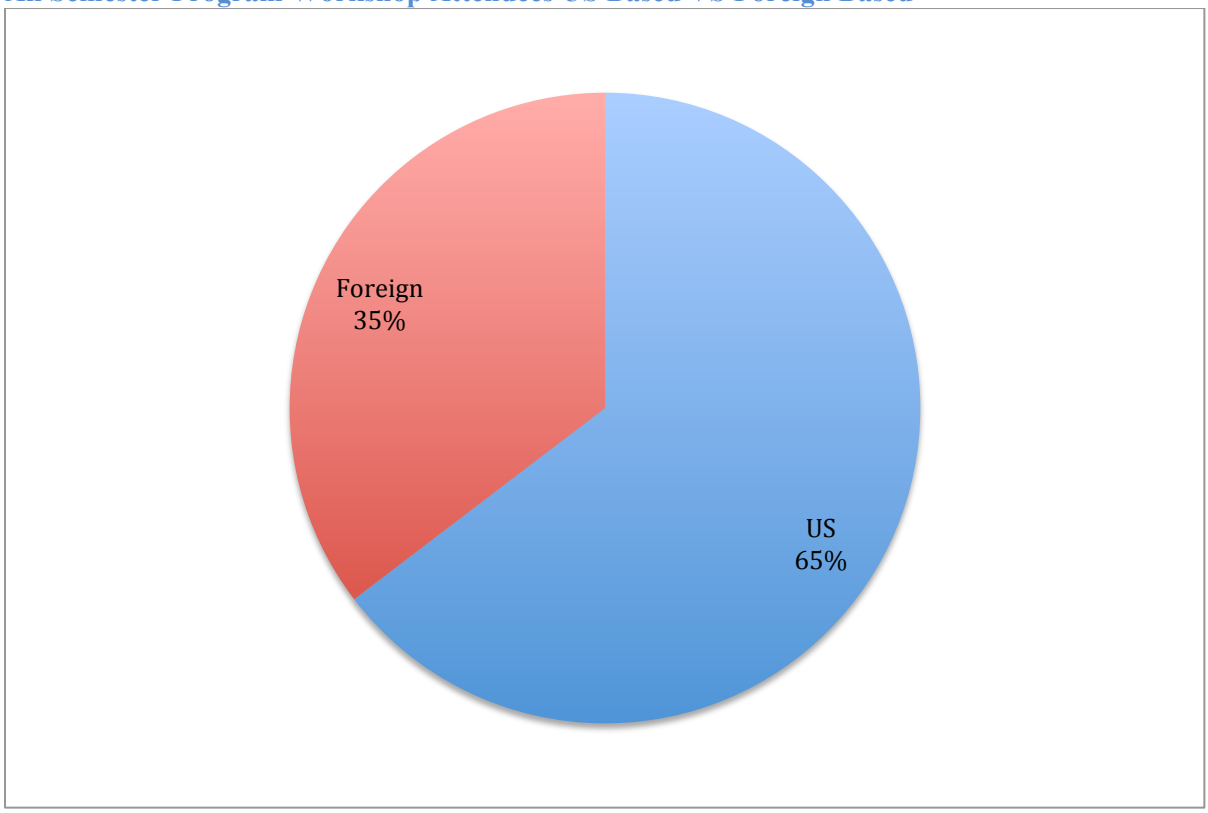

Figure 6

All Topical Workshop Attendees US Based VS Foreign Based

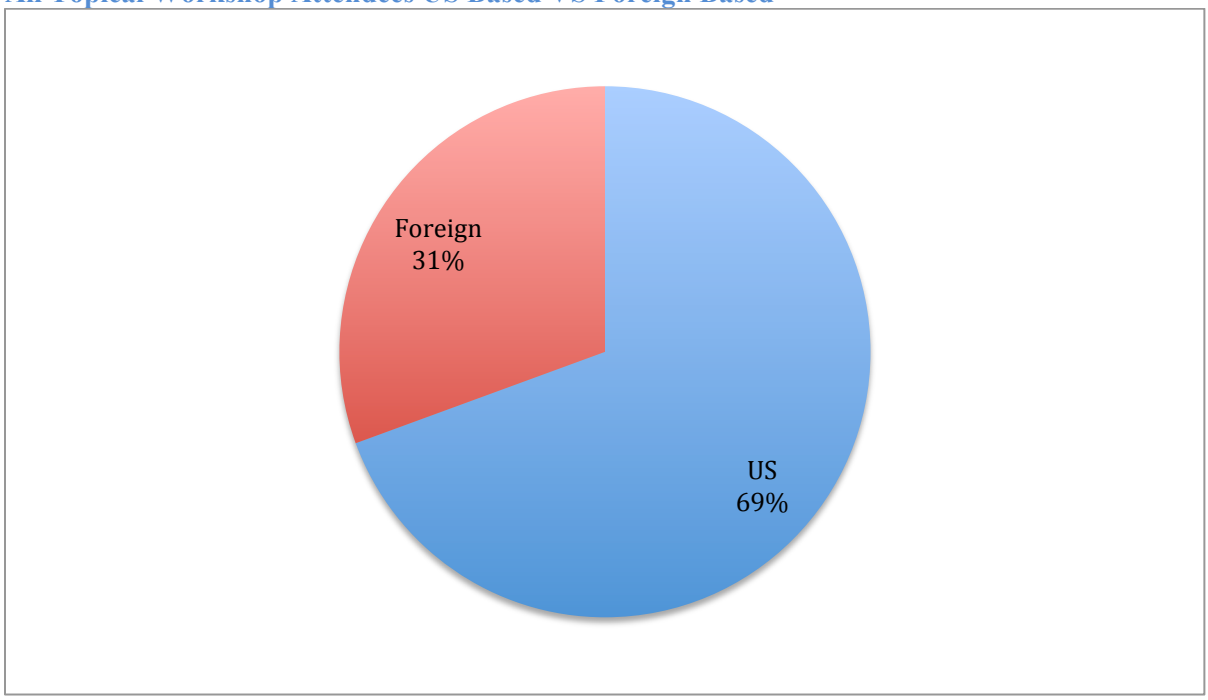

Figure 7

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 2014 annual meeting and a subsequent conference call in June resulted in the selection of semester programs and topical workshops through Spring 2017.

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 and 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 organizer(s), may consist of teamwork, daily/weekly seminars, and closing presentations. In collaboration with an ICERM director, Research Cluster organizer(s) 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 to 3 day closing event is planned with input from the organizing committee. Some possible models include:

- 3 days of 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

2014-2015 Semester Programs

Fall Semester 2014: High-dimensional Approximation

September 8, 2014 - December 5, 2014

Organizing Committee

Dmitriy Bilyk, University of Minnesota
William Chen, Macquarie University, Sydney
Frances Kuo, UNSW, Sydney, Australia
Michael Lacey, Georgia Institute of Technology
Volodya Temlyakov, University of South Carolina
Rachel Ward, University of Texas, Austin
Henryk Wozniakowski, Columbia University

Program Description

The fundamental problem of approximation theory is to resolve a possibly complicated function, called the target function, by simpler, easier to compute functions called approximants. Increasing the resolution of the target function can generally only be achieved by increasing the complexity of the approximants. The understanding of this trade-off between resolution and complexity is the main goal of approximation theory, a classical subject that goes back to the early results on Taylor's and Fourier's expansions of a function.

Modern problems in approximation, driven by applications in biology, medicine, and engineering, are being formulated in very high dimensions, which brings to the fore new phenomena. One aspect of the high-dimensional regime is a focus on sparse signals, motivated by the fact that many real world signals can be well approximated by sparse ones. The goal of compressed sensing is to reconstruct such signals from their incomplete linear information. Another aspect of this regime is the "curse of dimensionality" for standard smoothness classes, which means that the complexity of approximation depends exponentially on dimension. An important step in solving multivariate problems with large dimension has been made in the last 20 years: sparse representations are used as a way to model the corresponding function classes. This approach automatically entails a need for nonlinear approximation, and greedy approximation, in particular.

This program addresses a broad spectrum of approximation problems, from the approximation of functions in norm, to numerical integration, to computing minima, with a focus on sharp error estimates. It will explore the rich connections to the theory of distributions of point-sets in both Euclidean settings and on manifolds and to the computational complexity of continuous problems. It will address the issues of design of algorithms and of numerical experiments. The program will attract researchers in approximation theory, compressed sensing, optimization theory, discrepancy theory, and information based complexity theory.

Workshop 1: Information-Based Complexity and Stochastic Computation

September 15-19, 2014
Number of Participants: 76

Organizing Committee
Frances Y. Kuo, University of New South Wales
Erich Novak, Friedrich-Schiller-Universitat
Klaus Ritter, Universitat Kaiserslautern
Grzegorz W. Wasilkowski, University of Kentucky
Henryk Wozniakowski, Columbia University

Speakers
James Calvin, New Jersey Institute of Technology
Sonja Cox, Eidgenössische TH Hönggerberg
Dinh Dung, Vietnam National University
Michael Gnewuch, Christian-Albrechts Universität Kiel
Stefan Heinrich, Universität Kaiserslautern
Fred Hickernell, Illinois Institute of Technology
Aicke Hinrichs, Johannes Kepler Universität Linz
Arnulf Jentzen, Eidgenössische TH Hönggerberg
Peter Kritzer, Johannes Kepler Universität Linz
Thomas Kühn, Universität Leipzig
Frances Kuo, University of New South Wales
Christiane Lemieux, University of Waterloo
Thomas Müller-Gronbach, Universität Passau
Andreas Neuenkirch, Universität Mannheim
Dirk Nuyens, KU Leuven
Friedrich Pillichshammer, Johannes Kepler Universität Linz
Leszek Plaskota, University of Warsaw
Daniel Rudolf, Friedrich-Schiller-Universität
Winfried Sickel, Friedrich-Schiller-Universität
Pawel Siedlecki, University of Warsaw
Ian Sloan, University of New South Wales
Jeremy Staum, Northwestern University
Clayton Webster, Oak Ridge National Laboratory
Arthur Werschulz, Fordham University
Henryk Wozniakowski, Columbia University
Larisa Yaroslavtseva, Universität Passau
Yinyu Ye, Stanford University
Marguerite Zani, Université d'Orléans

Workshop Description
Information-based complexity (IBC) deals with the computational complexity of continuous problems for which available information is partial, priced and noisy. IBC provides a methodological background for proving the curse of dimensionality as well as provides various ways of vanquishing this curse.

Stochastic computation deals with computational problems that arise in probabilistic models or can be efficiently solved by randomized algorithms. Using IBC background, the complexity of stochastic ordinary (SDE) and partial differential (SPDE) equations have been studied.

Topics covered in the workshop will include: adaptive and nonlinear approximation for SPDEs, infinite-dimensional problems, inverse and ill- posed problems, quasi-Monte Carlo methods, PDEs with random coefficients, sparse/Smolyak grids, stochastic multi-level algorithms, SDEs and SPDEs with nonstandard coefficients, tractability of multivariate problems.

This workshop will bring together researchers from these different fields. The goal is to explore connections, learn and share techniques, and build bridges.

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"Our relaxed schedule has allowed for lots of interaction. The opportunity to continue this interaction afterwards with other long-term participants is extremely valuable."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"The questions, comments, and feedback I got after presenting my talk. Furthermore, there where some very interesting talks that gave me new ideas and turned my eye to new developments. A new collaboration, where I and some of my co-authors join weapons with another very strong researcher who works on similar problems, but has a different background. A further new collaboration which arose after an informal discussion in my office. The chance to meet with three other collaborators from different places to proceed the work on our joint paper."

"Fred Hickernells Talk - His totally different view on problems is striking. Talks that successfully linked practical problems with deep theory that has been developed before, especially Jeremy Staum. Also Frances Kuo's approach to find a theoretical framework for problems, first describing one input function, then thinking about a proper input class to set up IBC."

"Hearing about new results. Sitting down with two experts in the field I do not see often, discussing problems, and ending up with the outlines of two papers. Having my students meet experts in the field."

"The workshop schedule allowed many lively and valuable discussions following the various talks given in the workshop. This applies to talks given by other participants but also to my own talk: the discussion following my presentation inspired me for future work and was the starting point for possible future cooperation with other participants of the workshop."

"This workshop was for me an important step in continuing my research projects and establishing new connections and possible research projects. It was important to meet some of my current collaborators. In a friendly atmosphere and excellent conditions provided by ICERM we were able to discuss interesting topics and make plans for the future."

Workshop 2: Approximation, Integration, and Optimization

September 29-October 3, 2014
Number of Participants: 127

Organizing Committee
Albert Cohen, Universite de Paris VI (Pierre et Marie Curie)
Ronald Devore, Texas A&M International University
Robert Nowak, University of Wisconsin
Vladimir Temlyakov, University of South Carolina
Rachel Ward, University of Texas at Austin

Speakers
Marcus Bachmayr, RWTH Aachen
Eric Cances, Ecole Nationale des Ponts et Chaussees
Emmanuel Candes, Stanford University
Venkat Chandrasekeran, California Institute of Technology
Albert Cohen, Université de Paris VI (Pierre et Marie Curie)

Wolfgang Dahmen, RWTH Aachen
Alireza Doostan, University of Colorado
Maryam Fazel, University of Washington
Simon Foucart, University of Georgia
Omar Ghattas, University of Texas at Austin
Jarvis Haupt, University of Minnesota
Piotr Indyk, Massachusetts Institute of Technology
Frances Kuo, University of New South Wales
Yvon Maday, Brown University
Michael Mahoney, University of California, Berkeley
Habib Najm, Sandia National Laboratories
Angelia Nedich, University of Illinois at Urbana-Champaign
Anthony Nouy, Université de Nantes
Robert Nowak, University of Wisconsin
Holger Rauhut, RWTH Aachen
Justin Romberg, Georgia Institute of Technology

Workshop Description
The workshop is devoted to the following problem of fundamental importance throughout science and engineering: how to approximate, integrate, or optimize multivariate functions.

The breakthroughs demanded by high dimensional problems may be at hand. Good methods of approximation arise as solutions of optimization problems over certain function classes that are now well understood in small and modesty large dimensions.

In high dimensions, the appropriate models involve sparse representations, which give rise to issues in nonlinear approximation methods such as greedy approximation. High dimensional optimization problems become intractable to solve exactly, but substantial gains in efficiency can be made by allowing for a small probability of failure (probabilistic recovery guarantees), and by seeking approximate solutions (up to a pre-specified threshold) rather than exact solutions. The contemporary requirements of numerical analysis connect approximation, optimization, and probabilistic analysis.

The workshop will bring together leading experts in approximation, compressed sensing and optimization.

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"The talks were diverse and were presented in a clear and understandable for a wider audience way. Many of these talks were directly related to my recent research activities -- greedy approximation, convex optimization, and tensor product approximation. As an organizer of the workshop I am very satisfied with its outcome."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"The atmosphere was excellent: ideas were exchanged, questions were encouraged, junior and senior researchers contributed. It's been a while since I went to a conference/workshop that was so inviting and, as a result, enjoyable and productive."

"Top mathematicians working in approximation theory were present, talks were very interesting and the choice of subjects expanded my research horizons."

"The workshop was devoted to approximate, integrate and optimize the multivariate functions occurring in the varieties of the situations of the science and the engineering. A very nice gathering of the

researchers and the scientists were chosen for the workshop and speakers were of very high caliber who presented very recent and important findings."

Workshop 3: Discrepancy Theory

October 27-31, 2014
Number of Participants: 59

Organizing Committee
Michael Lacey, Institute of Technology
William Chen, Macquarie University
Dmitriy Bilyk, University of Minnesota
Aicke Hinrichs, Kepler Universität Linz
Mikhail Lifshits, St Petersburg State University
Friedrich Pillichshammer, Johannes Kepler Universitat Linz

Speakers
Christoph Aistleitner, Universität Graz
Nikhil Bansal, Technische Universiteit Eindhoven
Oleksandra Beznosova, University of Alabama
Sergiy Borodachov, Towson State University
Josef Dick, University of New South Wales
Benjamin Doerr, École Polytechnique
Carola Doerr, Max-Planck-Institut für Informatik
Frank (Fuchang) Gao, University of Idaho
Sigrid Grepstad, Norwegian University of Science and Technology (NTNU)
Aicke Hinrichs, Johannes Kepler Universität Linz
Roswitha Hofer, Johannes Kepler Universität Linz
Alex Iosevich, University of Rochester
Alex Kontorovich, Rutgers University
Christiane Lemieux, University of Waterloo
Lev Markhasin, Universität Stuttgart
Aleksandar Nikolov, Microsoft Research (Sillicon Valley)
Andrew Pollington, National Science Foundation
James Propp, University of Massachusetts
Ed Saff, Vanderbilt University
Zhongwei Shen, University of Kentucky
Maxim Skriganov, Russian Academy of Sciences
Craig Spencer, Kansas State University
Stefan Steinerberger, Yale University
Krystal Taylor, University of Minnesota
Robert Tichy, Technische Universität Graz
Giancarlo Travaglini, Università di Milano - Bicocca

Workshop Description
Discrepancy theory deals with the problem of distributing points uniformly over some geometric object and evaluating the inevitably arising errors. The theory was ignited by such famous early results as Herman Weyl's equidistribution theorem and Klaus Roth's theorem on the irregularities of point distributions.

