Department of Physics

The Department of Physics continues to be one of the largest and most successful physics departments in the world, with 75 tenure-track faculty slots. Because physics covers so many areas, the department has four divisions: astrophysics; atomic, biophysics, condensed matter, and plasma physics; nuclear and particle theory; and nuclear and particle experiment. The strength of the department comes from its unwavering devotion to both research and teaching. Together, the Physics Department's faculty and alumni have won 14 Nobel prizes; 20 faculty members are National Academy of Science members and two faculty are MacArthur Fellows.

Faculty Count, Promotions and Departures

At the end of FY2010, the Physics Department consisted of 71 faculty members: 46 full professors, 13 associate professors, and 12 assistant professors. As of July 1, 2010, the department will have four open slots, with one of those committed to a junior faculty offer in astrophysics.

Ray O'Neal, Jr., of Florida A&M University, was Martin Luther King, Jr. visiting professor of physics for the 2009–2010 academic year.

Seven faculty members were promoted this year. Jan Egedal-Pedersen, Steven Nahn, Joseph Formaggio, and Marin Soljacic were promoted to associate professor without tenure, Scott Hughes and Hong Liu were promoted to associate professor with tenure, and Christoph Paus was promoted to full professor.

The 2010 faculty search process resulted in an acceptance of an assistant professorship in astrophysics by Nevin Weinberg. Weinberg's appointment will begin on July 1, 2011.

Saul Rappaport retired, effective June 30, 2010. This year we lost two beloved faculty members to cancer. Richard Yamamoto passed away in October 2009, and Michael Feld passed away in April 2010. They will long be remembered by colleagues and students.

Administration

Edmund W. Bertschinger will continue as department head.

Krishna Rajagopal became the associate department head effective September 1, 2009.

The Physics Council membership will remain as follows:

Ed Bertschinger—department head

Krishna Rajagopal—associate department head

Deepto Chakrabarty—division head, astrophysics

Patrick Lee—division head, atomic, biophysics, condensed matter, and plasma physics

Peter Fisher—division head, experimental, nuclear, and particle physics

Eddie Farhi—division head, center for theoretical physics

Richard Milner—laboratory director, laboratory for nuclear science

Jacqueline Hewitt—laboratory director, Kavli Institute for Astrophysics and Space Research

Matthew Cubstead—administrative officer

Jacqueline Hewitt was reappointed as director of the Kavli Institute for Astrophysics and Space Research.

Faculty Honors

Many honors and awards were conferred on faculty members during the 2010 academic year.

Allan Adams and John McGreevy won the School of Science Undergraduate Teaching Award.

David Pritchard won the Earll M. Murman Award for excellence in undergraduate advising.

Martin Zwierlein won the 2010 Young Investigator Award from the Office of Naval Research and the 2010 Young Investigator Award from the Air Force Office of Scientific Research.

Joshua Winn was awarded the Class of 1942 Career Development Professorship.

Senthil Todadri was named Outstanding Young Physicist by the American Chapter of the Indian Physics Association.

Krishna Rajagopal was named a MacVicar Faculty Fellow. Pablo Jarillo-Herrero won the David and Lucille Packard Fellowship.

Mildred Dresselhaus won the 2010 American Chemical Society Award for Encouraging Women into Careers in the Chemical Sciences.

Education

A total of 235 students pursued an SB degree in physics and 80 SB degrees were awarded. Of the degree recipients, 77 percent chose the flexible degree option. The flexible option was introduced in academic year 2001 to allow students to develop a strong foundation in physics and then to build on this foundation as they prepare for career paths that may not involve a graduate degree in physics. This option remains attractive today in light of the growing spectrum of technology-related career opportunities. Some 30 percent of our graduating seniors earned dual degrees; 19 percent of degree recipients were nominated to Phi Beta Kappa.

A total of 236 students pursued graduate degrees in physics; 44 PhD and two SM degrees were awarded. The 2010 admissions cycle for graduate students continued to be very competitive. Offers of admission were made to 88 applicants, 17 of whom were women. Yield rates were very high: 43 percent in general and 50 percent among admitted women.

Diversity

Diversity is a consideration at all levels: undergraduate; graduate; postdoctoral; and faculty. The Physics Department uses multiple strategies to recruit women and members of underrepresented minorities at all these levels.

The percentage of female physics majors increased significantly after the introduction of the flexible SB option in 2001. Currently about 34% of undergraduate physics majors are women, compared with a national average of 22% reported by the American Institute of Physics in 2005.

In January 2011, MIT will act as one of four simultaneous hosts for the sixth annual Conference for Undergraduate Women in Physics. The goals of the conference are to help motivate young women, and to provide resources for them, to apply to graduate school in physics or related disciplines, and to make undergraduate women in physics more aware of the wide range of career opportunities available. It is hoped that hosting this event will continue to show that the department views diversity as being important.

At the graduate level, a faculty member is assigned to oversee diversity efforts in graduate recruitment. This faculty member, along with the graduate admissions coordinator, reviews all minority applications in the candidate review. The department subsequently funds all travel expenses for accepted North American applicants from underrepresented minorities who choose to visit the MIT campus.

