

# Your NSF Mathematical Sciences Institutes<sup>1</sup>

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The US NSF Mathematical Sciences Institutes represent a wonderful resource for the mathematics community. In this article we describe the seven US institutes supported by NSF: American Institute of Mathematics (AIM), Institute for Advanced Study (IAS), Institute for Mathematics and its Applications (IMA), Institute for Pure and Applied Mathematics (IPAM), Mathematical Biosciences Institute (MBI), Mathematical Sciences Research Institute (MSRI), and Statistical and Applied Mathematical Sciences Institute (SAMS), as well as the Banff International Research Station (BIRS) in Canada that is supported by Canada, the US, and Mexico. Links to the pages of all the institutes can be found at <http://mathinstitutes.org/>.

In this article, we emphasize opportunities to organize or participate in week-long research workshops offered by all of these institutes. Participants are typically provided with support for local expenses and in some cases travel funds are available. Although it is generally expected that one or more of the organizers be US citizens (and in the case of BIRS, one or more be Canadian citizens), participants are usually invited from all over the world. In addition to workshops, many of the institutes have many other programs for researchers, graduate students, undergraduates, industry, and the public; we will only briefly and partially mention such programs in this article. Any of these programs can be highly stimulating to research.

While all the institutes offer workshops, there are substantial differences in suitable topics for proposals. Some of the institutes have a particular institutional focus (for example, SAMS emphasizes statistics) or a different theme each year with most workshops related to the theme. Also, many of the institutes have some form of university membership and some special programs are restricted to faculty and students at member universities.

The websites for AIM, IMA, IPAM, MSRI, SAMS and BIRS all make it easy to find out how to propose activities; AIM, IPAM, MSRI and BIRS have links for proposers on their main page; IMA and SAMS have such links on the “Programs” page.

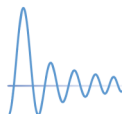
Many of the institutes have been supportive of linear algebra and offer excellent access to research support. IMA, AIM, and BIRS are of particular interest to ILAS members. IMA hosted a linear algebra year in 1991-1992 organized by R. A. Brualdi, G. Cybenko, A. George, G. Golub, M.B. Luskin, and P. Van Dooren (see <http://www.ima.umn.edu/programs/annual/1991-1992.html>), sponsored the Topics in Linear Algebra Conference at Iowa State University (ISU) in 2002, and will offer a graduate summer program in linear algebra and applications to be held at ISU in 2008 (see <http://www.ima.umn.edu/2007-2008/PISG6.30-7.25.08/>). Both AIM and BIRS have hosted workshops in aspects of linear algebra, including the 2006 AIM workshop “Spectra of Families of Matrices described by Graphs, Digraphs, and Sign Patterns” (<http://aimath.org/pastworkshops/matrixspectrum.html>) and the 2004 BIRS 2-day workshop “Directions in Combinatorial Matrix Theory” ([http://www.birs.ca/birspages.php?task=displayevent&event\\_id=04w2525](http://www.birs.ca/birspages.php?task=displayevent&event_id=04w2525)).

We will now briefly discuss each institute separately.

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<sup>1</sup> The opinions expressed are those of the authors, not those of ISU, NSF, or any of the NSF Mathematical Sciences Institutes.

<sup>2</sup> Full disclosure: The authors have much more experience with some of the institutes than with others. Over the past ten years, as a professor of mathematics at Iowa State University, Leslie Hogben has proposed, organized, and/or participated in programs at IMA (3), AIM (2), and BIRS (2); in fall 2007 she also became the Associate Director for Program Diversity of AIM. Jason Grout participated in four MSRI programs and one AIM workshop while a graduate student at Brigham Young University.



**American Institute of Mathematics (AIM)** <http://www.aimath.org/>

AIM was founded in 1994 with support from Fry's Electronics and became an NSF supported institute in 2002 (Fry's continues to be a major sponsor). Since its founding, AIM has emphasized mathematicians working in groups to solve hard problems.