The subject has now grown into a broad field with deep connections to many areas such as number theory, combinatorics, approximation theory, harmonic analysis, and probability theory, in particular empirical and Gaussian processes. The computational aspects of the subject include searching for well-distributed sets and numerical integration rules. Despite years of research, many fundamental questions, especially in high dimensions, remain wide open, although several important advances have been achieved recently.

The participants of this workshop will share a wide range of views on topics related to discrepancy with an eye towards the recent developments in the subject. The workshop will bring together different communities working on various aspects of discrepancy theory. The exchange of ideas and approaches, the cross-fertilization of viewpoints, sharing the visions of near and far term goals of the field will be the highlight of the conference.

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"There are some absolutely amazing new results, such as those described in the first morning by Skriganov and Nikolov. There are many good talks. Of greatest importance is the number of young colleagues with fine results. The subject is in good hands and has a very bright future. For someone who has spend more than a third of a century on the subject, this is indeed gratifying."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"The workshop has a really nice blend of computational and theoretical researchers. I learned a lot from people outside of my regular research area."

"Gaining an overview of researchers and important open problems in discrepancy theory, a field which is fairly new to me."

"Meeting and discussing with senior scholars from discrepancy theory and relevant application field are very helpful for the early career researchers like myself."

Fall 2014 Semester: Research Cluster

Computational Challenges in Sparse and Redundant Representations
November 3-21, 2014
Number of participants: 25

Research Cluster Organizers

Ben Adcock, Simon Fraser University
Anne Gelb, Arizona State University
Karlheinz Grochenig, Universität Wien
Yang Wang, Michigan State University

Research Cluster Description

Harmonic analysis provides the mathematical backbone for modern signal and image processing. It also constitutes an important part of the foundation several scientific and engineering areas, including communication theory, control science, fluid dynamics, and electromagnetics, that underpin a much broader set of current applications. Although computer implementation of concepts from harmonic analysis is prevalent, relatively little attention is given to computational and numerical aspects of the discipline in its own literature. Further, many of the most capable young mathematicians working in this area have only modest exposure to the roles of such crucial computational considerations as finite data effects; e.g., How much error is introduced by truncating this infinite-series representation of a function in terms of a frame, and where will it be manifested?

On the other hand, new tools and ideas have entered the mainstream of harmonic analysis in recent years that have not yet become established in areas of applied mathematics where numerical and computational issues are routinely treated as integral aspects of problem formulation and methodological development. Among these are tools for non-orthogonal and overcomplete representations in linear spaces and the exploitation of sparsity and related (e.g., low rank) assumptions in inverse problems of various types. This research cluster seeks to bridge this perceived gap by (i) fostering understanding and appreciation of the computational perspective among harmonic analysts and (ii) increasing awareness of emerging mathematical tools and techniques in applied harmonic analysis among computational mathematicians.

Note: see Appendix B for a Research Cluster report. (During the fall 2014 research cluster, a new connection between discrepancy theory and one-bit sensing was observed by M. Lacey and there is an ongoing collaboration on this project.)

Some Research Cluster Organizer Comments for "Briefly describe research cluster highlights":
"The opportunity to focus in depth on some research questions in very pleasant surroundings. The relaxed schedule really helped in allowing me to discuss and develop ideas in detail."

"Relaxed atmosphere for talking with other researchers. Time available to do so Not too many talks."

"The research cluster provided ample time for discussion. The stay at ICERM allowed me to do research without the usual interruptions."

Some participant Comments for "Briefly describe research cluster highlights":
"There was a very well selected mix of faculty, postdocs and students with interests in both theoretical and computational aspects of the scientific problems discussed. The schedule (especially the group discussion and research group sessions) was perfect to foster collaboration and discussions among the participants. This was an ideal platform to learn about new areas of research and also discuss open problems in an informal but very fruitful manner."

"There were only a modest number of talks scheduled and the highlight of the research cluster to me was the ample time in between the talks, where everybody was writing mathematics on both sides of the big white wall: beautiful."

"Small groups with intense interactions. Meeting experts in the field and opportunity to talk with them more closely about my research."

"The discussion sessions were great. I liked watching and listening and participating in informal conversation around the morning's research talks. It was a great place to get problem ideas and learn how people with various backgrounds view a particular problem."

All Visitors to Fall 2014 Semester Program

Gray highlight represents anyone staying over 9 days

Name	Organization	Time Spent at ICERM (days)
Adcock, Ben	Simon Fraser University	13
Ahmed, Ali	Georgia Institute of Technology	89
Aldroubi, Akram	Vanderbilt University	7

Archibald, Rick	Oak Ridge National Laboratory	19
Ayaz, Ulas	Rheinische Friedrich-Wilhelms-Universität Bonn	257
Balan, Radu	University of Maryland	21
Bandeira, Afonso S.	Princeton University	5
Beck, József	Rutgers University	7
Bilyk, Dmitriy	University of Minnesota	61
Borodachov, Sergiy	Towson State University	18
Boufounos, Petros	Mitsubishi Electric Research Laboratories	3
Byrenheid, Glenn	Rheinische Friedrich-Wilhelms-Universität Bonn	39
Cances, Eric	Ecole Nationale des Ponts et Chaussees	5
Chen, William Wai Lim	Macquarie University	66
Christensen, Ole	Technical University of Denmark	11
Cohen, Albert	Université de Paris VI (Pierre et Marie Curie)	5
Davis, Jacqueline	Vanderbilt University	89
Dung, Dinh	Vietnam National University	73
Duong, Xuan Thinh	Macquarie University	6
Dyn, Nira	Tel Aviv University	7
Eftekhari, Armin	Colorado School of Mines	47
Fazel, Maryam	University of Washington	5
Foucart, Simon	University of Georgia	74
Gataric, Milana	University of Cambridge	22
Gelb, Anne Elizabeth	Arizona State University	5
Gilbert, Alexander Dominik	University of New South Wales	62
Gröchenig, Karlheinz	Universität Wien	14
Griebel, Michael	Institute for Numerical Simulation	5
Gunturk, C. Sinan	Courant Institute of Mathematical Sciences	89
Hefter, Mario	Universität Kaiserslautern	43
Heinrich, Stefan	Universität Kaiserslautern	22
Huybrechs, Daan	KU Leuven	5
Krahmer, Felix	Georg-August-Universität Göttingen	22
Krishtal, Ilya A.	Northern Illinois University	5
Kunsch, Robert Joachim	Friedrich-Schiller-Universität	42
Kuo, Frances Yi-Chun	University of New South Wales	22
Lacey, Michael	Georgia Institute of Technology	45
Lemvig, Jakob	Technical University of Denmark	13
Lyon, Mark Edward	University of New Hampshire	19
Müllerr-Gronbach, Thomas Rudolf	Universität Passau	35
Maday, Yvon	Brown University	5
Markhasin, Lev	Universität Stuttgart	12
Matthysen, Roel	KU Leuven	23
Mayboroda, Svitlana	University of Minnesota	2

Migliorati, Giovanni	École Polytechnique Fédérale de Lausanne	23
Mixon, Dustin	Air Force Institute of Technology	5
Narayan, Akil	University of Massachusetts	103
Needell, Deanna	Claremont McKenna College	5
Nemirovski, Arkadi	Georgia Tech College of Computing	5
Nguyen, Dong Thi Phuong	KU Leuven	45
Nichols, James Ashton	University of New South Wales	24
Novak, Erich	Friedrich-Schiller-Universität	36
Nuyens, Dirk	KU Leuven	51
Petermichl, Stefanie	Université de Toulouse III (Paul Sabatier)	6
Platte, Rodrigo Barcelos	Arizona State University	7
Pollington, Andrew	National Science Foundation	5
Powell, Alex	Vanderbilt University	5
Rauhut, Holger	RWTH Aachen	9
Ravikumar, Pradeep	University of Texas at Austin	1
Ritter, Klaus	Universität Kaiserslautern	40
Romero, Jose Luis	Universität Wien	19
Rudolf, Daniel	Friedrich-Schiller-Universität	22
Schwab, Christoph	ETH	18
Shu, Chi-Wang	Brown University	19
Siedlecki, Pawel	University of Warsaw	91
Skriganov, Maxim	Russian Academy of Sciences	43
Sloan, Ian Hugh	University of New South Wales	28
Song, Guohui	Clarkson University	7
Staum, Jeremy C.	Northwestern University	5
Suryanarayana, Gowri	KU Leuven	50
Temlyakov, Vladimir N.	University of South Carolina	87
Todd, Michael J.	Cornell University	21
Traub, Joseph F.	Columbia University	5
Travaglini, Giancarlo	UniversitÃ di Milano - Bicocca	22
Ullrich, Tino	Rheinische Friedrich-Wilhelms-Universität Bonn	22
Viswanathan, Aditya	Michigan State University	20
Wang, Li	University of California, San Diego	89
Wang, Yang	Michigan State University	10
Wang, Yingwei	Purdue University	91
Ward, Rachel	University of Texas at Austin	12
Wasilkowski, Grzegorz W.	University of Kentucky	77
Webster, Clayton Garrett	Oak Ridge National Laboratory	5
Wozniakowski, Henryk	Columbia University	35
Yilmaz, Ozgur	University of British Columbia	7
Zhang, Xiaoqun	Shanghai Jiaotong University	13

Zhu, Houying	University of New South Wales	55
Zhuang, Xiaosheng	City University of Hong Kong	7

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

Some Semester Organizer Comments for "Briefly describe program highlights":
"High-dimensional approximation is an extremely relevant and important research topic currently. Excellent researchers both in theoretical and applied areas attended the semester and its workshops. Presentations at workshops were diverse and at a very high scientific level. The atmosphere was great! Post docs and graduate students were very active. The administration of the ICERM did a great job!"

"The amazing new results discussed in the discrepancy theory workshop."

Some Semester Organizers Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"Nonlinear tensor product approximation of functions (joint with D. Bazarkhanov, a participant of Workshop 2); Hyperbolic cross approximation (joint with T. Ullrich, a 1 month visitor, and Dinh Dung, a 3 months visitor); Greedy algorithms in convex optimization (joint with R. DeVore, an organizer of Workshop 2); Dictionary descent in optimization (influenced by Workshop 2)."

"Phase retrieval is something I have been working on, and now has gotten a few other interested through the workshop. I also learned some other ideas such as dynamic sampling, and have plans to work in the area."

Some Long-Term Participant Comments for "Briefly describe program highlights":
"High-dimensional approximation is an extremely relevant and important research topic currently. Excellent researchers both in theoretical and applied areas attended the semester and its workshops. Presentations at workshops were diverse and at a very high scientific level. The atmosphere was great! Post docs and graduate students were very active. The administration of the ICERM did a great job!"

"1) Working on the two ongoing projects and starting the new projects together with my collaborators. 2) The workshop on information-based complexity (high quality talks, good discussions)"

"Many eminent mathematicians attended this semester program, this allowed me to expand my knowledge of current developments in the area of information-based complexity, approximation theory and discrepancy."

Some Long-term Visitor Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"Nonlinear tensor product approximation of functions (joint with D. Bazarkhanov, a participant of Workshop 2); Hyperbolic cross approximation (joint with T. Ullrich, a 1 month visitor, and Dinh Dung, a 3 months visitor); Greedy algorithms in convex optimization (joint with R. DeVore, an organizer of Workshop 2); Dictionary descent in optimization (influenced by Workshop 2)."

"Uniform weak tractability of weighted integration, (s,t)-weak tractability: a refined classification of problems with (sub)exponential information-based complexity, computational complexity of problems defined on spaces of functions with infinitely many variables."

"Uniform weak tractability of weighted integration, (s,t)-weak tractability: a refined classification of problems with (sub)exponential information-based complexity, computational complexity of problems defined on spaces of functions with infinitely many variables."

"1. Minimal energy point configurations on higher-dimensional sphere with respect to a logarithmic potential. 2. Continued working the book on minimal energy."

Some Postdoc Comments for "Briefly describe program highlights":
I enjoyed the research cluster and the informal discussion sessions in it. I also enjoyed being paired with a mentor and starting a new project."

"Many eminent mathematicians attended this semester program, this allowed me to expand my knowledge of current developments in the area of information-based complexity, approximation theory and discrepancy."

Some Postdoc Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"Approximation of rank one tensors - probabilistic arguments for deriving the existence of good point sets with small dispersion - Sensitivity of Markov chain via Wasserstein distance."

"QMC for continuous time random walks and anomalous diffusion."

"Sampling with moving sensors, reconstruction from partial Fourier data."

"Uniform weak tractability of weighted integration, (s,t)-weak tractability: a refined classification of problems with (sub)exponential information-based complexity, computational complexity of problems defined on spaces of functions with infinitely many variables."

Some Graduate Student Comments for "Briefly describe program highlights":
"My PhD topic actually is somewhat a combination of the first and third workshop. To participate this workshop, first I get a big picture of my research field including what have been done, what the current focuses of other scholars and what gonna be new concentration which are extremely helpful to my future research. Secondly, tutorial talks before each workshop efficiently provided overview of specific areas. Finally, I benefit a lot from the professional development seminars running by ICERM directors."

"I learned lots of new knowledge s about high-dimensional approximation."

Some Graduate Student Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"Continued work on Bernstein Widths and Lower Bounds for adaptive Monte Carlo Methods (approximation with all linear functionals as information), finally successful Started work on approximation of d-variate monotone functions."

Note: for upcoming programs please see Appendix C.

Spring Semester 2015: Phase Transitions and Emergent Properties

February 2 - May 8, 2015

Organizing Committee
Mark Bowick, Syracuse University

Beatrice de Tiliere, Université Pierre et Marie Curie, Paris
Richard Kenyon, Brown University
Charles Radin, University of Texas
Peter Winkler, Dartmouth College

Program Description
Emergent phenomena are properties of a system of many components which are only evident or even meaningful for the collection as a whole. A typical example is a system of many molecules, whose bulk properties may change from those of a fluid to those of a solid in response to changes in temperature or pressure. The basic mathematical tool for understanding emergent phenomena is the variational principle, most often employed via entropy maximization. The difficulty of analyzing emergent phenomena, however, makes empirical work essential; computations generate conjectures and their results are often our best judge of the truth.

The semester will include three workshops that will concentrate on different aspects of current interest, including unusual settings such as complex networks and quasicrystals, the onset of emergence as small systems grow, and the emergence of structure and shape as limits in probabilistic models. The workshops will (necessarily) bring in researchers in combinatorics and probability as well as statistical physics and related areas. We aim to have experimental contributors for workshops 1 and 2 where we will highlight the comparison between computational and theoretical modeling and the real world. This will be combined with computational modules for the student participants.

