

## Department of Physics

The academic year of 2011–2012 was a busy and exciting one for the [Department of Physics](#) MIT's Physics Department is one of the largest university physics departments in the world, with the ability to excel in many subfields. The department is organized into four research divisions: astrophysics; atomic, biophysics, condensed matter, and plasma physics; nuclear and particle theory; and nuclear and particle experiment. Since 2002, the department has been ranked at the top of graduate physics programs by U.S. News and World Report. The strength of the department comes from its unwavering devotion to both research and teaching. Together, the department's faculty and alumni have won 19 Nobel Prizes; 10 current faculty members are National Academy of Science members, and 3 are MacArthur Fellows.

### Faculty Count, Promotions, and Departures

As of June 30, 2012, the Physics Department had 69 appointed, regular-rank faculty members: 43 full professors, 12 associate professors, and 14 assistant professors.

Six faculty members were promoted this year. Enectalí Figueroa-Feliciano was promoted to associate professor without tenure; Joseph Formaggio, Joshua Winn, and Martin Zwierlein were promoted to associate professor with tenure; and Young Lee was promoted to full professor. These promotions took effect July 1, 2012.

Keivin Stassun of Vanderbilt University was a Martin Luther King, Jr., visiting professor of physics for the 2011–2012 academic year.

The 2011–2012 faculty search process was highly successful. Each of the department's divisions conducted a search; the department made five offers and four were accepted. The four new faculty members are William Detmold in quantum chromodynamics (started July 1, 2012), Aram Harrow in quantum information (starting January 16, 2013), and Tracy Slatyer and Yen-Jie Lee in particle physics (starting July 1, 2013). Michael Williams joined the nuclear and particle experiment division on July 1, 2012, after a one-year deferral. The past two years of searches have resulted in nine new junior faculty members, with an acceptance rate of 69%.

George Benedek, Wit Busza, Erich Ippen, Roman Jackiw, and June Matthews all retired effective July 1, 2012, after years of dedicated service to MIT and the department. Sadly, this year we also lost George Koster and Louis Osborne, two of our emeritus faculty members, to cancer. Their many years of contributions helped bring the department to its current state of excellence.

## Administration

Edmund Bertschinger began a second term as department head on July 1, 2012. In 2012–2013, Krishna Rajagopal is taking a one-year sabbatical leave as associate department head for Education. During this time, John Belcher will serve as associate department head for education.

Patrick Lee stepped down as the atomic, biophysics, condensed matter and plasma physics division head after more than 15 years of service in this capacity. His efforts helped strengthen the department and the division. Vladan Vuletic took over these responsibilities on July 1, 2012. The department also added one more member to its Physics Council: Mehran Kardar from the atomic, biophysics, condensed matter, and plasma physics division. This appointment adds strength to the council from the largest of the four departmental divisions.

The Physics Council membership is now as follows:

Edmund Bertschinger—department head

John Belcher—associate department head (AY2013)

Deepto Chakrabarty—astrophysics division head

Vladan Vuletic—atomic, biophysics, condensed matter and plasma physics division head

Mehran Kardar—atomic, biophysics, condensed matter, and plasma physics: member-at-large

Peter Fisher—experimental nuclear and particle physics division head

Edward Farhi—director, Center for Theoretical Physics

Richard Milner—director, Laboratory for Nuclear Science

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

Matt Cubstead—administrative officer

## Faculty Awards

Following are a few of the many awards and recognitions conferred on faculty members during the 2011–2012 academic year:

- Deepto Chakrabarty, Edward Farhi, and Christoph Paus were elected fellows of the American Physical Society.
- John Belcher won the Arthur C. Smith Award, which is presented to a member of the MIT faculty for meaningful contributions and devotion to undergraduate student life and learning at MIT.
- Pablo Jarillo-Herrero and Jesse Thaler received the Presidential Early Career Award for Scientists and Engineers. Jarillo-Herrero was also named to the Mitsui career development assistant professorship.
- Nuh Gedik won an Alfred P. Sloan research fellowship.

- Scott Hughes won a Guggenheim fellowship.
- Walter Lewin was selected as one of America's 300 best professors in all fields covered by the Princeton Review.
- Sara Seager won the Raymond and Beverly Sackler International Prize in Physics and was named a fellow of the American Association for the Advancement of Science.
- Martin Zwierlein was appointed to the Silverman (1968) career development chair and was named an American Physical Society (APS) outstanding referee.
- Mildred Dresselhaus won the Enrico Fermi Award and the Kavli Prize in Nanoscience.
- Edmund Bertschinger won the Institute's Dr. Martin Luther King, Jr. leadership award.
- Hong Liu and Senthil Todadri won the Simons fellowship in theoretical physics.
- Jeremy England was named to the Forbes Magazine list of 30 "rising stars" of science under the age of 30.

### Staff Awards

Erin McGrath, director of development for the department, received the 2012 MIT Excellence Award for her outstanding dedication and service to MIT. This award is given to acknowledge the extraordinary efforts made by members of the MIT community toward fulfilling the goals, values, and mission of the Institute and is among the highest honors awarded to staff by MIT.

### Education

295 students pursued a bachelor of science degree in physics and 83 SB degrees were awarded, 33% of them to women and 13% to members of underrepresented minority groups. Of the graduating seniors, 81% chose the flexible degree option, 42% had more than one major, and 23% were nominated to Phi Beta Kappa.

