PHYSICS

Physicists explore the nature of the physical world and search for improved descriptions and understandings of the structure, laws, origin, and ultimate fate of the universe. Broad in scope, highly diverse, and yet always attendant to the most fundamental aspects of the physical world, physics spans vast ranges in space, time, energy, and other dimensions of nature. Physics encompasses two mutually supporting perspectives: theoretical and experimental. Physics students at Lawrence engage actively in both areas.

Theoretical physics involves the invention and exploration of models and theories of nature, while experimental physics entails investigation of physical systems and provides evaluation and refinement of theory. Increasingly, computation plays a substantial and crucial supporting role in both arenas.

While course work is an important component of the Lawrence physics major, the physics program encourages extensive involvement beyond the curriculum. Majors participate in independent studies, pursue research objectives, and serve as assistants in introductory laboratories. They are issued keys to various student spaces within the department to encourage collaborative intellectual engagements.

Twice weekly, departmental teas attended by students and faculty provide a context for discussion of various topics of current interest. Evening and weekend interactions are frequent and lively.

The size of the department is attractive in several respects. Typically, there are 10–12 senior majors, a similar number of junior majors, and perhaps 15–18 sophomores seriously considering a major. (About 20 percent of these majors are women.) Introductory courses typically draw 35–45 students, with weekly laboratory sections having 16 students. Enrollment in intermediate and advanced courses is usually 10–15. Each year, we graduate 10–12 majors and one or two minors.

CURRICULUM - *The Physics Major*

The physics curriculum at Lawrence focuses on developing a firm understanding of important theories and competence in the application of contemporary experimental techniques. On the theoretical side, majors move from a general survey to more detailed intermediate courses to advanced electives, mixing the study of traditional approaches with the examination of computational approaches to significant problems. On the experimental side, majors learn the basic techniques of data analysis (traditional as well as computer-based), study electronics in an intermediate laboratory, and enroll in a research-oriented advanced laboratory course before joining an ongoing research program.

Typically, physics majors take a two-term introductory sequence in their freshman year and complete the calculus sequence. During the sophomore and junior years, students take a number of intermediate courses in a variety of areas and elect additional courses in specific areas of interest.

The Senior Capstone program is designed to engage seniors in ambitious undertakings custom-tailored to their interests, needs, and career plans. Recent project topics include: non-sequential ionization, equilibrium and stability in toroidal non-neutral plasma, saturated absorption laser spectroscopy, LEGO robots controlled by on-board micro-computers, sonoluminescence, coherent population trapping, and X-ray analysis of phase transitions in liquid crystals.

INTERDISCIPLINARY AREAS

The interdisciplinary major in the natural sciences enables students to construct science majors around subject areas that bridge two or more disciplines in the natural sciences. An interdisciplinary major in the natural sciences requires a primary concentration in biology, chemistry, geology, or physics and a secondary concentration in another of these sciences.

Students interested in majoring in a natural science with a primary focus in physics are required to complete the two-term introductory sequence in physics and two-term introductory sequences in two other sciences. Additionally they take ten intermediate and advanced courses in the sciences, at least five of them in physics and at least three in the secondary emphasis.

SPECIAL OPPORTUNITIES

Collaborative research, in which undergraduates work with faculty members, is a special emphasis of the Lawrence physics program. A Departmental Development Grant — one of only a few such grants made by Research Corporation — supported a recent five-year effort to increase faculty and faculty/student research in connection with the Senior Capstone program. Capstone projects can lead to honors in independent study at graduation, to papers presented by students at national undergraduate research symposia and professional meetings, and to student/faculty publications in professional journals. In addition, the department typically offers four or five ten-week summer opportunities for students to engage full time in a research program directed by a faculty member.

FACILITIES

As a result of a long-standing departmental commitment to providing exceptional facilities and with the help of several outside grants, Lawrence physics majors enjoy access to outstanding experimental and computational resources. Among the facilities are:

- An introductory laboratory equipped with microcomputers and a variety of transducers to facilitate data gathering, analysis, and display.
- An advanced laboratory equipped with modern instrumentation to permit performance of numerous landmark experiments.
- The Lawrence *Laser Palace*, equipped with hundreds of lasers and supporting both course work and independent study in laser physics, atomic physics, and modern optics.
- The Lawrence *Computational Physics Laboratory*, equipped with eight Silicon Graphics workstations that support both course work and theoretical independent research in computational physics, nonlinear dynamics, and chaos.
- The Lawrence *Surface Physics Laboratory*, equipped with a Siemens x-ray diffractometer, four scanning tunneling microscopes, and two atomic force microscopes for studying

the structure and properties of matter. The surface laboratory supports course work and independent research in materials science, condensed matter physics, and liquid crystal physics.
- Versatile and competently staffed machine and electronics shops for on-site construction of specialized apparatus.