Workshop 1: Crystals, Quasicrystals and Random Networks
February 9 - 13, 2015
Number of Participants: *76*

Organizing Committee
Mark Bowick, Syracuse University
Persi Diaconis, Stanford University
Charles Radin, University of Texas, Austin
Peter Winkler, Dartmouth College

Speakers
David Aristoff, Colorado State University
Giulio Biroli, Commissariat à l'Énergie Atomique (CEA), Centre d'Études Nucléaires de Saclay (CENS)
Christian Borgs, Microsoft Research
Jennifer Chayes, Microsoft Research
Henry Cohn, Microsoft Research
Noam Elkies, Harvard University
Veit Elser, Cornell University
Natalie Frank, Vassar College
Richard Kenyon, Brown University
Abhinav Kumar, Massachusetts Institute of Technology
Eyal Lubetzky, New York University
Vinothan Manoharan, Harvard University
Remi Monass, École Normale Supérieure
Yuval Peres, Microsoft Research
Oleg Pikhurko, University of Warwick
Charles Radin, University of Texas at Austin

Alexander Razborov, University of Chicago
Lorenzo Sadun, University of Texas at Austin
Senya Shlosman, Aix-Marseille University
Miklós Simonovits, Hungarian Academy of Sciences (MTA)
Boris Solomyak, University of Washington
Vera Sos, Hungarian Academy of Sciences (MTA)
Mei Yin, Brown University
Yufei Zhao, Massachusetts Institute of Technology

Workshop Description
The densest packing of unit disks in the plane is easily seen to be highly symmetric. This is exploited in statistical mechanics in arguing that as the density parameter is decreased from its optimum most packings at fixed density remain quite orderly ('solid'), changing only gradually until at a specific density they suddenly begin to `melt' into the disordered ('fluid') packings of low density. This workshop will explore two variants of this fundamental phenomenon. One variant concerns packings of special shapes, such as the Penrose kites and darts of the accompanying figure, whose densest packings are aperiodic tilings. The other concerns complex networks for which the optima are certain extremal graphs. These optimization problems, and especially their associated solid phases and solid/fluid phase transitions, are the subject of the workshop.

In summary, our workshop will explore two optimization problems on which there is active mathematical research. It will then focus on their associated solid phases and solid/fluid phase transitions which, on the contrary, are in dire need of mathematical clarification/understanding. It is hoped that progress can be made by pooling the expertise of researchers interested in various versions of this phenomenon. To promote cross-disciplinary information flow between the participants, the workshop format will have long tutorial/discussion sessions in the mornings, and short, more specialized talks in the afternoons.

The following tutorial/discussion sessions have been arranged so far:

- Densest packings by Noam Elkies (Harvard)
- Aperiodic tilings by Boris Solomyak (Washington)
- Phases from hard spheres by Veit Elser (Cornell)
- Extremal graphs by Alexander Razborov (Chicago)
- Multipodal phases in graphs by Lorenzo Sadun (Austin)
- Nonequilibrium solids by Giulio Biroli (CEA-Saclay)
- Other transitions by Remi Monasson (ENS-Paris)

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"The tutorials and exposure to mathematicians working in related fields."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"There were several. My expertise is somewhat on the side of the main themes of the workshop, but I enjoyed learning about new directions, both theoretical (graph limits, graphons, harmonic functions in R. Kenyon's talk), more classical things, like dense packings (lectures by Elkies and Cohn), as well as more applied/experimental. It was also great to have discussions with people I have met before and make new contacts."

"I find very important the results of very precise simulations of hard sphere packings and tetrahedron packings. They confirm to me the picture of the Kosterlitz-Thouless phase diagram, the rigorous

understanding of which remains very far from complete. The whole field of graphons is also very attractive."

"1) Learning about graphons and limit objects in random graph theory. 2) The organizer, Charles Radin, has set a very collaborative tone for the workshop, which is refreshing and energizing."

"A very interesting mix of topics of borderline between stat mech, physics, graph theory, etc."

Workshop 2: Small Clusters, Polymer Vesicles and Unusual Minima

March 16-20, 2015
Number of Participants: 77

Organizing Committee
Mark Bowick, Syracuse University
Michael Brenner, Harvard University
Miranda Holmes-Cerfon, Courant Institute of Mathematical Sciences
Robert Kusner, University of Massachusetts, Amherst
Charles Radin, University of Texas, Austin

Speakers
Maria Cameron, University of Maryland
Paul Chaikin, New York University
Beth Chen, Harvard University
Bryan Chen, Rijksuniversiteit te Leiden
Henry Cohn, Microsoft Research
Robert Connelly, Cornell University
Gustavo Düring, Pontificia Universidad Catolica de Chile
Sharon Glotzer, University of Michigan
Gregory Grason, University of Massachusetts
Robert Hardt, Rice University
Randall Kamien, University of Pennsylvania
L. Mahadevan, Harvard University
Apala Majumdar, University of Bath
Vinothan Manoharan, Harvard University
Elisabetta Matsumoto, Princeton University
Jayson Paulose, Rijksuniversiteit te Leiden
Itai Shafrir, Technion-Israel Institute of Technology
Eran Sharon, Hebrew University
Meera Sitharam, University of Florida
John Sullivan, TU Berlin
Louis Theran, Aalto University
David Wales, University of Cambridge
Thomas Yu, Drexel University

Workshop Description
This workshop will explore emergent phenomena in the context of small clusters, supramolecular self-assembly and the shape of self-assembled structures such as polymer vesicles. The emphasis will be on surprises which arise when common conditions are not satisfied, for instance when the number of components is small, or they are highly non-spherical, or there are several types of components. Interactions vary from hard sphere repulsion to competition between coarse-grained liquid-crystalline

ordering competing with shape deformation. Examples of this behavior are common in materials such as bulk homopolymers (rubber), copolymers, liquid crystals and colloidal aggregates. A basic mathematical setting would be to consider small clusters of hard spheres with isotropic short-range attractions and study the shape of the clusters as a function of the number of components. One known surprise is that highly symmetric structures are suppressed by rotational entropy. This emphasizes the need to accurately count the number of particle configurations that lead to the same final state. Small clusters can also generate anisotropic building blocks which can in turn serve as nano- or meso-scale building blocks for supermolecules and bulk materials (supramolecular chemistry) freed from the limited scope of atoms and quantum-mechanical bonding. These structures frequently possess topological defects in their ground states because they lower the energy. The challenge is to determine the shape and equilibrium defect structure of such superatoms and the number and geometry of their arrangement. The number of defects determines the effective valence of the super atoms and the global geometry of their arrangement determines the types of directional bonding possible when defects are linked together. The phenomenon of the appearance of singularities/defects because they are minimizers not necessarily required by topology or boundary conditions is also encountered in the study of harmonic maps. Moving up to self-assembly of large numbers of units, block copolymers self-assemble into a wide variety of structures including vesicles, nano-fibers and tori. Many of the structures formed are essentially two-dimensional surfaces embedded in R3. The mathematical challenge is to find both the shape and the order of the assembled object. This requires minimizing of a functional that depends on both the local and global order of the relevant matter fields and the shape of the surface.

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"Bob Connelly's talk and the subsequent discussion, especially interchange with Bob, Charles Radin and several other participants about the relationship between rigidity, shear stress and the "existence of incompressible fluids" - it was best summarized by a New Yorker-style cartoon of two scientists dueling (with exaggeratedly long index fingers raised at an angle like foil fencers) that the moderator sketched on the board afterward, with the caption 'My model doesn't fit your problem'!"

"I was an organiser and for me the highlight was that many of the speakers I had contacted and asked to address certain ideas were willing to do exactly that. They did not give their packaged talks but instead saw the workshop as an opportunity to address a potentially different audience from their standard peers."

"Time to interact with collaborators, and meet new collaborators. Having social time and space was important for this. the space was really nice."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"The tutorial of Eran Sharon and the talks of Randy Kamien and Greg Grason were insightful, constructive and novel. Physical problems they address are challenging and mathematically involved. On the other side, talking to people outside the lecture room is intellectually stimulating and it was sufficient time for this. Overall I appreciate a lot this workshop. Thank you for making it possible."

"For me the particular highlight of the workshop was the diversity in the topics talked about but also the fact that they all shared the same common underlying themes relevant to the workshop. The interaction of physicists with mathematicians is always a useful endeavor, and I think some bit of that was achieved for me personally."

"This workshop helped me to broaden my perspective about theoretical concepts in mathematics and come up with new ideas for my own research work in the field of computational chemistry. I also forged new collaborations with few groups working in the field of physics as well as mathematics. Overall, It was a good experience."

"I addition to many excellent talks, I really valued the opportunity for informal discussion between researchers from different communities (i.e. physics/engineering and geometry/applied math)."

Workshop 3: Limit Shapes

April 13 - 17, 2015
Number of Participants: 77

Organizing Committee
Marek Biskup, University of California, Los Angeles
Alexei Borodin, MIT
Béatrice de Tilière, Université Pierre et Marie Curie, Paris 6
Richard Kenyon, Brown University
Senya Shlosman, Aix-Marseille University
Speakers
Ken Alexander, University of Southern California)
Dan Betea, Université de Paris VI (Pierre et Marie Curie))
Alessandra Bianchi, Università di Padova)
Thierry Bodineau, École Polytechnique)
Filippo Colomo, National Institute of Nuclear Physics (INFN))
Ivan Corwin, Columbia University)
Codina Cotar, University College London)
Patrik Ferrari, Rheinische Friedrich-Wilhelms-Universität Bonn)
Vadim Gorin, Massachusetts Institute of Technology)
Dmitry Ioffe, Technion-Israel Institute of Technology)
Roman Kotecky, University of Warwick)
Lionel Levine, Cornell University)
Greta Panova, University of Pennsylvania)
Leonid Petrov, University of Virginia)
Dan Romik, University of California, Davis)
Andrea Sportiello, Università di Milano)
Fabio Toninelli, Université Claude-Bernard (Lyon I))
Amanda Turner, University of Lancaster)
Mirjana Vuletic, University of Massachusetts)

Workshop Description
Since the days of Boltzmann, it has been well accepted that natural phenomena, when described using tools of statistical mechanics, are governed by various "laws of large numbers." For practitioners of the field this usually means that certain empirical means converge to constants when the limit of a large system is taken. However, evidence has been amassed that such laws apply also to geometric features of these systems and, in particular, to many naturally-defined shapes. Earlier examples where such convergence could be proved include certain interacting particle systems, invasion percolation models and spin systems in equilibrium statistical mechanics.

The last decade has seen a true explosion of "limit-shape" results. New tools of combinatorics, random matrices and representation theory have given us new models for which limit shapes can be determined and further studied: dimer models, polymer models, sorting networks, ASEP (asymmetric exclusion processes), sandpile models, bootstrap percolation models, polynuclear growth models, etc. The goal of the workshop is to attempt to confront this "ZOO" of combinatorial examples with older foundational work and develop a better understanding of the general limit shape phenomenon.

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"Apart from the scientific program which I thought was great, I really appreciated ICERM and the way things are done to create connections: time for coffee breaks, black/white boards available everywhere, nice central hall available for discussion, office space."

"Colomo's talk on the six-vertex model limit shape was very interesting."

"The following people presented outstanding results: Romik, Corwin, Petrov, Ioffe, Toninelli, Gorin, Panova, Wilson This is much more than the average conference I attend."

"Stimulating atmosphere, attractive environment, plenty of available space to have undisturbed discussions. I appreciated the ability to watch talks on screens from outside."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"I think this was the first time that I understood the connection there is between random surfaces and such topics like sandpiles, six vertex models, and Markovian systems."

"Convergence to limit shapes of certain interacting particle systems. New tools of combinatorics and representation theory which applied to the study of interacting particle systems, such as dimer models and sandpile models, show the appearance of limit shapes."

"1. Informal discussion during the breaks and in the evenings. 2. More than half a dozen talks introducing to new areas or rearranging the old ones. 3. Generally the infective enthusiasm of the coworkers. 4. Superb staff: everything was running well, all request were promptly and cheerfully fulfilled."

"It was a dynamic and collaborative environment with huge potential for concrete future research output."

"There was a phenomenal group of (fellow) young researchers presenting on their recent work."

All Visitors to Spring 2015 Semester Program

Gray highlight represents anyone staying over 9 days

Name	Organization	Time spent at ICERM (days)
Abrams, Aaron	Washington and Lee University	13
Alexander, Ken	University of Southern California	14
Aristoff, David	Colorado State University	96
Bianchi, Alessandra	Università di Padova	22
Biroli, Giulio	Commissariat à l'énergie atomique (CEA)	5
Biskup, Marek	University of California, Los Angeles	5
Bowick, Mark	Syracuse University	96
Brenner, Michael P.	Harvard University	96
Brightwell, Graham	London School of Economics and Political Science	22
Chen, Beth	Harvard University	5
Chhita, Sunil	Rheinische Friedrich-Wilhelms-Universität Bonn	22
Corwin, Ivan	Columbia University	96

de Tilière, Béatrice	l'université de Paris VI (Pierre et Marie Curie)	21
Elkies, Noam	Harvard University	5
Eloranta, Kari	Aalto University	69
Elser, Veit	Cornell University	6
Esenturk, Emre	Pohang University of Science and Technology (POSTECH)	38
Ferrari, Patrik Lino	Rheinische Friedrich-Wilhelms-Universität Bonn	5
Gorin, Vadim	Massachusetts Institute of Technology	77
Grossman, Doron	Hebrew University	43
Haddadan, Shahrzad	Dartmouth College	53
Hammond, Alan	University of Oxford	7
Harrison, Michael	Pennsylvania State University	126
Helmuth, Tyler	University of British Columbia	107
Henkes, Silke	University of Aberdeen	16
Holmes-Cerfon, Miranda	Courant Institute of Mathematical Sciences	7
Holroyd, Alexander	Microsoft Research	21
Infeld, Ewa Joanna	Dartmouth College	88
Ioffe, Dmitry	Technion-Israel Institute of Technology	14
Jansen, Sabine	Ruhr-Universitat Bochum	39
Kallus, Yoav	Santa Fe Institute	12
Kamien, Randall David	University of Pennsylvania	4
Kenyon, Richard	Brown University	96
Kotecky, Roman	University of Warwick	36
Kral, Daniel	University of Warwick	13
Krieger, Madison S	Brown University	96
Kumar, Abhinav	Massachusetts Institute of Technology	5
Kusner, Robert	University of Massachusetts	96
Kusner, Woden	Technische Universität Graz	96
Lagarias, Jeffrey	University of Michigan	96
Li, Zhongyang	University of Connecticut	96
Lis, Marcin	Vrije Universiteit Amsterdam	121
Liu, Andrea	University of Pennsylvania	96
Louidor, Oren	Technion-Israel Institute of Technology	7
Lubetzky, Eyal	New York University	3
Luczak, Malwina	Queen Mary and Westfield College	22
Mahadevan, L.	Harvard University	96
Manoharan, Vinothan	Harvard University	5
Manyuhina, Oksana	Syracuse University	21
Mkrtchyan, Sevak	University of Rochester	96
Monasson, Remi	École normale supérieure	8
Pakianathan, Jonathan	University of Rochester	2

Pikhurko, Oleg	University of Warwick	7
Pismen, Len	Technion-Israel Institute of Technology	40
Radin, Charles	University of Texas at Austin	89
Ramassamy, Sanjay	Brown University	96
Razborov, Alexander	University of Chicago	5
Rudneva, Daria	State University Higher School of Economics	5
Russell, Emily Ruth	Institute for Computational and Experimental Research in Mathematics (ICERM)	274
Sadun, Lorenzo A	University of Texas at Austin	7
Sadun, Lorenzo A	University of Texas at Austin	21
Saldanha, Nicolau	Catholic University of Rio de Janeiro (PUC)	1
Shafrir, Itai	Technion-Israel Institute of Technology	5
Sharon, Eran	Hebrew University	6
Shlosman, Senya	Aix-Marseille University	96
Sidoravicius, Vladas	Institute of Pure and Applied Mathematics (IMPA)	24
Simonovits, MiklÃ³s	Hungarian Academy of Sciences (MTA)	29
Sknepnek, Rastko	University of Dundee	61
Solomyak, Boris	University of Washington	6
Sos, Vera	Hungarian Academy of Sciences (MTA)	10
Stein, Daniel L.	New York University	6
Striker, Jessica	North Dakota State University	24
Sun, Wangru	l'université de Paris VI (Pierre et Marie Curie)	77
Toninelli, Fabio Lucio	l'université Claude-Bernard (Lyon I)	7
Vuletic, Mirjana	University of Massachusetts	38
Wang, Xuan	University of North Carolina	121
Watson, Samuel	Massachusetts Institute of Technology	121
Winkler, Peter	Dartmouth College	96
Yin, Mei	Brown University	7
Zhao, Yufei	Massachusetts Institute of Technology	5

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

Semester Organizer Comments for "Briefly describe program highlights":
"*All three workshops were great but the most fun, most time and hardest work were associated with the first-listed project (variational principle for permutations). This was made possible by co-location of the four participants (three of which were here through the whole semester), and of course by the excellent facilities and staff. Also very useful were these continuing events: Kenyon's course; problem sessions; ICERM seminars; Brown's Math and Applied Math colloquia."*

"We got a nice result working together with Kral, Radin, Winkler on the large deviation principle for permutations. I believe this will have far-reaching applications."