Graduate degrees in physics were sought by 242 students; 37 PhD and two SM degrees were awarded, including four PhDs to women and four to underrepresented minorities. The 2012 graduate admissions cycle remained highly competitive as the department moved to an all-electronic application, with 754 applications received. Offers of admission were made to 84 applicants, 22 of whom were women. The acceptance rate was 41%.

During the past year, provost L. Rafael Reif launched MITx, an online education platform for open online courses. This was soon extended in partnership with Harvard University to become edX ([www.edxonline.org](http://www.edxonline.org)). The Physics Department will be a major player in this arena, with current plans to launch freshman electromagnetism 8.02x in 2013.

## Diversity

In January 2012, MIT held the Institute Diversity Summit, which was a full-day program that focused on the theme of “diversity and excellence.” The Physics Department head was co-chair of the summit and a member of one of the panels, and one of the department’s postdoctoral fellows helped lead a breakout session. The summit was extremely successful. A similar event will be held in January 2013.

During the 2011–2012 academic year, the Department of Physics hosted 12 undergraduate minority scholars selected by the American Physical Society. This was 29% of all the APS minority scholars nationwide, and many more scholars than were hosted by other institutions.

This year MIT received a grant from the Henry Luce Foundation to support two-year graduate fellowships for women. This should help the department recruit women PhD students who are frequently offered multi-year fellowships by peer universities.

Finally, the department continues to support a wide range of undergraduate groups that help focus on diversity efforts throughout the Institute. The department gave financial support to the MIT Black Students’ Union, the Black Women’s Alliance, the Society of Hispanic Professional Engineers, MAES (Latinos in Science and Engineering), La Unión Chicana por Aztlán (LUChA, an undergraduate group that supports Mexican-American culture) and the Undergraduate Women in Physics organization. The department covered the travel costs for undergraduates who attended the Undergraduate Women in Physics Conference at Yale University in January 2012, and supports other travel by undergraduates, graduates, postdoctoral students, and faculty who attend conferences supporting diversity in physics.

## Research Highlights

Vladan Vuletic and a team of MIT and Harvard University researchers led an experiment that allowed a single photon to control the quantum state of another photon. The result could have wide-ranging consequences for quantum computing and quantum communication, the quantum analog to conventional telecommunications, as was reported in *Science*.

Pablo Jarillo-Herrero was part of an MIT team that found that graphene, an exotic form of carbon consisting of sheets a single atom thick, exhibits a novel reaction to light. Sparked by light’s energy, the material can produce electric current in unusual ways. The research was published in *Science*.

Sara Seager co-authored a paper in *Nature* that detailed the discovery of two new planets some 950 light-years away that are not only the smallest yet detected but also the closest in size to Earth, bringing us closer to the discovery of Earth-like planets capable of supporting life.

Martin Zwierlein led a team of researchers that observed an elusive phase transition: that from a gas into a superfluid, a state where particles flow without any friction. The MIT work, published in *Science*, sheds light on the superconductivity of electrons in metals, including high-temperature superconductors that have the potential to revolutionize energy efficiency.

Anna Frebel was the co-author of a paper in *Astrophysical Journal Letters* that reported the presence of the element tellurium for the first time in three ancient stars. The researchers found traces of this brittle, semiconducting element—which is very rare on Earth—in stars that are nearly 12 billion years old. The finding supports the theory that tellurium, along with even heavier elements in the periodic table, likely originated from a very rare type of supernova during a rapid process of nuclear fusion.

Jeff Gore led a team that used populations of yeast to demonstrate that large amounts of stress can make a population less resilient to new disturbances until a “tipping point” is reached, at which any new small disturbance could actually wipe out the entire population. This research could help wildlife and fishery managers identify warning signs before the total collapse of a species occurs. These findings were published in *Science*.

To end the academic year with a flourish, faculty, research staff, and students from the Department of Physics helped to discover a new particle at the Large Hadron Collider. This particle may be the long-sought Higgs boson, and—even more exciting—it may behave differently than it is expected to, thereby leading to new physics research.

### **Pappalardo Fellows**

The purpose of the Pappalardo fellowships in physics, founded by A. Neil Pappalardo, is to identify, attract to MIT, and support unusually talented young physicists, providing them with 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 45 fellows. Nearly 35% of all Pappalardo Fellows have been women, and the program has proved to be a strong source of the Physics Department’s own faculty recruiting; five fellows have joined the department.

## Community/Upcoming Events

The Physics Department strives to create a community of scholars and endeavors to create opportunities for its faculty, students, and alumni to come together to share and explore ideas. The department sponsors the following events, which are all 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 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.
- Monthly luncheons are held for faculty, postdocs, graduate students, and staff members to discuss broad topics associated with diversity and inclusion.
- Twice a semester, alumni are invited to a breakfast to hear about physics research 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.
- Each fall the department hosts a Distinguished Pappalardo Lecture. In October 2011, the speaker was Adam Riess, an MIT alumnus from the class of 1992. Riess had won the Nobel Prize in physics three weeks earlier.
- During the Cambridge Science Festival each spring, the department holds an Open House— area residents are invited to campus to view our technology enabled active learning classrooms and witness various physics laboratory demonstrations presented by our Technical Services Group.

**Edmund W. Bertschinger**  
**Professor of Physics**  
**Department Head**