AIM hosts 15-25 five-day workshops per year in all areas of mathematics. The workshops are fully funded (travel as well as local expenses) for up to 32 participants. The deadlines to propose a workshop are Nov. 1 and May 1 each year, and organizers are encouraged to consult with AIM staff when developing a proposal; see <http://www.aimath.org/research/workshopproposals.html> for more information. Workshops are held throughout the year. Eight participants are selected through an on-line application process (the organizers invite 24 participants). The deadline to apply to participate in a workshop depends on the date of the workshop; see <http://www.aimath.org/research/upcoming.html> for a list of upcoming workshops.

AIM workshops are quite different from those usually offered by other programs. Far fewer talks are given and the participants spend much of their time doing research in small groups. The AIM staff have extensive experience with this unusual format and advise the organizers throughout the process. After the workshop a website of information is created to disseminate results.

AIM also offers support for small research groups called SQuaREs, hosts long-term projects, such as the one that led to the determination of all the representations of  $E_8$  and another that led to the resolution of the perfect graph conjecture, supports post-docs, and provides outreach activities to the local community.

Advice for ILAS members: AIM workshops, with their emphasis on doing research in groups during the workshop, are ideally suited to the collaborative style of research practiced by many linear algebraists. AIM is also one of the most accessible of all the institutes, with no annual theme and no membership requirements.



**Institute for Advanced Study (IAS)** <http://www.math.ias.edu/>

IAS is the oldest of the institutes and encompasses science as well as mathematics. Unlike the other institutes, it has its own permanent faculty, as well as members, short-term visitors, and post-doctoral fellows. IAS has year and semester-long programs (see <http://www.math.ias.edu/pages/activities.php> for a current schedule), but at all times a wide range of mathematical activities take place.

Advice for ILAS members: Park City Math Institute (PCMI) <http://pcmi.ias.edu/>, which is part of IAS, hosts education activities that may be of interest - for example, the 1998 PCMI program for undergraduate faculty was on linear algebra.



**Institute for Mathematics and its Applications (IMA)** <http://www.ima.umn.edu/>

Founded in 1982, IMA was one of the first two NSF Mathematical Sciences Institutes and has an emphasis on interdisciplinary research involving mathematics related to challenging problems in science and industry. IMA pioneered the formal involvement of industry throughout its programming, from IMA industrial post-docs to Participating Corporations.

IMA hosts 5-15 workshops each year, mostly related to the annual theme (in 2008-2009 the theme is Mathematics and Chemistry). Workshops related to the annual theme are organized in conjunction with the planning for the theme year; others can be proposed as hot topics. For all workshops, some participants are long-term visitors to the IMA, others are invited for the workshop, and some apply through the on-line application process; see <http://www.ima.umn.edu/docs/application.php> for

more information. As part of the application process, visitors may apply for support (local and/or travel expenses).

IMA has both academic partners (Participating Institutions, called PIs) and industrial partners (Participating Corporations, PCs). Faculty, staff, and students at PIs and PCs enjoy preference for funding for participation in IMA activities, and some programs are restricted to people affiliated with PIs and PCs. IMA also offers a variety of other programs, including long-term memberships for individuals in conjunction with the annual theme and programs specifically for graduate students.

Advice for ILAS members: IMA has an applied focus that makes it particularly attractive to those in numerical or applied linear algebra. Over the years IMA has sponsored several programs relating to linear algebra and applications. If you have one specific topic in mind, the chance that it will be suitable for an IMA workshop in a specific year is not great, but there are a variety of programs available at any time, and often some have connections to some aspect of linear algebra (this is especially true for those at PIs, who have more IMA programs available).



**Institute for Pure and Applied Mathematics (IPAM)** <http://www.ipam.ucla.edu/>

IPAM emphasizes connections between mathematics and other sciences. Each year IPAM offers two one-semester programs. Each program begins with tutorials, followed by 3-4 workshops, and culminates in a “Oberwolfach-like workshop.” In addition to workshops associated with the long programs, IPAM hosts workshops on a variety of topics throughout the year.

Advice for ILAS members: IPAM accepts workshop proposals unrelated to the long programs, and a workshop with an applied linear algebra focus would be appropriate for IPAM.