Some Semester Organizer Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"Initiated: Variational principle for permutations (w/Kenyon, Kral & Radin) Permutations from random walk (w/Kenyon) Extreme and random posets (w/Brightwell, Luczak & Radin) Tetrahedral inequalities (w/Schlosman) Loss networks and hard spheres (w/Jansen) Models of Levy glass (w/Bianchi) continued: Abelian networks (w/Holroyd & Levine)."

"We started working with Winkler, Kral, Radin on limits of large permutations. We started working with Shlosman and Watson on defects in Dyson Brownian motions We continued working with Radin and Sadun on graphons We discussed a possible project with Corwin on large deviations for the random averaging process."

Some Long-Term Participant Comments for "Briefly describe program highlights":
"Many highlights. Learning about the ubiquity how maximizing entropy creates order from disorder. (This counterintuitive idea take time to sink in.) The notion of graphon, as a measure of limiting behavior of large graphs, and its phase diagram. Meeting various people with whom I can work in future."

"I have learned a lot from extensive numerical and experimental results, presented a the workshops. Among many talks I liked a lot the lecture by Sharon Glotzer. I hope to work with her in the future. 2. I was interacting with Jeffrey Lagarias, and I am delighted by the prospect to work together with him. 3. The topic of graphon theory is a fascinating subject, and I plan to work on it."

"Learning about the surprising connections between various disparate topics."

"The problem sessions organized by Peter Wrinkler were a great idea. It was very nice to have a semester long course (taught by Rick Kenyon) on a topic closely related to the semester program."

Some Long-Term Participant Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"Finished preprint "Cluster and virial expansions for the multi-species Tonks gas", started thinking on related combinatorial problem."

"I started potentially 3 new collaborations with people who visited during the workshops."

"Initiated a project with Graham Brightwell, Peter Winkler and Charles Radin about partially ordered sets limits."

"1. Pont processes on the plane with power law distributed distance 2. Spectral analysis of Markov operator 3. Ising model on the hyperbolic tesseletions 4. Dynamics of the condensate in the inclusion process."

"Project on arrangements of spheres touching a given sphere project on conductances to energy map, connections with algebraic geometry and number theory properties of generalizations of Laplacian operator acting on manifolds (continuing) ideas on graphon concept and its connection with point processes (not clear if this will work)."

"1. Statistical mechanics of interacting dimers. 2. Problem of sphere packing. 3. Improvement of critical temperature estimates in statistical mechanics."

Some Postdoc Comments for "Briefly describe program highlights":
"The limit shapes conference was a particular highlight, especially Filippo Colomo's talk."

"Let me first thank the organizer for putting together a nice semester program. As for the workshop I think a denser program could be designed. There is a huge physics community working on various aspects of phase transitions. The program seemed to focus on the graph theoretical perspective."

"Scientific conversations with other participants, exposure to many new problems and ideas, exposure to current trends in research I had not yet been exposed to."

"I have learnt many different topics/models in statistical mechanics during this workshop. I was introduced to the the Biham-Middleton-Levine traffic model, which is very interesting. I have also got many opportunities to discuss and interact with other participants of the workshops or the semester program."

Some Postdoc Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"I am discussing a possible project with Miranda Holmes, whom I met while attending, about computing the thermodynamic stability of nonlinearly rigid sticky sphere clusters. I continued writing a paper with Woden Kusner on local optimality of a certain general class of packings of congruent polygons in the plane."

"I initiated two new projects with new collaborators, modeling a self-assembly system, and understanding the interplay between thermal fluctuations and topology in two-dimensional membranes."

"Continued work on aspects of loop-weighted walk. Initiated work on problems relating to the hard-core model."

"Asymptotical behavior of critical first-passage percolation. The Biham-Middleton-Levine traffic mode."

Some Graduate Student Comments for "Briefly describe program highlights":
"Great discussions with the participants in April, mostly those who attended the limit shapes workshop."

Some Graduate Student Comments for "What, if any, specific projects or collaborations did you pursue during this program?":
"One project initiated with Andrea Sportiello, on commutation of rail yard graphs via urban renewal. Two other projects continued, on circle patterns and isoradial graphs."

The following is a summary of the simulation sessions that occurred during the Spring 2015 program, as described by Rastko Sknepnek:
We had two types of sessions. First were regular research talks (two of those), a bit less formal than usual for a seminar with a lot of interruptions and discussions. Second set of sessions were tutorials. I gave a series of three 50 minutes lectures on the topic of Monte Carlo simulations of two-dimensional Ising model. I introduced the problem and developed Python code to solve it. I started from simplest snippets of code and gradually extended them to a larger usable application. During those sessions, I was switching between a PowerPoint presentation and actual code. I would discuss a specific task and then go into the code, explain how it was implemented and demonstrate how it ran. I shared all codes with those participants who were interested. We covered topics such as importance sampling, Metropolis algorithm, Wolff algorithm, Binder cummulat, and finite size scaling. Finally, last week Sevak gave a "chalk-talk" tutorial on Shur processes. It was very well organised and very informative.

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 15th and May 15th. 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 Workshops in 2014-2015

ICERM has hosted 5 topical workshops from June 2014 to June 2015. These workshops focus on topics of current interest in the mathematical sciences.

Topical Workshop 1: Computational Nonlinear Algebra

June 2-6, 2014
Number of participants: 43

Organizing Committee
Greg Blekherman, Georgia Institute of Technology
Lek-Heng Lim, University of Chicago
Pablo Parrilo, MIT
Andrew Sommese, University of Notre Dame
Rekha Thomas, University of Washington

Speakers
Harm Derksen, University of Michigan
Sandra Di Rocco, Royal Institute of Technology (KTH)
Jean-Charles Faugère, INRIA
Shmuel Friedland, University of Illinois
João Gouveia, University of Coimbra
Wenrui Hao, University of Notre Dame
Aram Harrow, Massachusetts Institute of Technology
Jonathan Hauenstein, North Carolina State University
Christopher Hillar, University of California, Berkeley
Zuzana Kúkelová, Technical University of Prague (ČVUT)
Joseph Landsberg, Texas A & M University
Jean Lasserre, Centre National de la Recherche Scientifique (CNRS)
Anton Leykin, Georgia Institute of Technology
Susan Margulies, U.S. Naval Academy
Bernard Mourrain, Institut National de Recherche en Informatique Automatique (INRIA)

Giorgio Ottaviani, Università di Firenze
James Renegar, Cornell University
J. Maurice Rojas, Texas A & M University
Agnes Szanto, North Carolina State University
Russ Tedrake, Massachusetts Institute of Technology
Frank Vallentin, Universität zu Köln
Cynthia Vinzant, University of Michigan

Workshop Description
Over the last two decades, algebraic and numerical techniques for nonlinear problems have begun a steady and relentless transition from mostly academic constructions, to widely used tools across the mathematical sciences, engineering and industrial applications. The workshop will bring together participants from many diverse fields including computer vision, cryptography, optimization and control, partial differential equations, robotics, and quantum computation, with the common interest in nonlinear algebraic computations. The main goal is to assess the state of the art, to stimulate further progress, and to accelerate developments by bringing together these diverse communities and have them share computational challenges and successes.

Workshop 1 Participants (Computational Nonlinear Algebra)

Name	Organization
Alevy, Ian	Brown University
Cheruvu, Vani	University of Toledo
Cifuentes, Diego Fernando	Massachusetts Institute of Technology
Cohn, Henry	Microsoft Research
Derksen, Hendrikus 'Harm'	University of Michigan
Di Rocco, Sandra	Royal Institute of Technology (KTH)
Faugère, Jean-Charles	INRIA
Fawzi, Hamza	Massachusetts Institute of Technology
Friedland, Shmuel	University of Illinois
Gopal, Venu	Brown University
Gouveia, João	University of Coimbra
Hao, Wenrui	University of Notre Dame
Harrow, Aram Wettroth	Massachusetts Institute of Technology
Hauenstein, Jonathan David	North Carolina State University
Hillar, Christopher	University of California, Berkeley
Kileel, Joseph David	University of California, Berkeley
Krone, Robert	Georgia Institute of Technology
Masáková, Zuzana	(Czech) Technical University of Prague (ÄŒVUT)
Landsberg, Joseph M.	Texas A & M University
Lasserre, Jean B.	Centre National de la Recherche Scientifique (CNRS)
Lee, Hon Leung	University of Washington
Leykin, Anton	Georgia Institute of Technology
Liddell, Alan Claude	North Carolina State University
Lim, Lek-Heng	University of Chicago

Majumdar, Anirudha	Massachusetts Institute of Technology
Margulies, Susan	U.S. Naval Academy
Mata, Cristina	Massachusetts Institute of Technology
Mourrain, Bernard	Institut National de Recherche en Informatique Automatique (INRIA)
Ottaviani, Giorgio	Université di Firenze
Parrilo, Pablo Antonio	Massachusetts Institute of Technology
Permenter, Frank	Massachusetts Institute of Technology
Renegar, James	Cornell University
Rojas, J. Maurice	Texas A & M University
Saunderson, James	Massachusetts Institute of Technology
Skau, Erik West	North Carolina State University
Sommese, Andrew	University of Notre Dame
Stojanac, Zeljka	Rheinische Friedrich-Wilhelms-Universität Bonn
Szanto, Agnes	North Carolina State University
Tedrake, Russ	Massachusetts Institute of Technology
Tetali, Prasad	Georgia Institute of Technology
Thomas, Rekha Rachel	University of Washington
Vallentin, Frank	Universität zu Köln
Vinzant, Cynthia	University of Michigan

Some Workshop Organizer Comments for "Describe the highlight of this workshop":
"The conference brought together researchers from different areas and with different tools, who were all interested in aspects of polynomial systems, and were mainly concerned with serious computational problems. The goal was cross-pollination between the areas, which was successfully achieved."
"The conference was very diverse and yet flowed calmly. Many connections were made and several people commented on the many new people they met unlike in several other meetings of this small size. It went better than expected."

Some Workshop Participant Comments for "Describe the highlight of this workshop":
"The highlight for me was in learning of such a broad range of cutting-edge research within 5 days. Generally when I go to workshops, they are focused, so I learn about a specific topic, but not much about topics outside my areas of expertise. Here, instead, I learned about subjects that have piqued my interest, but for which I have never seemed able to find the time to get a handle on (e.g., research in computational tensor analysis). Of course not every new topic to which one is exposed proves to be enticing, but even when it is not, still there is an efficiency gained by having the realization after only a couple of talks rather than after having had pursued the literature for weeks. Another highlight was the setting. My, my, how absolutely gorgeous, even stellar!"

"I especially like the two-part introductory lectures given during the talks. I thought they did a great job of giving everyone a background in a slightly new area and a common terminology for further discussions."

"Meeting new people was definitely the highlight. It was great to meet people from a community that I don't generally meet much and learn about their ideas, tools and methods."

Topical Workshop 2: Challenges in 21st Century Experimental Mathematical Computation

July 21-25, 2014
Number of participants: 46

Organizing Committee
David H. Bailey, Lawrence Berkeley Lab and UC Davis
Jonathan Borwein, University of Newcastle, Australia
Olga Caprotti, University of Helsinki, Finland
Ursula Martin, Queen Mary College
Michela Taufer, University of Delaware
Bruno Salvy, INRIA, France

Speakers:
Dorian Arnold, University of New Mexico
David Bailey, Lawrence Berkeley National Laboratory
Amber Boehnlein, Stanford University
Folkmar Bornemann, TU München
Jonathan Borwein, University of Newcastle
Alin Bostan, INRIA
Neil Calkin, Clemson University
Howard Cohl, National Institute of Standards and Technology
Silvia Crivelli, University of California, Davis
Clint Dawson, University of Texas at Austin
Elise Dedoncker, Western Michigan University
Diego Dominici, SUNY at New Paltz
Ali Eshragh, University of Newcastle
Frank Garvan, University of Florida
Ganesh Gopalakrishnan, University of Utah
Matt Knepley, University of Chicago
Sherry Li, Lawrence Berkeley National Laboratory
Dan Lozier, National Institute of Standards and Technology
Ursula Martin, University of Oxford
Michael Mossinghoff, Davidson College
Veronika Pillwein, Johannes Kepler Universität Linz
Konrad Polthier, Freie Universität Berlin
Nathalie Revol, INRIA
Sinai Robins, Nanyang Technological University
Michael Rubinstein, University of Waterloo
Bruno Salvy, INRIA
Alexey Solovyev, University of Utah
Armin Straub, University of Illinois at Urbana-Champaign
Matthew Tam, University of Newcastle
Michela Taufer, University of Delaware
Christophe Vignat, Tulane University

Workshop Description
Over the past 25 years, experimental mathematics has developed as an important additional arrow in the mathematical quiver. Many mathematical scientists now use powerful symbolic, numeric and graphic (sometimes abbreviated "SNAG") computing environments in their research, in a remarkable departure from tradition. While these tools collectively are quite effective, challenges remain in numerous areas, including: (a) rapid, high-precision computation of special functions and their derivatives; (b) user-

customizable symbolic computing; (c) graphical computing; (d) data-intensive computing; and (e) large-scale computing on parallel and GPU architectures (including algorithm and software design for such systems).

This workshop will convene mathematical and computer scientists who create or exploit these tools, together with computational tool developers and commercial vendors of mathematical software, to exchange approaches and extend the state of the art in the field, both in the design of software and in the usage of this software for serious mathematical research.

Note: see Appendix D for workshop organizer's report on this program.

Workshop 2 Participants (Challenges in 21st Century Experimental Mathematical Comp Workshop)

Name	Organization
Arnold, Dorian Cecil	University of New Mexico
Bailey, David	Lawrence Berkeley National Laboratory
Becchi, Michela	University of Missouri
Ben Hamza, Abdessamad	Concordia University
Boehnlein, Amber	Stanford University
Bornemann, Folkmar	TU München
Borwein, Jonathan Michael	University of Newcastle
Bostan, Alin	INRIA
Brennan, Brian William	Baylor University
Calkin, Neil	Clemson University
Chiang, Wei-Fan	University of Utah
Cohl, Howard	National Institute of Standards and Technology
Corless, Robert M.	University of Western Ontario
Crivelli, Silvia	University of California, Davis
Dawson, Clint	University of Texas at Austin
Dedoncker, Elise	Western Michigan University
Dominici, Diego	SUNY at New Paltz
Eshragh, Ali	University of Newcastle
Garvan, Cyndi	University of Florida
Garvan, Frank	University of Florida
Gopal, Venu	Brown University
Gopalakrishnan, Ganesh	University of Utah
Graham, Lindley Christin	University of Texas at Austin
Knepley, Matt Gregg	University of Chicago
Li, Sherry	Lawrence Berkeley National Laboratory
Linton, Steve	University of St. Andrews
Lozier, Dan	National Institute of Standards and Technology
Martin, Ursula Hilda	University of Oxford
Mossinghoff, Michael John	Davidson College

Park, Chunjae	Kon-Kuk University
Pillwein, Veronika	Johannes Kepler Universität Linz
Polthier, Konrad	Freie Universität Berlin
Ravindran, Sivaguru S	University of Alabama at Huntsville
Revol, Nathalie	INRIA
Robins, Sinai	Nanyang Technological University
Rubinstein, Michael	University of Waterloo
Sajid, Mohammad	Qassim University
Salvy, Bruno	INRIA
Saunders, B. David	University of Delaware
Silverman, Joseph	Brown University
Solovyev, Alexey	University of Utah
Straub, Armin	University of Illinois at Urbana-Champaign
Tam, Matthew Kyle	University of Newcastle
Taufer, Michela	University of Delaware
Vignat, Christophe	Tulane University
Wood, David Harlan	University of Delaware

Some Workshop Organizer Comments for "Briefly describe workshop highlights":
"I was very pleased with the level of interaction and discussion."

"Nice discussions between researchers from diverse areas."

Some Workshop Participant Comments for "Briefly describe workshop highlights":
"The talk on calculation of Fredholm determinants was eye opening. I was not familiar with this use for integral equation techniques, and the computational program was quite impressive. I was able to talk at length with the author afterwards as well. Moreover, I thought David Bailey and Jon Borwein did a fantastic job of encouraging broad and incisive discussion after each set of talks, and keeping a stringent schedule so that this time was not eaten up. Too few meetings have this opportunity for wide ranging discussion."

