Newest NSF Institute Opens Its Doors

On August 5, 2000, the Institute for Pure and Applied Mathematics (IPAM) held its official inauguration. Located on the campus of the University of California, Los Angeles, IPAM joins the Mathematical Sciences Research Institute in Berkeley and the Institute for Mathematics and its Applications at the University of Minnesota as the newest of the mathematics institutes funded by the National Science Foundation (NSF). The main purpose of IPAM is to foster interactions between mathematicians and scientists in other disciplines. IPAM's first scientific program, on the mathematics of functional genomics, began in September 2000.

The scientific flavor of IPAM was illustrated in two lectures presented during the inauguration ceremony. One of the speakers was Michael E. Phelps, director of UCLA's Crump Institute for Biological Imaging and one of the inventors of the PET (positron emission tomography) scan, which is a three-dimensional image reconstruction technique based on the Radon transform. Phelps discussed the use of PET scans in anatomical and molecular diagnoses of diseases. He noted that a recent application of mathematics resulted in a 30-percent improvement in the resolution techniques used in PET scans. In the second lecture I. M. Singer of the Massachusetts Institute of Technology discussed interactions between mathematicians and physicists in the last fifty years. He noted that the lack of interaction during the 1950s and 1960s meant that it took over twenty years for Yang-Mills theory and geometry to impact each other. Said Singer, "It's sobering to think that there are other subjects where the interplay with mathematics is ripe for development but the mechanisms and contacts between the two are not available." This is why he is "delighted," he said, that IPAM was established to promote such interactions.

Also on display at the inauguration was the strong support of the UCLA administration. One of the main advocates for IPAM has been theoretical physicist Roberto Peccei, who serves as UCLA's interim vice chancellor for research and dean of physical sciences. At the inauguration Peccei described some of what he and the UCLA mathematicians lived through as IPAM came into being. The site visit by NSF representatives was one of the main hurdles. After a "masterful presentation" by the IPAM proposers, Peccei said, the "coup de grace" was showing the site-visit team the building UCLA had promised to provide rent-free to IPAM. The building was designed in 1973 by Frank Gehry, who has since become one of the world's most sought-after architects; one of his recent projects was designing the new Guggenheim Museum in Bilbao, Spain. By coincidence, Gehry appeared on the cover of the *Los Angeles Times Magazine* during the week of the NSF site visit.

IPAM director Tony Chan in his office in the institute building.

IPAM co-director Eitan Tadmor (left) and Mark Green (center) at the IPAM inauguration with another mathematics institute director, Jean-Pierre Bourguignon of the Institut des Hautes Études Scientifiques.

IPAM is run by three UCLA mathematicians: Tony Chan, who serves as director, and Mark Green and Eitan Tadmor, who are co-directors. The three credit Peccei and the UCLA administration with providing the support IPAM needed to win NSF funding. The effectiveness of the administration is also one of the reasons behind the decision by the AMS to hold its main millennium event, "Mathematical Challenges of the 21st Century", at UCLA. The IPAM inauguration took place just prior to the start of "Mathematical Challenges". This meeting, with its emphasis on connections between mathematics and other disciplines, resonated well with the purpose of IPAM. Chan noted that the decision to hold "Mathematical Challenges" at UCLA brought additional attention to mathematics on the campus and added wind to the sails of the IPAM proposal.

Although IPAM is a separate entity from the UCLA mathematics department, it benefits from the fact that the department has strength in both pure and applied mathematics. "We get along very well," remarked Chan. The culture of combining these two facets of the subject was already present at UCLA, he said, so "we didn't have to invent that culture to write the proposal" for IPAM. Of the five principal investigators on the IPAM proposal, three work in applied areas (Chan, Tadmor, and Bjorn Engquist), and two work in pure areas (Green and John Garnett). Green and Tadmor were the founding co-directors of IPAM, and the institute has now made a transition to a more traditional governing structure, with Chan as director.