**Mathematical Biosciences Institute (MBI)** <http://www.mbi.osu.edu/>

The Mathematical Biosciences Institute at Ohio State University focuses on the mathematical theory, statistical methods, and computational problems in the biosciences. Activities include year-long emphasis programs, week-long workshops, and summer undergraduate programs. Partial support is available for long-term visitors (see <http://www.mbi.osu.edu/forms/visitorapplication.html>). Full and partial support for three-year postdocs is also available (see <http://www.mbi.osu.edu/postdoctoral/postdoctoral.html>).

Advice for ILAS members: The modeling and computational investigations of this institute may interest ILAS members.



**Mathematical Sciences Research Institute (MSRI)** <http://www.msri.org/>

MSRI was founded in 1982 and is funded primarily by NSF and other government agencies, industry, foundations, and participating institutions. MSRI hosts year-long and semester-long programs (usually more than one at the same time) as well as several shorter workshops (three days to two weeks) and summer graduate-student workshops each year. Proposals for a semester-long or year-long program are generally submitted three years in advance. Proposals for a week-long workshop are generally submitted 1.5-2 years in advance. Additionally, a “Hot Topics” week-long workshop in the spring is selected from proposals submitted by November 1 of the previous year. Information on submitting proposals for any of these programs is at <http://www.msri.org/propapps/>. A list of upcoming activities is available at <http://www.msri.org/activities>.

MSRI offers full or partial support to researchers and postdocs for the semester or year programs, but also offers support for a few appointments outside of the themes for the year. Also, for member institutions, MSRI offers full support for three graduate students to attend a summer workshop. These

workshops provide a rich educational and research experience for graduate students.

MSRI videotapes many lectures given at the facility and makes them freely available on the web (see <http://www.msri.org/communications/vmath>). Available recordings include lectures from workshops and other special occasions.

Advice for ILAS members: MSRI accepts workshop proposals that are not related to the yearly or semester programs. Many past and future programs at MSRI involve algebra, combinatorics, and computation, so may also be of interest.



**Statistical and Mathematical Sciences Institute (Samsi)** <http://www.samsi.info/>

Samsi, a partnership of several universities and organizations, emphasizes statistics and is located in North Carolina. Year-long programs and workshops are hosted (see <http://www.samsi.info/programs/> for the current programs). Proposals are generally submitted in September two years before the program starts (see <http://www.samsi.info/programs/programssought.shtml>). Full or partial support is provided for visiting researchers, postdocs, and visiting graduate students. Information on these positions is available at <http://www.samsi.info/opportunities/>.

Advice for ILAS members: There have been recent programs investigating linear algebra (e.g., “Random Matrices” in 2006-2007, <http://www.samsi.info/programs/2006ranmatprogram.shtml>). Programs will naturally emphasize applications and connections to statistics.



**Banff International Research Station (BIRS)** <http://www.birs.ca/>

BIRS is the newest of the institutes discussed here; it was founded in 2001 and began the operation of its workshops in 2003. Located at the Banff Center, BIRS is modeled on Oberwolfach; the physical setting, nestled in the mountains, is spectacular.

BIRS is jointly supported by Canada’s NSERC, the US NSF, Mexico’s National Council for Science and Technology, and Alberta’s Science Research Authority. Workshops are the main program of BIRS, which operates 44-48 workshops each year for up to 42 participants (in some weeks two 20-person half workshops are offered). BIRS provides housing and all meals for participants. There is no annual theme and the deadline to propose a workshop is Oct. 1 each year (more than a year in advance – Oct. 1, 2008 for 2010); see <http://www.birs.ca/applicants/guidelines/> for more information. BIRS hosts workshops in all areas of mathematics throughout the year (except mid-December to mid-January). BIRS does not have member universities, but is affiliated with the Canadian institutes Pacific Institute for the Mathematical Sciences (PIMS) and Mathematics of Information Technology and Complex Systems (MITACS), the U.S. MSRI, and the Mexican Instituto de Matematicas (IM-UNAM).

BIRS also offers some 2-day workshops and space for smaller groups of researchers (Focused Research Groups and Research in Teams).

Advice for ILAS members: BIRS is one of the more accessible institutes since it has no annual theme and operates the largest number of workshops. It is suitable for all areas of linear algebra. Potential organizers should also consider other BIRS programs, such as 2-day workshops and small groups.

These institutes provide a valuable and accessible resource for organizing and attending workshops and other programs in linear algebra.