"The highlights were these: 1) To know what Computational Mathematics really meant. I had no idea what people in this area did; now I see playing a role to help computational mathematicians conduct parallel executions to speed-up their codes 2) I also made new contacts with researchers who overlap with CS but address HPC and precision-related challenges."

"To see the depth of common interests and enthusiasms among a MUCH more diverse group than at most meetings I attend. Comp sci, pure math, applied math, application specialists. It was a nice mix of interest in and results reported from both exact computations (computer algebra) and high precision computation (double double, etc.)."

Topical Workshop 3: Combinatorial Link Homology Theories, Braids, and Contact Geometry

August 4-8, 2014
Number of participants: 82

The graduate students attending this workshop were funded by NSF CAREER award DMS-1151671.

Organizing Committee
John Baldwin, Boston College
Joshua Greene, Boston College
Elisenda Grigsby, Boston College
Keiko Kawamuro, University of Iowa
Dan Margalit, Georgia Tech

Workshop Description
A two-day strategic workshop aimed at convening a diverse group of mathematicians, This workshop will focus on recent advances in combinatorial link homology theories (e.g., Heegaard-Floer homology and Khovanov homology), especially as they apply to questions about braids and, more generally, mapping class groups of surfaces. There will be short mini-courses on

- Combinatorial knot Floer homology, with applications to contact geometry,
- Braid foliations and the Jones conjecture,
- Nielsen-Thurston theory, and
- Garside theory and a linear order on the braid group,

along with a number of research and expository talks. The talks will emphasize the role that computation and experiment have thus far played in stating key conjectures and establishing key results. The workshop will culminate in a computational problem session, in which participants will discuss promising directions for future exploration and indicate which computations may be most useful in that exploration.

As the main goal of the workshop is to facilitate interaction across a broad swath of the low-dimensional topology community, all talks will be at a level appropriate for "non-experts." Graduate students and early career researchers interested in learning the big open problems in this area--as well as the main techniques at hand to approach them--are particularly encouraged to apply.

Workshop 3 Participants (Combinatorial Link Homology Theories, Braids, and Contact Geometry)

Name	Organization
Abe, Tetsuya	Tokyo Institute of Technology
Atiponrat, Watchareepan	University at Buffalo (SUNY)
Bae, Yeongjin	Institute for Basic Science, Center for Geometry and Physics
Baker, Ken	University of Miami
Baldwin, John	Boston College
Banfield, Ian Matthew	Boston College
Bosman, Anthony Michael	Rice University
Bryant, Kathryn	Bryn Mawr College
Burke, John R	Rhode Island College
Cengiz, Merve	Koc University
Cengiz, Mustafa	Bogaziçi University
Chakraborty, Apratim	Stony Brook University
Clarkson, Corrin	Columbia University
Cornwell, Chris	Duke University

Daemi, Aliakbar	Harvard University
Dunfield, Nathan	University of Illinois at Urbana-Champaign
Duong, Nguyen Dat	University of Alabama
Dynnikov, Ivan	Moscow State University
Etnyre, John	Georgia Institute of Technology
Feller, Peter Richard	Universität Bern
Gao, Honghao	Northwestern University
Graham, Matthew D.	Northwestern University
Greene, Joshua	Boston College
Grigsby, Elisenda	Boston College
Hendricks, Kristen Elyse	University of California, Los Angeles
Herr, Daniel Zimmerman	Wheaton College
Hironaka, Eriko	Florida State University
Hom, Jennifer	Columbia University
Hubbard, Diana Dorothy	Boston College
Ince, Kenan Andrew	Rice University
Ito, Tetsuya	Kyoto University
Jeon, Choonbae	Daeduk College
Kawamuro, Keiko	University of Iowa
Kutluay, Deniz	Indiana University
Kuzbary, Miriam	Rice University
Kwashira, Rugare	University of the Witwatersrand
LaFountain, Doug	Western Illinois University
Lambert-Cole, Peter	Louisiana State University
Le, Quang Nhat	Brown University
Lee, Hwa Jeong	Korea Advanced Institute of Science and Technology (KAIST)
Lee, Juhyun	Institute for Basic Science, Center for Geometry and Physics
Leverson, Caitlin June	Duke University
Levine, Adam Simon	Princeton University
Lidman, Tye	University of Texas at Austin
Liechti, Livio	Universität Bern
Liu, Yajing	University of California, Los Angeles
Mangahas, Johanna	Brown University
Margalit, Dan	Georgia Institute of Technology
Misev, Filip	Universität Bern
Moore, Allison Heather	Rice University
Ng, Lenny	Duke University
O'Donnol, Danielle	Oklahoma State University
Ortiz, Marcos A	University of Iowa

Pan, Yu	Duke University
Park, JungHwan	Rice University
Petkova, Ina	Rice University
Prasolov, Maxim Vyacheslavovich	Moscow State University
Ramassamy, Sanjay	Brown University
Ramirez, Camila Alexandra	University of Iowa
Raoux, Katherine	Brandeis University
Ravelomanana, Huygens Christian	University of Quebec
Ray, Arunima	Rice University
Roberts, Rachel	Washington University
Saltz, Adam R	Boston College
Sarkar, Sucharit	Princeton University
Scaduto, Christopher William	University of California, Los Angeles
Schwartz, Hannah Rebecca	Bryn Mawr College
Shastin, Vladimir Alekseevich	Moscow State University
Sheikh Alishahi, Akram	Max Planck Institute for Mathematics
Shumakovitch, Alexander N.	George Washington University
Sivek, Steven	Princeton University
Stipsicz, Andras Istvan	Hungarian Academy of Sciences (MTA)
Toko, Wilson Bombe	University of the Witwatersrand
Truong, Linh	Princeton University
Vance, Katherine Rose Poulsen	Rice University
Vela-Vick, Shea	Louisiana State University
Vertesi, Vera	L'Université de Nantes
Wehrli, Stephan Martin	Syracuse University
Wong, Biji	Brandeis University
Wong, Chuen-Ming Mike	Columbia University
Zelenyuk, Yuliya	University of the Witwatersrand
Zibrowius, Claudius Bodo	University of Cambridge

Some Workshop Organizer Comments for "Describe the highlight of this workshop":
"Scientifically, the highlight for me was a sequence of lectures by Doug LaFountain. I felt that the level and quality of the lectures in general were ideal, and I am very grateful that ICERM agreed to play host to this graduate workshop. I hope it will consider to do so in the future!"

"Tetsuya Ito's minicourse on algebraic aspects of braid theory. I learned about a number of recent results and open questions that were directly relevant to my graduate student's research problem. I also really enjoyed hearing about Dynnikov and Prasolov's solution to the generalized Jones conjecture (and also to the "minimal grid number maximizes Thurston-Bennequin number" conjecture)."

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

"I truly enjoyed the minicourses. They helped cement my understanding of the foundations of areas that are peripheral yet relevant to my research. Additionally, the workshop offered me the opportunity to discuss my current research with other experts."

"I was fascinated by how some deep concepts of mathematics are made easy through computational aspects. The combinatorial nature of the presentations ,made it much easier even for participants who are not experts in the discussed topics to be able to follow and even to make some important links with one's area of research, that one can either reinvent (picking up new areas of research) or diversify one's current research topic making a readily accessible link between one's area of expertise and some of the topics that were presented. The workshop has highlighted that the infusion of combinatorial nature of some topics makes some deep areas in mathematics to be easily accessible and become even more interesting to study. This is a great and exciting way to show that abstract mathematics can cultivate more interest and motivate one to explore even further. The combinatorial nature has highlighted that abstract Mathematics has more than fixing concepts, definitions and theorems but it can be visualized and enjoyed through simple presentations e.g. diagrams."

"The highlight for me was the talk given by Tetsuya Ito, despite his average english, was perfect and will be remembered by me for a long time to come. If it was my area of interest I would definitely opt for the approach presented by him. I would have asked many questions and looked for further collaboration. His slides will serve me a lot for my academic career."

Topical Workshop 4: Integrability and Cluster Algebras: Geometry and Combinatorics

August 25-29, 2014
Number of participants: 49

Organizing Committee
Vladimir Fock, Université de Strasbourg I (Louis Pasteur)
Max Glick, University of Minnesota
Olga Kravchenko, Institut Camille Jordan, Université Lyon 1
Sophie Morier-Genoud, Université de Paris VI (Pierre et Marie Curie)
Valentin Ovsienko, Institut Camille Jordan, Université Lyon 1
Rich Schwartz, Brown University

Speakers:
Karin Baur, Karl-Franzens-Universität Graz
Alexander Bobenko, Technische Universität Berlin
Philippe Caldero, Université Claude-Bernard (Lyon I)
Philippe di Francesco, Commissariat à l'Énergie Atomique Saclay (CEA)
Sergey Fomin, University of Michigan
Michael Gekhtman, University of Notre Dame
Alexander Goncharov, Yale University
Rei Inoue Yamazaki, Chiba University
Rinat Kedem, University of Illinois at Urbana-Champaign
Richard Kenyon, Brown University
Boris Khesin, University of Toronto
Igor Krichever, Columbia University
Andrei Marshakov, Institute of Theoretical and Experimental Physics
Gregg Musiker, University of Minnesota
Vincent Pilaud, École Polytechnique
Ralf Schiffler, University of Connecticut

Richard Schwartz, Brown University
Michael Shapiro, Michigan State University
Fedor Soloviev, University of Toronto
Yuri Suris, Technische Universität Berlin
Sergei Tabachnikov, ICERM
Zijian Yao, Brown University

Workshop Description
This workshop focuses on certain kinds of discrete dynamical systems that are integrable and have interpretations in terms of cluster algebras. Some such systems, like the pentagram map and the octahedral recurrence, are motivated by concrete algebraic constructions (taking determinants) or geometric constructions based on specific configurations of points and lines in the projective plane. The systems of interest in this workshop have connections to Poisson and symplectic geometry, classical integrable PDE such as the KdV and Boussinesq equations and also to cluster algebras. The aim of the workshop is to explore geometric, algebraic, and computational facets of these systems, with a view towards uncovering new phenomena and unifying the work to date.

Workshop 4 Participants (Integrability and Cluster Algebras: Geometry and Combinatorics)

Name	Organization
Artamonov, Semeon	Rutgers University
Banchoff, Tom	Brown University
Baur, Karin	Karl-Franzens-Universität Graz
Bejleri, Dori	Brown University
Bobenko, Alexander	Technische Universität Berlin
Bouarroudj, Sofiane	New York University
Caldero, Philippe	l'université Claude-Bernard (Lyon I)
di Francesco, Philippe	Commissariat à l'Énergie Atomique (CEA)
Early, Nicholas Joseph	Pennsylvania State University
Fock, Vladimir	l'université de Strasbourg I (Louis Pasteur)
Fomin, Sergey	University of Michigan
Fraser, Christopher Michael	University of Michigan
Garver, Alexander Christian	University of Minnesota
Gekhtman, Michael	University of Notre Dame
Glick, Max	University of Minnesota
Golden, John	Brown University
Goncharov, Alexander	Yale University
Guenther, Felix	Technische Universität Berlin
Inoue Yamazaki, Rei	Chiba University
Kedem, Rinat	University of Illinois at Urbana-Champaign
Kenyon, Richard	Brown University
Khesin, Boris	University of Toronto
Kravchenko, Olga	Institut Camille Jordan, l'université Lyon 1
Kreusch, Marie	l'université de Liège
Krichever, Igor	Columbia University

Lamberti, Lisa	University of Oxford
Le, Quang Nhat	Brown University
Ma, Ningning	Brown University
Marshakov, Andrey	Higher School of Economics (National Research University)
Morier-Genoud, Sophie	Université de Paris VI (Pierre et Marie Curie)
Musiker, Gregg	University of Minnesota
Ovsienko, Valentin	l'université de Reims
Pilaud, Vincent	École Polytechnique
Ramassamy, Sanjay	Brown University
Schiffler, Ralf	University of Connecticut
Schrader, Gus	University of California, Berkeley
Schwab, Burkhard Ulrich	Brown University
Schwartz, Richard	Brown University
Shapiro, Alexander	University of California, Berkeley
Shapiro, Michael	Michigan State University
Soloviev, Fedor L	University of Toronto
Suris, Yuri	Technische Universität Berlin
Tabachnikov, Sergei	Institute for Computational and Experimental Research in Mathematics (ICERM)
Vishnyakova, Elizaveta	Centre Universitaire de Luxembourg
Vogel, Hannah Juliane	Karl-Franzens-Universität Graz
Volovich, Anastasia	Brown University
Williams, Harold Matthew	University of California, Berkeley
Yao, Zijian	Brown University
Yi, Ren	Brown University

Some Workshop Organizer Comments for "Describe the highlight of this workshop":
"Well, 30 years ago (when I was a teenager) I started investigating something I subsequently called the pentagram map. I studied it episodically for many years, always convinced of its importance, but people rarely took it seriously. This conference had a number of talks on the pentagram map, which is now considered to be one of the central and motiving examples at the intersection of integrable systems and cluster algebras. So, I had the pleasure of watching an idea of mine have a lot of impact in the wider mathematical world."

"The best aspect was to listen to algebraists, geometers and combinatorialists (who usually do not speak to each other) at the same time on essentially the same subject."

"Several talks were of a high quality and impressed me very much. Discussions between the talks and during the reception(s) and poster session were pleasant and useful."

Some Workshop Participant Comments for "Describe the highlight of this workshop":
"The workshop allowed me to present my recent work on Noncommutative Inverse Scattering Method for integrable systems on associative algebras and have multiple fruitful discussions with another researches in the area. During the talks on workshop I become familiar with modern methods in discrete integrable

systems."

"Several of my last research papers are directly related to the topic of the workshop. Therefore, it was extremely important to present my results to the community and explore links to other people's research/directions."

"The workshop really was as workshops are meant to be - a brief community created to advance a topic and inform each other of their various points of view. Of course, I believe the space where the workshop is held is extremely useful in helping form this productive community, as well as the careful planning of the organizers."

Topical Workshop 5: Mathematics of Data Analysis in Cybersecurity

October 22-24, 2014
Number of participants: 53

This workshop was fully funded by SaTC award CNS-1354474.

Organizing Committee
Edo Airoldi, Harvard University
Paul Barford, University of Wisconsin
Henry Cohn, Microsoft
John Harer, Duke University
John Johnson, Pacific Northwest National Laboratory
Mauro Maggioni, Duke University
Jill Pipher, ICERM

Speakers:
You Chen, Vanderbilt University
Peter Chin, Boston University
Ann Cox, Department of Homeland Security
Mark Crovella, Boston University
Gábor Csárdi, Harvard University
Sharon Goldberg, Boston University
Aric Hagberg, Los Alamos National Laboratory
John Harer, Duke University
John Heidemann, University of Southern California
Nadia Heninger, University of Pennsylvania
Emilie Hogan, Pacific Northwest National Laboratory
Cliff Joslyn, Pacific Northwest National Laboratory
Sanjeevi Krishnan, University of Pennsylvania
Mauro Maggioni, Duke University
Bobak Nazer, Boston University
Linda Ness, Applied Communication Sciences
Tristan Nguyen, US Air Force Office of Scientific Research
David Nicol, University of Illinois at Urbana-Champaign
Jose Perea, Duke University
Michael Salpukas, Raytheon Company
Daniel Sussman, Johns Hopkins University
Brian Witten, Symantec

Workshop Description
The goal of this workshop is to bring mathematicians and cybersecurity practitioners together to outline the key challenges in the mathematics of cybersecurity data analysis. The expected outcome of the workshop will be a roadmap for investment in specific mathematical topics that will directly impact the advancement of the science of cybersecurity.

Mathematicians have long been involved in information security through cryptography, and thus algebra and number theory. But modern cyber security is a much larger field, and the perspectives and methodologies of other parts of the mathematical sciences have been only rarely been brought to bear. Given the complexity and dynamics of cyberspace it is essential to have a formal scientific basis for the field of cybersecurity. Indeed, a variety of sources have called for the creation of a "science of cybersecurity", and mathematical methods should play a critical role in such a science.

The purpose of this workshop is to bring together mathematical scientists and cybersecurity practitioners with expertise in several main areas, including especially high dimensional data analysis and cryptography, to establish a road map for bringing more mathematicians into the field of cybersecurity. Sharing our visions of near and far term goals of the field will be the highlight of the conference.