Several faculty members, including the department head, participated in Campus Preview Weekend and supervised students in the MIT Summer Research Program (MSRP). We plan to begin recruitment of physics students through MSRP, a program that brings promising college juniors and seniors to MIT for summer research, mentoring, community building, and graduate school preparation. This summer there were nine students in MSRP working with physics faculty or staff, including in the Laboratory for Nuclear Science.

To assist further with the recruitment of graduate students from underrepresented groups, the department is developing a PhD bridge program. As part of this endeavor, in June 2010, three MIT physics faculty (Krishna Rajagopal, Enectali Figueroa-Feliciano, and the department head) attended the APS Minority Bridge Program Workshop, where they discussed plans and broadened the department's network of contacts with institutions that primarily serve members of minority groups.

Throughout the recruitment process, the department advertises in diversity and organizational job boards and publications. Recruiting women and members of underrepresented minorities to the physics faculty and retaining them continue to be high priorities.

Research Highlights

Joshua Winn led one of two teams of astronomers that found a planet outside the solar system that might be orbiting backwards compared with its star's rotation, a discovery that could shed light on how unique the relatively perfect alignment of our solar system is, compared with that of other planetary systems.

Alexander van Oudenaarden began leading the Physical Science-Oncology Center, which was created by a five-year grant from the National Cancer Institute. The center will take nontraditional approaches to cancer research, using the principles and techniques from physics to help understand the evolution of cancer and to unravel cancer's complexity.

Tali Figueroa-Feliciano and his group members reported possible evidence of two dark matter particles in a detector located in a former iron mine in Minnesota.

Wolfgang Ketterle and David Pritchard observed ferromagnetic behavior in an atomic gas, addressing a decades-old question of whether it is possible for a gas to show properties similar to those of a magnet made of iron or nickel. If confirmed, the result may enter the textbooks on magnetism, showing that a gas of elementary particles known as fermions does not need a crystalline structure to be ferromagnetic.

Bernd Surrow reported on new results from the STAR experiment at the relativistic heavy ion collider at Brookhaven National Laboratory that provide a better understanding of the internal structure of the proton. His research established the different polarization patterns of up and down quarks that are consistent with fundamental calculations within the standard model of particle physics. This new technique should allow for direct sensitivity to the polarization of antiquarks.

Robert Jaffe led a team of researchers that showed that universes quite different from ours still have elements similar to carbon, hydrogen, and oxygen, and life forms quite similar to our planet's could therefore evolve, or have evolved, even when the masses of the elementary particles are dramatically altered.

PhD students Alexander McCauley and Alejandro Rodriguez, working with faculty member John Joannopoulos, found a way to calculate the effects of Casimir forces, thereby offering a way to keep micromachines' parts from sticking together.

Ernest Moniz led a team of researchers at MIT that issued a report titled "The Future of Natural Gas." The report urges US lawmakers to find ways to use more of the nation's supply of natural gas, and to place higher economic costs on greenhouse gas emissions to help flatten demand in the electricity sector.

Pappalardo Fellows

Neil Pappalardo has made possible a program in the department to attract recent PhDs of exceptional promise. The purpose of the Pappalardo Fellowships in Physics is to identify and support unusually talented young physicists and to give them the opportunity to pursue research of their own choosing. The Pappalardo Fellows have

complete freedom in their choice of research and are matched with a mentor chosen on the basis of their research interests. Fellows have special status in the department and are invited to attend faculty events. The first three Fellows arrived in September 2000; since then the program has supported 35 Fellows. About 35% of all Pappalardo Fellows have been women, and the program has proved to be a strong source for faculty recruiting; five members have joined the Physics Department, including two women, Gabriella Sciolla and Jocelyn Monroe.

Community/Upcoming Events

The Physics Department strives to create a community of scholars and endeavors to create opportunities for our faculty, students, and alumni to come together to share and explore ideas. The following events are designed to foster the exchange of ideas:

- Faculty lunches are held each week during the fall and spring semesters. All faculty are invited to join their colleagues for an informal meal and to hear a talk from one of their colleagues on their research.
- An afternoon colloquium series is held each week at which a physicist, often from outside MIT, is invited to give a talk on a topic of interest. This event is open to the MIT community. These talks are digitized and then made available to MIT physicists and students who are unable to attend the colloquia.
- Twice a semester alumni are invited to a breakfast to hear about physics research being done by one of our outstanding faculty presenters.
- The Pappalardo Fellowship program sponsors a weekly lunch that brings Pappalardo Fellows and physics faculty together for conversation.
- In January 2011, MIT will act as one of four simultaneous hosts for the Sixth Annual Conference for Undergraduate Women in Physics (for more detail, see Diversity, above).
- In spring 2011 the department will sponsor a symposium centered on the MIT 150 Year Celebration entitled "Leaders in Science and Engineering: The Women of MIT." The two-day event will celebrate the leadership roles played by MIT women in science and engineering, and will be woven around the landmark 1996 and 1999 reports of the Faculty Committee on Women in Science. The symposium will include talks by outstanding women researchers at the graduate, postdoctoral, and faculty levels. It will also include sessions giving a historical assessment of women in science and panel discussions.

Edmund W. Bertschinger
Professor of Physics
Department Head