The main part of IPAM's yearly scientific activity consists of two semester-long programs plus several shorter ones (see sidebar for titles of upcoming programs). Each semester-long program has two streams, one in mathematics and one in another scientific discipline, and is led by two senior mathematicians and two senior scientists from the other discipline. The senior leaders and eight postdoctoral researchers form the "core participants" and are ordinarily in residence at IPAM for the duration of the program. A few others might stay for the whole program, and at any one time there might be twenty-five to thirty short-term participants. Each program culminates in a one- to two-week workshop at a UCLA conference facility at Lake Arrowhead. These workshops are intended to be similar to the meetings held at the mathematics institute in Oberwolfach, Germany. In addition, in order to sustain interactions, reunion conferences will be held one and two years after the end of each program. Topics for IPAM programs are solicited from the mathematical and scientific community, and the directors choose the most promising and appropriate proposals, with advice and input from the Scientific Advisory Board, currently chaired by Peter Jones of Yale University.

Interior of the IPAM building.

The IPAM building has office space for about forty visitors. The building is located in the heart of the UCLA campus, just steps away from the mathematics department, the other science departments, and the medical school. UCLA paid for renovation of the interior of the building to create offices and seminar rooms. There is also an open area designed for mingling, with plenty of blackboard space. Because the mathematics and sciences libraries, as well as the mathematics department reading room, are close by, IPAM has plans for only a small library that will mostly carry books related to the topics of the programs.

Upcoming IPAM Events

Program on Functional Genomics:
September 18–December 15, 2000

Conference on Financial Mathematics:
January 3–12, 2001

Conference on Oscillatory Integrals and Dispersive Equations:
March 19–23, 2001

Program on Geometrically Based Motions:
March 27–June 15, 2001

Program on Conformal Field Theory:
September–December 2001

Program on Communication Networks:
February–June 2002

Institute for Pure and Applied Mathematics
IPAM Building
460 Portola Plaza
Box 957121
Los Angeles, CA 90095-7121

E-mail: ipam@ucla.edu

Phone: 310-825-4755
Fax: 310-825-4756

World Wide Web: http://www.ipam.ucla.edu/

IPAM has funds to pay for travel and local expenses for selected participants, though it is expected that the programs will attract many participants who will come using their own funding. For senior scientists and mathematicians the standard arrangement would be to pay for a teaching replacement at the visitor's home department so that the participant can continue to receive full salary from the home institution. IPAM negotiates these arrangements on a case-by-case basis. Unlike some other mathematics institutes, IPAM does not offer yearlong postdoctoral fellowships; postdocs visit the institute only in conjunction with a regular program. Because the programs last only part of the academic year, having postdocs stay the whole academic year would lead to a lack of continuity in mentorship from the senior mathematicians and scientists associated with the programs and also would not serve IPAM's purpose of stimulating interactions within the program area.

IPAM co-director Green became involved with the development of IPAM partly as a result of his collaboration with an applied mathematician at UCLA, Stanley Osher. The two discussed some geometric problems that arose in Osher's work on crystal growth, and the result was a paper in pure mathematics. "I came to realize there are tremendous opportunities for using pure mathematics in new ways in applications," Green remarked. Pure mathematicians "are sitting on all these beautiful bits of mathematics" that could be very valuable in other disciplines. Identifying and developing those "bits of mathematics" is one of the aims of IPAM. For example, the first IPAM program focuses on functional genomics, an area where there is a need for new mathematical tools for analyzing high-dimensional data. Peter Jones has developed for his work in pure mathematics an algorithm for recognizing when data lies on a lower-dimensional submanifold. He will speak on this work during the genomics program.

IPAM hopes to provide starting points for mathematicians to engage with other fields in order to attract those who have not worked in applied areas before. Green noted that there is "an art to choosing programs" to strike a good balance between considerations of how substantial the mathematics is and how important the scientific problems are. "You are not going to get something out of genomics that leads to invariants of four-manifolds," Green said. On the other hand, the IPAM program on conformal field theory, slated for the fall of 2001, might very well produce such results. Said Green, "How deep an idea is mathematically, and how useful it is—there is a spectrum," and the whole spectrum needs to be nurtured. The mathematical community is a "rich ecosystem" that supports many people doing many different things, he said, and IPAM will reflect that diversity.

IPAM co-director Tadmor noted at the inauguration that right now there seems to be a readiness among mathematicians to participate in interdisciplinary ventures with other scientists. IPAM is in many ways an experiment that will try to capitalize on that readiness. "We don't claim to have a recipe for interdisciplinary research," Tadmor said. "We are just trying to create a good atmosphere where it can happen."

—Allyn Jackson