Workshop 5 Participants (Mathematics of Data Analysis in Cybersecurity)

Name	Organization
Airoldi, Edo	Harvard University
Ando, Megumi	Brown Univ. / MITRE
Baldimtsi, Foteini	Boston University
Beck, József	Rutgers University
Bresten, Christopher	University of Massachusetts
Cavazos, John	University of Delaware
Chen, You	Vanderbilt University
Chin, Peter	Boston University
Cohn, Henry	Microsoft Research
Cox, Ann	Department of Homeland Security
Crovella, Mark	Boston University
Csardi, Gabor	Harvard University
Farley, Jonathan David	Morgan State University
Feinman, Reuben	Brown University
Goldberg, Sharon	Boston University
Hagberg, Aric	Los Alamos National Laboratory
Harer, John	Duke University
Heidemann, John	University of Southern California
Heiland, Randy	Indiana University
Heninger, Nadia	University of Pennsylvania
Hogan, Emilie Ann	Pacific Northwest National Laboratory
Joslyn, Cliff	Pacific Northwest National Laboratory
Kim, Saeja Oh	University of Massachusetts
Kornaropoulos, Evgenios	Brown University

Krishnan, Sanjeevi	University of Pennsylvania
Langston, Matthew Harper	Reservoir Labs Inc
Maggioni, Mauro	Duke University
Markowsky, George	University of Maine
Markowsky, Linda	University of Maine
Nazer, Bobak	Boston University
Ness, Linda Ann	Applied Communication Sciences
Nguyen, Tristan	US Air Force Office of Scientific Research
Nicol, David Malcolm	University of Illinois at Urbana-Champaign
Perea, Jose	Duke University
Pipher, Jill Catherine	Institute for Computational and Experimental Research in Mathematics (ICERM)
Pollington, Andrew	National Science Foundation
Ravindran, Sivaguru	University of Alabama at Huntsville
Salpukas, Michael R	Raytheon Company
Savage, John E	Brown University
Schwab, Burkhard Ulrich	Brown University
Shin, SeungWon	University of Illinois at Urbana-Champaign
Sommers, Eric	University of Massachusetts
Sussman, Daniel Lewis	Johns Hopkins University
Tannouri, Ahlam E	Morgan State University
Tannouri, Sam F	Morgan State University
Tian, Yahui	The University of Texas
Voroninski, Vladislav	Massachusetts Institute of Technology
Witten, Brian	Symantec
Xie, Wei	Vanderbilt University
Yin, Wotao	University of California, Los Angeles
Zhang, Bo	IBM
Zheng, Bin	Pacific Northwest National Laboratory
Zhu, Quanyan	New York University

Some Workshop Organizer Comments for "Describe the highlight of this workshop":
No organizer comments to report.

Some Workshop Participant Comments for "Describe the highlight of this workshop":
"There were several: 1) the problems, results and approaches to the Los Alamos data (and learning of its availability in the near future) - specifically the need for a system to manage credential resources, and Peter Chinn's belief propagation experiment to detect threats 2) Learned about a new recently proved theorem by Bill Allard, Harer et. al for more rapidly computing simplicial complexes for persistent homology 3) Met program managers interested in cybersecurity and open to mathematical approaches to their problems -- this was very important 4) Learned about the program of cybersecurity experiments at PNNL planning to exploit manifold learning and computational topology."

"The workshop was a good mix of Cyber Security Experts, Mathematicians, and those who were already experts in both fields. Because the Domain Expertise required to solve problems is so varied, collaboration is demonstrably helpful. I know I was able to help others with some Time Series questions, and I certainly learned a lot about the Cyber Domain and Graph Theory/Topology/Geometry applications."

"I was surprised at how well my talk was received. It was less mathematical than most of the talks, so I didn't think there would be much interest, but there was."

"Our school will launch inter-collegiate "Data Science BS& MS program" officially from fall 2015. As the Chair of the Mathematics Department, I've learned current research areas and underlying subjects pertaining to train/nurture students in this area. I can share funding opportunities in research and education with my colleagues."

Topical Workshop 6: Mathematics of Lattices and Cybersecurity

April 21-24, 2015
Number of participants: 86
This workshop was fully funded by SaTC award CNS-1354474.

Organizing Committee
Jeffrey Hoffstein, Brown University
Stephen Miller, Rutgers University
Ramarathnam Venkatesan, Microsoft Research

Speakers:
Daniel J. Bernstein, Technische Universiteit Eindhoven
Jean-Francois Biasse, University of Calgary
Leo Ducas, Center for Mathematics and Computer Science (CWI)
Shai Halevi, IBM Research Division
Nadia Heninger, University of Pennsylvania
Tanja Lange, Technische Universiteit Eindhoven
Stephen Miller, Rutgers University
Phong Nguyen, Normale Supérieure
Helen Nissenbaum, New York University
Chris Peikert, Georgia Institute of Technology
Richard Pinch, HMG
Oded Regev, Courant Institute of Mathematical Sciences
Peter Sarnak, Princeton University
Alice Silverberg, University of California, Irvine
Joseph Silverman, Brown University
Vinod Vaikuntanathan, Massachusetts Institute of Technology
Ramarathnam Venkatesan, Microsoft Research India
Akshay Venkatesh, Stanford University

Workshop Description
Lattices are abstractly very simple objects, yet their concrete realizations contain beautifully intricate problems that are stubbornly difficult even in low dimensions. For example, our present day understandings of densest lattice packings and reduction theory are still plagued with large gaps.

In the 1970's and 1980's lattices entered the world of cryptography as tools used to break certain crypto systems, particularly those based on the subset sum problem, and since the 1990's they have become increasingly important in the building of other types of crypto systems (thanks to the difficulty in the underlying mathematics). Their significance has recently been bolstered by average-case complexity bounds and their present resistance to quantum computing attacks.

Currently the theory of lattices is a lively research topic among mathematicians, computer scientists, and experts in cybersecurity. However, to this date, there has been little to no interaction between these communities. The goal of this workshop is to stimulate activity between these different groups interested in lattice problems. Topics to be covered include, but are not restricted to, recent results on densest lattice packings, the geometry of lattice moduli space and its connections with automorphic forms and algebraic number theory, cryptographic applications of lattices, and the state of the art of lattice reduction in high dimensions.

Workshop 6: Participants (Mathematics of Lattices and Cybersecurity)

Name	Organization
Avitabile, Therese Michelle	New York University
Barak, Boaz	Microsoft Research
Bernstein, Daniel J.	Technische Universiteit Eindhoven
Biasse, Jean-Francois	University of Calgary
Bröker, Reinier	Worcester Polytechnic Institute
Cetin, Gizem Selcan	Worcester Polytechnic Institute
Chen, Cheng	MIT
Chen, Yilei	Boston University
Coppersmith, Don	Institute for Defense Analyses (IDA)
Damelin, Steven	Mathematical Reviews, American Mathematical Societ
Degwekar, Akshay Dhananjai	Massachusetts Institute of Technology
Deshpande, Apoorvaa	Brown University
Doroz, Yarkin	Worcester Polytechnic Institute
Ducas, Leo	Center for Mathematics and Computer Science (CWI)
Eisenbarth, Thomas	Worcester Polytechnic Institute
Eldar, Lior	Massachusetts Institute of Technology
Gandikota, Venkata	Purdue University
Hajir, Farshid None	University of Massachusetts
Hales, Thomas	University of Pittsburgh
Halevi, Shai	IBM Research Division
Heninger, Nadia	University of Pennsylvania
Hewett, Campbell	Brown University
Hoffstein, Jeffrey	Brown University
Holmgren, Justin Lee	MIT
Hosseini, Seyed Kaave	University of California, San Diego

Infeld, Ewa Joanna	Dartmouth College
Janwa, Heeralal	University of Puerto Rico
Judge, Samuel David	Michigan Technological University
Karasiewicz, Edmund	Rutgers University
Kim, Miran	Seoul
Kim, Saeja Oh	University of Massachusetts
Kim, Seungki	Stanford University
Kolpakov, Aleksandr	University of Toronto
Kopp, Gene S	University of Michigan
Lagarias, Jeffrey	University of Michigan
Lange, Tanja	Technische Universiteit Eindhoven
Liu, Tianren	Massachusetts Institute of Technology
Markowsky, George	University of Maine
Markowsky, Linda	University of Maine
Martin, William Joseph	Worcester Polytechnic Institute
Miller, John C	Rutgers University
Miller, Stephen David	Rutgers University
Mozzochi, Charles Jeffey	not affiliated-retired
Murat, Osmanoglu	University of Connecticut
Nguyen, Phong	École normale supérieure
Nichols, Daniel Gregory	University of Massachusetts
Nissenbaum, Helen	New York University
Oksuz, Ozgur	NYU Medical Center
Pastine, Adrian	Michigan Technological University
Peikert, Chris	Georgia Institute of Technology
Pham, Lam	Yale University
Pinch, Richard	HMG
Pollington, Andrew	National Science Foundation
Prest, Thomas Varuna	École normale supérieure
Radin, Charles	University of Texas at Austin
Regev, Oded	Courant Institute of Mathematical Sciences
Ricci, James Lewis	Daemen College
Robins, Sinai	Nanyang Technological University
Russell, Emily Ruth	Institute for Computational and Experimental Research in Mathematics (ICERM)
Sarnak, Peter	Princeton University
Schanck, John	University of Waterloo
Schoof, Rene	University of Rome Tor Vergata
Sealfon, Adam	MIT
Silverberg, Alice	University of California, Irvine

Silverman, Joseph	Brown University
Silverman, Thomas J	Brown University
Sommers, Eric	University of Massachusetts Amherst
Stephens-Davidowitz, Noah	New York University
Stevens, Sophie Clara Charlotte	University of Bristol
Sunar, Berk	Worcester Polytechnic Institute
Tonchev, Vladimir D	Michigan Technological University
Tran, Ha Nguyen Thanh	University of Rome Tor Vergata
Triantafillou, Nicholas George	Massachusetts Institute of Technology
Ulmer, Douglas	Georgia Institute of Technology
Vaikuntanathan, Vinod	Massachusetts Institute of Technology
Valenta, Luke Taylor	University of Pennsylvania
van Vredendaal, Christine	Technische Universiteit Eindhoven
Vasudevan, Prashant	MIT
Venkatesh, Akshay	Stanford University
Whitehead, Ian Michael	University of Minnesota
Winkler, Peter	Dartmouth College
Wunderer, Thomas	Technische Universtaet Darmstadt
Yakoubov, Sophia	Boston University
Yao, Zijian	Brown University
Zhang, Zhenfei	security innovation
Zhang, Zhuohui	Rutgers University

Some Workshop Organizer Comments for "Describe the highlight of this workshop":
"Talks by Venkatesh and Regev. In general, the great participation of a strong, diverse audience."

Some Workshop Participant Comments for "Describe the highlight of this workshop":
*"Learning how the pros view various developments or possibilities in cryptology. E.g., Pinch's views on the probability of a significant quantum computer by 2020, Lange's insights into the key overlap discovery (widely reported, but not with content like this), and the Peikert/Bernstein discussions. I *particularly* commend ICERM and Nissenbaum for including a social science perspective. Brave of her to speak before such an audience, and farsighted of the organizers to put it on the program."*

"The unbelievably broad audience, from experts in algebraic number theory, to cryptographers, and probabilists."

"Insights into a new field of maths, closely related to my research. Started a new collaboration, with expected results in a short term (6 months), very likely evolving into a long term (up to several years) research project."

"I can bring scholarship to undergraduate teaching classroom. The Commutative algebra is embedded in the mathematics of Lattices."

The most exciting aspect of this conference was the fact that it brought people at the forefront of research in Algebra and Number Theory in contact with people at the forefront of cryptography. Since my

University is preparing to invest heavily in Cybersecurity, both as a number theorist who has done some work on lattices and as a Department Head, this conference was enormously useful to me in the future directions of my research and even more so in terms of positioning my Department strategically within the University's efforts to plan for more involvement in cybersecurity. Another important opportunity was created by the presence of NSF Program Director Andy Pollington, who provided a lot of interesting data and information."

"I am new to the field of cybersecurity so the highlight(s) would include the majority of the talks! They were a lot more accessible than I expected and gave me a good idea of what are the current problems in the field. I hope to start moving my research in this direction soon."

"The two communities brought together by this workshop both think deeply about lattices as they relate to their own research interests, yet do so with strikingly different objectives and tools. Perhaps due to the growing sophistication of the techniques employed by the cybersecurity researchers, and their corresponding need to engage with deeper mathematics, there seemed to be a unique atmosphere of mutual interest and wide-eyed curiosity. I came away from the workshop aware of connections between my work and that of others in fields that I had previously felt were quite disparate."

"Please pass on to your co-organizers my congratulations for such an incredible meeting. These four days were chock-full of serious mathematics and the theme clearly matched ICERM's mission with plenty of computational issues and several talks that contained significant experimental components.

As the one mathematician at WPI expected to interact with the cryptographers (hardware engineers), I really benefited from this meeting. I learned a lot, and got plenty of ideas for future projects with students as well as with Berk Sunar and his team. I also have some notes which will liven up my graduate algebra course in the fall.

I appreciate all of the work you put into this. I may not be an expert in the area — and therefore may not be in the "target" audience — but I gained a lot from the workshop. I really enjoyed meeting Thomas Hales (finally — I am a fan) and had great conversations with Lagarias, Radin, and others."

Topical Workshop 7: Integrability in Mechanics and Geometry: Theory and Computations

June 1-5, 2015
Number of participants: Estimated 36

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

Speakers:
Simonetta Abenda, Università di Bologna
Gil Bor, Center of Investigations in Mathematics (CIMAT)
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 (UNAM)
Thomas Ivey, College of Charleston

Anton Izosimov, University of Toronto
Joel Langer, Case Western Reserve University
Melvin Leok, University of California, San Diego
Mark Levi, Pennsylvania State University
L. Mahadevan, Harvard University
Vladimir Matveev, Friedrich-Schiller-Universität
Ron Perline, Drexel University
Chong Song, Xiamen University
Yuri Suris, Technische Universität Berlin
Sergei Tabachnikov, ICERM
Tadashi Tokieda, University of Cambridge
Alexander Veselov, Loughborough University
Dmitry Zenkov, North Carolina State University

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 7 Participants to date (Integrability in Mechanics and Geometry: Theory and Computations) as of May 5, 2015

Name	Organization
Abenda, Simonetta	Università di Bologna
Arnold, Maxim	University of Texas at Dallas
Ball, Kenneth Ray	University of Texas
Baryshnikov, Yuliy	University of Illinois at Urbana-Champaign
Boll, Raphael	Technische Universität Berlin
Bor, Gil	Center of Investigations in Mathematics (CIMAT)
Calini, Annalisa	College of Charleston
Celletti, Alessandra	University of Rome Tor Vergata
Domokos, Gabor	Budapest University of Technology and Economics
Fedorov, Yuri	Universitat Politecnica de Catalunya
Fernandez, Oscar	Wellesley College
Garcia-Naranjo, Luis	National Autonomous University of Mexico (UNAM)
Ivey, Thomas	College of Charleston
Izosimov, Anton	University of Toronto
Khesin, Boris	University of Toronto

Langer, Joel	Case Western Reserve University
Leok, Melvin	University of California, San Diego
Levi, Mark	Pennsylvania State University
Mahadevan, L.	Harvard University
Mari-Beffa, Gloria	University of Wisconsin
Matveev, Vladimir	Friedrich-Schiller-Universität
Mestdag, Tom	University of Ghent (UG)
Montgomery, Richard	University of California, Santa Cruz
Perline, Ron	Drexel University
Santoprete, Manuele	Wilfrid Laurier University
Soloviev, Fedor L	University of Toronto
Song, Chong	Xiamen (Amoy) University
Suris, Yuri	Technische Universität Berlin
Tabachnikov, Sergei	Institute for Computational and Experimental Research in Mathematics (ICERM)
Tokieda, Tadashi	University of Cambridge
Vermeeren, Mats	Technische Universität Berlin
Veselov, Alexander	Loughborough University
Vollmer, Andreas Dominik	University of Jena
Zenkov, Dmitry	North Carolina State University
Zharnitsky, Vadim	University of Illinois at Urbana-Champaign

Note: for upcoming programs please see Appendix C.

VI-MSS International Workshops

During this reporting period, ICERM co-funded its first partnership workshop with two institutes in South Africa, established relationships with institutes in Brazil, Israel and Japan, and funded XX research visits to partner institutes.