Particular strengths in laser and computational physics have been features of the Lawrence program for more than fifteen years; additional emphases in condensed matter physics and plasma physics are emerging as recently appointed members of the faculty establish their special areas. Together, these activities have been supported by various grants to the department that total over $2.5 million dollars in the last decade and a half.

AFTER LAWRENCE

With the appropriate selection of courses and other activities, physics majors are well-prepared for graduate work in various scientific and non-scientific fields, entrance into law and medical schools, secondary teaching, or immediate employment in many sectors of business and industry.

Typically, more than half of our graduates go on to graduate programs in physics or engineering at such places as Harvard, Stanford, Oxford, Columbia, Dartmouth, Rensselaer, Washington University, Colorado, Wisconsin (Madison), Minnesota, California (Berkeley; San Diego), Oregon, Washington, and Stony Brook. There are Lawrence graduates on the faculties at Beloit College, Carleton College, the University of Wisconsin-Madison, Kenyon College, Colorado School of Mines, and Widener College. Others have pursued careers in various industries, secondary school teaching, biomedicine, law, and computer science. Recent graduates and their current activities include:

Steven Hahn, ’05, spent the summer after his sophomore year in an REU program at Coe College and the summer after his junior year in a similar program at Northwestern University. He is pursuing a Ph. D. in condensed matter physics at Iowa State University.

Lauren Kost, ’05, was a research assistant at Lawrence in the summer after her sophomore year and a research assistant at the University of Washington in the summer after her junior year. She is pursuing a Ph. D. in physics at the University of Colorado.

Nicholas Mauro, ’05, spent the summers after his freshman and sophomore years as a research assistant at Lawrence and the summer after his junior year as a research assistant as UCLA. With interests in alternate energy sources, he is pursuing a degree in engineering at Washington University.

Paul Schonfeld, ’05, who pursued the interdisciplinary major in the natural sciences with primary discipline physics and secondary discipline geology, spent summers as a research assistant at the University of Alaska and Michigan Technological University and also did research in Costa Rica. He is working as a programs coordinator at a public access community service television station in Madison, WI.

Matthew Stackpole, ’05, spent the summer after his sophomore year working as a research assistant at Lawrence, the summer after his junior year as an intern with the National Security Agency, and the fall term of his senior year at the Budapest (Hungary) Mathematics Institute. He completed majors in mathematics and physics and is pursuing a Ph. D. in mathematics at the University of Colorado.

Matthew Dietrich, ’04, spent the summer after his junior year as a research assistant at Baylor University and is pursuing a Ph.D. in physics at the University of Washington.

Michelle Milne, ’04, is pursuing a Ph.D. in physics at Washington University. In the summers after her sophomore and junior years, she served as a research assistant at Lawrence and presented her work of the second summer at a national meeting.

Suzanne T. Witt, ’03, who also completed a music major, is pursuing a Ph.D. in medical physics at the University of Wisconsin-Madison. She spent several summers in research appointments at various laboratories, including the Mayo Clinic, and she presented a poster on her work at a major national meeting during her senior year.

Robin Sampson, ’02, completed an M.S. degree in applied physics at Cornell University. She participated in the plasma physics research program for two summers at Lawrence, and she presented a poster at a major plasma physics meeting in San Diego during her senior year.

Cindy Regal, ’01, pursued various research interests, co-authored research articles, and received Luce, Goldwater, and Hertz fellowships. She is pursuing a Ph.D. in atomic physics at the University of Colorado-Boulder.

Paul Kondratko, ’00, co-authored a research publication on phase transitions in liquid crystals, and delivered talks at two professional meetings. He is a Ph.D. candidate in astronomy at Harvard University in the Harvard-Smithsonian Center for Astrophysics.

Erik Brubaker, ’99, spent the summer before his senior year in a research appointment at CERN. He completed his Ph.D. at the University of California-Berkeley, doing thesis work at FermiLab. He is now in a post doctoral position at the University of Chicago.

FACULTY

John R. Brandenberger, Chapman Professor of Physics
Carleton College, B.A.; Brown University, Sc.M., Ph.D.
Interests: atomic physics, laser physics, laser spectroscopy

Jeffrey A. Collett, associate professor
St. Olaf College, B.A.; Harvard University, A.M., Ph.D.
Interests: condensed matter physics, x-ray scattering, phase transitions, critical phenomena, and surface physics

David M. Cook, Philetus E. Sawyer Professor of Science
Rensselaer Polytechnic Institute, B.S.; Harvard University, A.M., Ph.D.
Interests: mathematical physics, computational physics, chaos, physics of musical instruments

James O. Dunn, visiting assistant professor
University of Illinois, B.A.; University of North Carolina, Ph.D.
Interests: cosmology, especially dark energy

Joan Marler, Lawrence fellow in physics
Wellesley College, B.S.;
University of California, San Diego, Ph. D
Interests: atomic physics, antimatter, plasma physics

Matthew R. Stoneking, associate professor
Carleton College, B.A.; University of Wisconsin-Madison, Ph.D.
Interests: non-neutral plasma physics, magnetic confinement of plasmas