Computational Topology and Data Analysis Workshop

November 17-21, 2014 – Johannesburg, South Africa

Description

The review of Mathematical Sciences research at South African universities commissioned by the National Research Foundation highlighted the isolation of South African mathematics from its applications and related disciplines and not being fully distributed across different areas of mathematics. In particular it noted that there are contemporary mainstream subfields that are not represented and some research is disconnected from areas of contemporary interest. The newly established Centre for Mathematical and Computational Sciences and the African Institute for Mathematical Sciences are collaborating to address some of these gaps by co-organising workshops that will introduce new areas of study to the South African Mathematical Sciences Research landscape.

There is heightened awareness and renewed interest in (Big) Data Analysis since the announcement that South Africa together with Australia would be hosting the Square Kilometre Array project. One of the

programmes to be pursued by the Centre for Mathematical and Computational Sciences is the Mathematical and Statistical underpinnings of Big Data.

Computational Topology or Applied Algebraic Topology is a fairly new line of study that combines topological results with efficient computational tools to analyse data and solve problems in many fields, including sensor networks, clustering, robotics, protein biochemistry, computer graphics and image analysis etc. The main objectives of the workshop are to (a) is to introduce the relatively new area of Computational Topology to the attendees and to 'seed' this area in the mathematical research landscape in South Africa; (b) give an overview of some of the most important developments and results; (c) discuss some of the contemporary issues, promising directions and open problems and questions. It is hoped that at the end of the workshop researchers in the mathematical sciences and related disciplines will have acquired the basic knowledge prerequisite to undertake research in Topological Data Analysis. The target audience will be researchers from the mathematical, statistical and computational sciences who may want to incorporate into their research aspects or computational topology; postgraduate students who might want to undertake a doctoral project in this area and practitioners from public or private sector.

A typical day will consist of two lectures in the morning and one lecture in the afternoon, each of one hour duration followed by thirty minutes of discussion, brainstorming or hands-one activities. There will be a 90-minute session in the afternoon which will vary from short presentations by young mathematicians; case study presentations by practitioners; panel discussion by experts from academia, private and public sectors.

Note: No exit surveys were collected for this program. K. Mischaikow reported on his experience as faculty leader for the mini-courses orally to the Director. One main impact of this activity, from his perspective, was to demonstrate to the graduate students and early-career researchers the importance of being "exposed to a large swath of mathematics".

VI-MSS International Research Visits 2014-2015

Name	Home Organization	Traveled To	Travel Dates	
Charlesworth, Ian	University of California, Los Angeles	Brown-Kobe Joint Simulation School	8/22/14	9/6/14
Glynn, Peter	Stanford University	TIRF, Mumbai	6/29/14	7/3/14
Huang, Jonathan	University of Maryland	IMSc, Chennai	8/24/14	9/8/14
Kelly, Sean	University of Maryland	IISc, Bangalore and TIRF, Mumbai	10/14/14	10/28/14
Kramar, Miroslav	Rutgers University	University of Witwatersrand, Johannesburg	11/17/14	11/20/14
Lizzi, Adam	University of Maryland	IISc, Bangalore and TIRF, Mumbai	8/4/14	8/17/14
Mischaikow, Konstantin	Rutgers University	University of Witwatersrand, Johannesburg	11/17/14	11/20/14
Misra, Kailash	North Carolina State University	TIRF, Mumbai	12/8/14	12/20/14
Pantev, Tony	University of Pennsylvania	TIRF, Mumbai	5/1/14	5/17/14
Ramachandran, Niranjan	University of Maryland	TIRF, Mumbai	6/1/14	8/31/14

Ramanan, Kavita	Brown University	TIRF, Mumbai	2/26/15	3/16/15
Schilling, Anne	University of California, Davis	IMSc, Chennai	7/1/14	8/31/14
Vinroot, Christopher	College of William and Mary	IMSc, Chennai	6/1/14	7/31/14

Note: for upcoming programs 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:

- Coalition for National Science Funding (CNSF), Spring 2014 (Washington, DC)
- MAA MathFest, Summer 2014 (Portland, OR)
- Mathematical Field of Dreams Conference, Fall 2014 (Mese, AZ)
- Modern Math Workshop at SACNAS, Fall 2014 (Los Angeles, CA)
- JMM, Winter 2014 (San Antonio, TX)
- (The SIAM Annual meeting is subsumed in ICIAM, Beijing, in 2015)

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 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.

ICERM Board of Trustees

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

Doug Arnold and Yann LeCun joined the SAB in 2015. Srinivasa Varadhan (2011-2014) rotated off.

Note: See Appendix E for the minutes of the June 2, 2014 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.

ICERM Scientific Advisory Board

Name	Institution
Henry Cohn	Microsoft Research
Charles Epstein	University of Pennsylvania
Anna Gilbert (new Chair)	University of Michigan
Sally Goldman	Google
Cynthia Phillips	Sandia
Guillermo Sapiro	Duke University
Anne Schilling (new member)	University of California, Davis
Richard Schwartz	Brown University
Cosma Shalizi (new member)	Carnegie Mellon University
Robert S. Sutor	IBM
Yuri Tschinkel	University of California at Berkeley
Peter Winkler	Dartmouth University

Anne Schilling and Cosma Shalizi joined the SAB in 2015. Anna Gilbert was approved by the BOT to become the new Chair of the SAB, replacing Andrea Bertozzi, who rotated off in late 2014. Jun Liu and Robert Pego also rotated off in late 2014. George Papanicoloaou rotated off in early 2015.

Note: see Appendix F for the minutes of the November 21-22, 2014 annual Scientific Advisory Board meeting and subsequent conference call on May 12, 2015.

Education Advisory Board (EAB)

The Education Advisory Board 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.

ICERM Education Advisory Board

Name	Institution
Karen Haberstroh	Brown University
Irina Mitrea	Institute for Mathematics and its Applications
Katy Ott (new member)	Bates College
Allison Pacelli	Williams College
Lynn Rakatansky	RI Math Teachers Association Executive Board
Sergei Tabachnikov (new Chair)	Brown University
Ulrica Wilson (new member)	Morehouse College

Katy Ott and Ulrica Wilson joined the EAB in 2014. Sergei Tabachnikov (soon to be ICERM Deputy Director emeritus) was approved by the BOT to replace Chair Tom Banchoff (2011-2015) who rotated off in early 2015. Frank Morgan (2011-2014) and Ken Wong (2011-2014) also rotated off.

Note: see Appendix G or the minutes of the December 2, 2014 annual Education Advisory Board meeting.

Mathematics Institute Directors Meeting (MIDs)

See Appendix H for the May 2014 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, summer research programs for undergraduates (Summer@ICERM), and IdeaLab for early career researchers. The addition of postdoctoral fellows (as described above) and graduate students is essential to the success of ICERM's programs.

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, and a smaller number of institute fellows, who stay at ICERM for one year and are supported by a salary for 9 months with the possibility of additional summer support.

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.

2014-2015 ICERM Postdoctoral Cohort

ICERM Postdoctoral Fellows (4 months; funds for travel to and from institute)

Name	Previous Institution	Semester
Ali Ahmed	Georgia Institute of Tech (RA)	Fall 2014 HDA
Jacqueline Davis	Vanderbilt University	Fall 2014 HDA
Pawel Siedlecki	Institute of Applied Math (RA)	Fall 2014 HDA
Li Wang	University of CA/San Diego	Fall 2014 HDA
Tyler Helmuth	University of British Columbia	Spring 2015 PTEP
Marcin Lis	Vriji Universiteit Amsterdam	Spring 2015 PTEP
Xuan Wang	University of NC/Chapel Hill	Spring 2015 PTEP
Samuel Watson	Massachusetts Institute of	Spring 2015 PTEP

	Technology	

Institute Fellows (9 months w/benefits; summer support may be available)

Name	Previous Institution	Semester
Ulas Ayaz	Hausdorff Center for Mathematics, Bonn	2014-15: focus Fall HDA
Emily Russell	Harvard University	2014-15: focus Spring PTEP

Based on available information, the ICERM stipend-supported postdocs for 2014-2015 break down as follows:

	Male		Female	
Black	0		0	
Hispanic	0		0	
American Indian/Alaskan Native	0		0	
Asian/Pacific Islands	1		1	
White	6		2	
Other (specify)	0	+	0	
	7		3	= 10 Total

Keeping Track of Former Postdocs (Institute and Semester)

ICERM Research Fellows are supported with a stipend for one semester. We expect that these postdoctoral fellows will be on leave from, or have deferred the start of, another position. 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	Plans After ICERM
Emre Esenturk	Fall 2011	Warwick Mathematics Institute, University of Warwick
Jeffrey Haack	Fall 2011	RTG Instructor, University of Texas/Austin
Andong He	***Fall 2011***- Spring 2012	Assistant Professor, University of HI
Ahmed Kaffel	Fall 2011	University of Maryland
Daniela Tonon	Fall 2011	Maître de Conférence, Université Paris Dauphine
Dongming Wei	Fall 2011	VP at PNC Bank
Cecile Armana	Spring 2012	Maître de Conférence, University of Franche-Comté
Anupam Bhatnagar	Spring 2012	Data Scientist at Velos
Alon Levy	Fall 2011 – ***Spring 2012***	University of British Columbia
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	Visiting Assistant Professor, Oklahoma State University
Zajj Daugherty	Spring 2013	Tenure Track, CCNY
Martina Lanini	Spring 2013	Research Fellow at University of Melbourne
Ben Salisbury	Spring 2013	Assistant Professor, 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	***Fall 2013*** – Spring 2014	Tenure track at Yale University
Anastasiia Tsvietkova	Fall 2013	Tenure track at UC-Davis
Danupon Nanongkai	Spring 2014	Lecturer at Kasetsart University
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
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	Chalmers University
Xuan Wang	Spring 2015	Georgia Institute of Technology, Visiting Assistant Professor
Samuel Watson	Spring 2015	Brown University
Ulas Ayaz	**Fall 2014** – Spring 2015	MIT
Emily Russell	Fall 2014 – **Spring 2015**	Google Software Engineer

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 director(s). 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 Bjorn Sandstede 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.

ICERM Postdoctoral Participant and Mentor list by Semester Program

Postdoc	Mentor	Program
Ali Ahemd	Michael Lacey	Fall 2014 ICERM Postdoctoral Fellow
Ulas Ayaz	Sinan Gunturk, Ozgur Yilmaz	Fall 2014 ICERM Institute Postdoc
Jacqueline Davis	Rachel Ward, Anne Gelb	Fall 2014 ICERM Postdoctoral Fellow
Armin Eftekhari	Vladimir Temlyakov	Fall 2014 ICERM/Independent
Alexander Gilbert*	Ian Hugh Sloan	Fall 2014 ICERM/Independent
Giovanni Migliorati	None assigned (short stay)	Fall 2014 ICERM/Independent
James Nichols	Frances Kuo	Fall 2014 ICERM/Independent
D. Rudolf	Josef Dick	Fall 2014 ICERM/Independent
Pawel Siedlecki	Henryk Wozniakowski	Fall 2014 ICERM Postdoctoral Fellow
Li Wang	Rachel Ward, Vladimir Temlyakov	Fall 2014 ICERM Postdoctoral Fellow
Sunil Chhita	None (short stay)	Spring 2015 ICERM/Independent
Emre Esenturk	None (short stay)	Spring 2015 ICERM/Independent
Tyler Helmuth	Senya Shlosman	Spring 2015 ICERM Postdoctoral Fellow

Marcin Lis	Charles Radin	Spring 2015 ICERM Postdoctoral Fellow
Oksana Manyuhina	None (short stay)	Spring 2015 ICERM/Independent
Emily Russell	Mark Bowick	Spring 15 ICERM Institute Postdoc
Mirjana Vuletic	None (short stay)	Spring 2015 ICERM/Independent
Xuan Wang	Alexander Holyroyd	Spring 2015 ICERM Postdoctoral Fellow
Samuel Watson	Rick Kenyon	Spring 2015 ICERM Postdoctoral Fellow

*Advisor also attended the program

Graduate Student Mentoring

Graduate Student	Mentor	Program
Yingwei Wang	Vladimir Temlyakov	Fall 2014
Mario Hefter*	Klaus Ritter	Fall 2014
Glenn Byrenheid*	Frances Kuo	Fall 2014
Robert Kunsch*		Fall 2014
Dong Nguyen*	Dirk Nuyens	Fall 2014
Suryanarayana*	Dirk Nuyens	Fall 2014
Houying Zhu*	Frances Kuo, Josef Dick	Fall 2014
Doron Grossman	Mark Bowick	Spring 2015
Shahrazad Haddadan	Peter Winkler	Spring 2015
Michael Harrison	Sergei Tabachnikov	Spring 2015
Ewa Infeld	Peter Winkler	Spring 2015
Madison Krieger	Rick Kenyon	Spring 2015
Sanjay Ramassamy	Rick Kenyon	Spring 2015
Wangru Sun	Rick Kenyon	Spring 2015

*Advisor also attended program/acted as mentor

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

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 a small panel of representatives from funding agencies 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.

IdeaLab Program Process

The IdeaLab early career research program selection process follows these steps:

1. Solicitation of Proposals

ICERM solicits and recruits proposals from faculty nationwide.

2. Future Proposal Selection

Programs are selected from proposals submitted to ICERM in an open competition. A subcommittee of the SAB 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

Applications are accepted via MathPrograms.org. Applicants indicate the research tier or track they are interested in (if more than one topic is being covered). A ranked list of applicants is made by the faculty program leaders and the Directors for each tier or track.

4. Applicant Selection

Participants are selected by the program organizers and the selections are finalized by ICERM Director(s). 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 expenses. Participants are funded by ICERM with travel funds, lodging and a meal per diem. In addition, 3 or 4 program funding officers are invited to serve on a panel during the last day of the program to observe the participants' final presentations, and answer questions about funding opportunities for early career researchers.

IdeaLab 2014

June 16 – August 8, 2014
Tier 1: Toward a more realistic model of ciliated and flagellated organisms
Tier 2: High frequency vibrations and Riemannian geometry

Organizing Committee
Ricardo Cortez, Tulane University
Mark Levi, Pennsylvania State University
Michael Minion, Stanford University
Richard Montgomery, University of California, Santa Cruz

Tier 1 Description: Toward a more realistic model of ciliated and flagellated organisms
The biological world at the scale of cellular organisms is full of fascinating examples of fluid motion that is generated or affected by its interaction with elastic structures. Examples are the fluid motion around "swimming"' bacteria and sperm, and the ciliary function in the respiratory system. A common feature of these phenomena is the interaction of elastic flexible membranes or filaments with a surrounding fluid, where the forces generated by the elastic structures and their motion are coupled by the fluid dynamics.

The development of computational methods for the accurate simulation of thin filaments in a fluid has reached maturity. At the same time, the force-generating mechanism of eukaryotic flagella and cilia has been well-studied biologically. However, the vast majority of numerical models of flagellar and ciliary motions do not yet include a proper representation of the internal microtubule structure of flagella.

By bringing together mathematicians with a variety of backgrounds, the goal of this IdeaLab is to brainstorm on possible approaches to introduce a more faithful representation of the internal structure of flagella into a computational model that can be used to study a variety of flows generated by microorganisms.

Tier 2 Description: High frequency vibrations and Riemannian geometry
We will discuss several specific projects at the interface of mechanics, geometry and analysis. The fascinating phenomenon of stabilization by vibration suggests one group of problems. The most famous example of such a stabilization is the Kapitsa pendulum in which the upside-down unstable equilibrium of the standard pendulum becomes a stable equilibrium when the pendulum's pivot is vibrated vertically at a high enough frequency.

IdeaLab 2014 Cohort

Name	Home Institute	Role
Roza Aceska	Vanderbilt University	Participant
Alessandro Arsie	University of Toledo	Participant
Brian Benson	University of Illinois at Urbana-Champaign	Participant
Yougan Cheng	University of Minnesota	Participant
Ricardo Cortez	Tulane University	Organizer
William Cousins	Massachusetts Institute of Technology	Participant
Jim Curry	National Science Foundation	Program Officer

Marcelo Disconzi	Vanderbilt University	Participant
Amit Einav	University of Cambridge	Participant
Fariba Fahroo	DARPA	Program Officer
Mark Levi	Pennsylvania State University	Organizer
Reza Malek-Madani	ONR	Program Officer
Michael Minion	Stanford University	Organizer
Richard Montgomery	University of California, Santa Cruz	Organizer
Tomoki Ohsawa	University of Michigan	Participant
Sarah Olson	Worcester Polytechnic Institute	Participant
Emily Russell	Harvard University	Participant
Thomas Russell	National Science Foundation	Program Officer
Jason Teutsch	University of Chicago	Participant
Léon Tine	Institut Camille Jordan, Université Lyon 1	Participant
Guowei Yu	University of Toronto	Participant
Longhua Zhao	Case Western Reserve University	Participant

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

IdeaLab Organizer Comments for "Describe the highlight of this program":
"I was an organizer. The highlight was watching our teams present on Friday and seeing how much they had done, how far they had gotten and how they had helped each other."

IdeaLab Participant Comments for "Describe the highlight of this program":
"I didn't know anything about the topic before the workshop. After the workshop I can say I know what the state of the art is on how to model cilia and flagella and the type of research that is needed to do a better job."

"Getting feedback from the panel representing the various funding agencies and getting to learn more about how the funding agencies work was extremely insightful."

"The best part of the program was meeting and getting to know the other participants - everyone involved was enthusiastic and friendly, and having such a wide range of expertise made it a safe space in which to admit to not knowing particular things and to ask questions and learn from one another. The topic gave us a common ground from which to spark scientific discussions which were both educational and fun."

Summer Undergraduate Research Program

Summer Undergraduate Research Program Process

The summer undergraduate research program selection process follows these steps:

1. Solicitation of Proposals

ICERM has started to solicit and recruit proposals from faculty nationwide. Ideally, a successful summer program will run two consecutive years (as it has during this reporting cycle: "Geometry and Dynamics" during both the summer of 2012 and 2013). 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 Director(s). 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 2014: Summer@ICERM – Polygons and Polynomials

June 16 – August 8, 2014

Organizing Committee

Michael Mossinghoff, Davidson College
Sinai Robins, Nanyang Technological University

Program Description

The Summer@ICERM: Polygons and Polynomials program is designed for a select group of 15-18 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.

2014 Summer@ICERM Cohort

Name	Home Institute	Funding Source

Zach Blumstein (M)	Brown University	Outside Funding*
Yiwang Chen (M)	University of Illinois	NSF
Alexander Dunlap (M)	Chicago University	NSF
Nicholas Dunn (M)	NC State	NSF
Molly Feldman (F)	Swarthmore College	NSF
Campbell Hewett (M)	Brown University	Outside Funding*
Jason Hu (M)	UC/Berkeley	NSF
Robert Kenyon (M)	McGill University	Outside Funding
Alicia LaMarche (F)	Shippensburg University	NSF
Jiahui Liu (F)	Columbia University	Outside Funding
Brooke Logan (F)	Rowan University	NSF
Alexandru Mihai (M)	Jacobs University	NSF
Dat Nguyen (M)	SUNY Stony Brook	NSF
Spencer Saunders (F)	Regent University	NSF
Melissa Sherman-Bennett (F)	Bard College	NSF
Shashwat Silas (M)	Brown University	Outside Funding*
Paxton Turner (M)	Louisiana State	NSF
Yuhuai Wu (M)	University of New Brunswick	Outside Funding

*UTRA funded with stipend of $3,500.

In addition to the 18 undergraduate researchers and 2 faculty organizers, 4 teaching assistants were key members of the Summer@ICERM program: Tarik Aougab, Yale University graduate student, Sanya Pushkar, UMD graduate student, Emmanuel Tsukerman, UC/Berkeley graduate student, and Quang Nhat, Brown University graduate student

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":
"The final student presentations: they were the culmination of all the groups' work over the summer. Of course it was great to see my own groups presenting their results to their peers, but I greatly enjoyed seeing the other organizers' groups too, since I was not as familiar with all of their progress."

"It has been a wonderful and productive 8 weeks, and the students have worked hard, they were bright, and the whole program has been quite successful. I would say that of our 6 student groups, all of them have come up with publishable results. It was a pleasure to work with everyone, and I felt that the interactions were essentially always positive."

Summer@ICERM Participant Comments for "Describe the highlight of this program":
"Giving my final talk; it showed me that I was actually quite knowledgeable about my research field, that I could format a talk that kept viewers attention, and present a difficult research area so that a general audience could understand it."

"Two highlights of equal importance: (1) the results we obtained in our research and (2) making friends/spending time with all of the participants in the program."

"Definitely the collaboration with my group members."

"The highlight of this program for me was working with peers and the faculty leaders. It was a wonderful experience."

"The highlight of the program was the research process- finding proofs for things we explored and conjectured -and the presentations were a good way to wrap things up and put them into perspective."

"There were a couple things my group conjectured or proved that were not previously considered by other people. The highlight for me was the new discovery."

"The most valuable parts of this experience for me were the conferences, mini courses, and beginning lectures allowing us to become interested in several different specific topics for potential future research. I learned so much every day."

Summer@ICERM TA Comments for "Describe the highlight of this program":
None to report

Participant Selection Process

The "Summer@ICERM" program ran from June 16, 2014 through August 8, 2014 with a cohort of 18 students. Twelve students were funded through the NSF, and three via a Brown University Undergraduate Training and Research Award (UTRA), and three 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 2014 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 2014 Summer@ICERM *ICERM funded* cohort broke down as follows:

	Male	Female
Black	0	0
Hispanic	0	0
American Indian/Alaskan Native	0	0
Asian/Pacific Islands	2	0
White	5	5
Other (specify)	0	0
	7 +	5 = 12 Total

The 6 externally funded students were made up of 2 Asian/Pacific Islander (1 male and 1 female), and 4 white males.

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 30 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 these final presentation PDFs can be found at: https://icerm.brown.edu/summerug_2014/.

- "Equality of Dedekind sums" by Y. Chen, N. Dunn, C. Hewett, and S. Silas
- "Computation and analysis on Reinhardt polygons with multiple distinct prime divisors" by M.Feldman, R.Kenyon and J.Liu
- "Equidecomposability and period collapse" by P.Turner and Y.Wu
- "Will it k-tile? Structural aspects of polytopes and lattices in multiple tiling" by A.Dunlap, A.Mihai, D.Nguyen and M.Sherman-Bennett
- "Complex Pisot numbers and Newman multiples" by Z.Blumenstein, A.Lamarche and S. Saunders
- "Advances in possible orders of circulant Hadamard matrices and sequences with large merit factor" by J.Hu and B. Logan

Talks were also given by Alicia Lamarche and Zach Blumenstein:

- "Covering Systems of the Integers" by A.Lamarche
- "The Incompleteness of Arithmetic and Systems that Contain It" by Z.Blumenstein

Completed Student Projects

Links to these completed student project PDFs can be found at: https://icerm.brown.edu/summerug_2014/.

- "Conditions for Discrete Equidecomposabilty of Polygons" by P.Turner, Y.Wu. Preprint.
- "Discrete Equidecomposabilty and Ehrhart Theory of Polygons" by P.Turner, Y.Wu. Preprint.

Expanding Summer@ICERM

ICERM will continue 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.

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. ICERM has made several important advances in evaluation procedures since that first workshop, ranging from transitioning from paper to on-line surveys, to fine-tuning the survey questions, to determining how to use the data collected.

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). To help reach these goals the institute developed the following task list:

1. Hire an external evaluator,
2. Ensure all ICERM surveys are consistent and capture all relevant indicators,
3. Transition to a more sophisticated survey tool,
4. Embed unique identifiers in every survey,

5. Measure impact of programs across subgroups, and
6. Measure long-term outcomes.

External evaluator

ICERM augmented its internal evaluation efforts by hiring SRG, an external evaluation company. This addition to the ICERM evaluation team was the first important step towards reaching its larger-scale evaluation goals.

More consistent surveys

SRG reviewed all of ICERM's pre and exit program surveys. Their subsequent recommendations have ensured all institute surveys are similar in length and style. SRG also helped to define the questions that were best for tracking ICERM's impact on research and career growth over time, and ensured they were incorporated into every survey. These improvements will aid in streamlining the reporting-out and analysis of results.

Better survey tool

SRG used their expertise to create more customizable surveys using Qualtrics Research Suite. Qualtrics replaced the rudimentary Google Doc "Forms" ICERM had been using. Qualtrics includes the ability to link multiple surveys (e.g., pre, post, and long-term follow-up) to each participant in order to track satisfaction and impact over time. Qualtrics provides myriad functions for customization, including the ability to create more complex logic patterns, engage in an in-survey data analysis tool for preliminary reports of survey data, and create automated reports.

Unique identifiers

Next, SRG created a participant identifier system within ICERM's surveys that merges and embeds the existing unique identification number assigned to each participant when his or her application to ICERM is created. This identification number will allow a participant's evaluation of (potentially) multiple programs to be tracked across multiple surveys while connecting responses to initial application data (e.g., demographics). By tracking particular variables of interest across participants and over time, ICERM can 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.

Providing each participant with a unique identification number also allows ICERM to create surveys that are customized to a single participant instead of distributing a broad and generalized survey to all participants. By using Qualtrics' panel function, participants are able to receive a survey specific to their experiences at ICERM. An example of how customized surveys are starting to be 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 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 will be useful in understanding how influential ICERM programs are to one's research career long-term.

Finally, every survey ICERM sends to participants has the following confidentiality statement: *"It is important to note that ICERM maintains the strictest standard of confidentiality with all information provided by its participants. Responses are not shared or reported in any way outside of ICERM that is personally identifiable without your explicit permission."*

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 is 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

The largest and possibly most exciting change to ICERM's evaluation procedures is the addition of intermediate- (i.e., two-year) and long-term (i.e., five-year) follow-up surveys administered to program participants. Using the unique identification numbers and in-survey data analyses (as outlined above), these surveys aim to 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.

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.

Most significantly, ICERM played, and will continue to play, a large role in gathering and updating participant information for the customized intermediate- and long-term surveys. Specifically, one question in both the two- and five-year follow-up surveys 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 to include in both the two- and five-year surveys. Additionally, before implementing each survey, ICERM is involved in editing and testing the survey in order to have an end product that will most effectively provide data aligned with its goals.

Note: Appendix I shows results of the institute's first 2-year follow-up survey, sent to long-term visitors who attended the Fall 2011 and Spring 2012 semester programs (see pages 1-20), as well as links to exit survey summaries for all of the 2014-2015 core programs hosted to date.

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 2014 and spring 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 J for a list of projects initiated at ICERM in 2014-2015.

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
- 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 $51,875 in academic sponsorship funds.

Academic sponsors include:

- Cornell University, Department of Mathematics
- Georgia Tech, School 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. Brown also provides an annual seed fund from the office of Vice President of Research through the institute's first 5 years. This year Brown gave ICERM over $100,000 ($75K of which is the university operating budget).

Other Funding Support received in 2014-2015

Additional Grants	**Amount**

Mathematical Association of America (for GirlsGetMath@ICERM)	$ 6,000.00
CAREER Grant	$29,650.00
Sub-total	$35,650.00

University Funding Support	
University Research Committee	$75,000.00
VP of Research Support (Seed Fund)	$30,000.00
Supplemental Administrative Costs	$30,058.81
Brown UTRA Program for Summer@ICERM	$10,500.00
Sub-total	145,558.81

Sponsor Support	
Academic Sponsors	$15,500.00
Corporate Sponsors	$ .00
Sub-total	$15,500.00

TOTAL	$196,708.81

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. In 2014, she volunteered to chair 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 Event in 2014-2015

- **2014 Modern Mathematics Workshop at SACNAS**
  October 15-16, 2015
  ICERM participated in this event in Los Angeles, CA

Other Activities

- 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 (May 1, 2014 through April 30, 2015)

EPSCoR State	# of ICERM Participants
Alabama	4
Alaska	0
Arkansas	0
Delaware	5
Guam	0
Hawaii	0
Idaho	1
Iowa	3
Kansas	1
Kentucky	2
Louisiana	9
Maine	2
Mississippi	0
Missouri	2
Montana	0

Nebraska	0
Nevada	1
New Hampshire	5
New Mexico	3
North Dakota	2
Oklahoma	1
Puerto Rico	1
Rhode Island	60
South Carolina	2
South Dakota	0
Tennessee	13
US Virgin Islands	0
Utah	3
Vermont	0
West Virginia	0
Wyoming	1
Total	**121**

Administration and Staff
ICERM Directors funded by the grant are: Jeffrey Brock, Jill Pipher, and Bjorn Sandstede. 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 (the fourth PI on the grant) receives no financial support from the grant and volunteers his time for special projects at ICERM. Sergei Tabachnikov (Penn State) and Homer Walker (WPI) serve as Deputy Directors, each at 50% time, with appointments starting July 2013.

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.

Isani Cayetano, Technical Support Coordinator (hired in July 2011): 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). Besides support of the scientific research activities at the Institute, responsibilities include support of administrative IT and A/V equipment. Hires student employees as needed to assist with lecture capture and editing.

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.

Katie Droney, Financial Coordinator (hired in 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.

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.

Nicole Henrichs, Program Coordinator (hired in September 2011): reports to the Program Manager. Is the first point of contact for program participants, including scholars, students and visitors. Major responsibilities include front desk coverage, program evaluation distribution, event/visitor and administrative support.

Danielle Izzi, Administrative Assistant (hired May 2014): reports to both the Program and Financial Managers. Acts as receptionist/concierge and assists with basic event set-up and financial support, including processing reimbursement requests..

Brian Lavall, Events Support Technician, (part-time, hired April 2014): reports to the Director of IT. Provides A/V support for the institute's workshops and events, including teleconferences. Monitors and actively controls the Echo 360 lecture capture system and provides first level support for technical issues such as wireless connectivity and printing.

Bernadette McHugh, Web Content Editor (part-time, 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 marketing materials for distribution; coordinating special events; hiring and training student employees as needed to assist with event prep and administrative support.

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 is a Fellow of the American Mathematical Society and is a 2015 member of the American Academy of Arts and Sciences.

Jeffrey Brock is Professor and Chair of mathematics at Brown University. 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 has stepped down as Deputy Director beginning January 2013, when he became chair of the Mathematics Department at Brown.

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.

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.

Sergei Tabachnikov is a professor of mathematics at Penn State University, and will begin his term as an ICERM Deputy Director in June 2013. He became Chair of ICERM's Education Advisory Board (EAB) in May of 2015. Tabachnikov works in geometry, topology, and dynamics. He combines theoretical research with computer experiments. He (co)authored several books including "Mathematical Omnibus," a collection of 30 lectures on classic mathematics. Tabachnikov is the Director of the NSF-funded semester-long MASS (Mathematics Advanced Study Semesters) Program at Penn State. He is the Notes Editor of the American Mathematical Monthly, a column editor of the Mathematical Intelligencer, and the Editor-in-Chief of Experimental Mathematics. He has held visiting positions at mathematical institutes worldwide: IHES, ETH Zurich, I. Newton Institute Cambridge, MSRI, Max-Planck-Institut, Hausdorff Institute Bonn, Fields Institute. Tabachnikov is a Fellow of American Mathematical Society.

Homer Walker began his term as an ICERM 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 recently completed a twelve-year term as 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 (since 1992), 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 7, and the client machines are thin clients using a thin version of Debian. 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. In the next grant cycle, we will add a participant forum to allow for social interaction for past, current, and future participants.

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 Echo 360 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, eighteen 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 is also making new services available to ICERM participants in the coming year, including access to consultants for code creation and optimization and a new immersive display environment.

APPENDIX:

Appendix A: Sample Semester Schedule & Organizer Timeline
Appendix B: Fall 2014 Research Cluster Report
Appendix C: Upcoming Programs and Events
Appendix D: Organizers' Report: 21st Century Workshop
Appendix E: Minutes from Board of Trustees Meetings
Appendix F: Minutes from Scientific Advisory Board Meetings
Appendix G: Minutes from Education Advisory Board Meeting
Appendix H: MIDs Meeting Minutes
Appendix I: 2-Year Follow-up Survey '11-'12/Survey Summaries '14-'15
Appendix J: Projects Initiated at ICERM 2014-2015

NSF Required Materials Available in the Appendix

Appendix K: ICERM Participant List and Summary Table
Appendix L: ICERM Financial Support List
Appendix M: ICERM Income and Expenditure Report
Appendix N: VI-MSS Income and Expenditure Report