DEPARTMENT OF PHYSICS

The Department of Physics offers programs in physics and applied physics which lead to the Master of Science and the Doctor of Philosophy degrees. Active research gives students study opportunities at the forefront of physics. Financial support in the form of teaching and research assistantships is available to qualified students.

RESEARCH

The major areas of research in the department are:

Atomic, Molecular, and Optical Physics

The program is centered on high-resolution laser spectroscopy, nonlinear optics, and laser applications. Specific projects include optical tests of fundamental theories, single atom detection, search for neutrino mass by double beta decay, atom interferometry, manipulation and cooling of atoms using light forces, fabrication of nano-structures with atom lithography, fast-beam laser/radio frequency spectroscopy, studies of high angular momentum Rydberg states, high spectral resolution Lidar measurements of atmospheric parameters and long-term observation of mesopause temperatures for studies of climatic change.

Experimental Condensed Matter and Materials Science

This program encompasses studies of crystalline solids and disordered materials. Included are elemental and compound semiconductors, metals, alloys, magnetic materials, superconductors, glasses, hydrogen-metal systems, quasicrystals, conducting polymers, aggregates, and composites. Experimental investigations include Raman and Brillouin light scattering (BLS), IR-VIS-UV spectroscopy, luminescence, magnetic materials, spin waves, microwave solitons, time and space resolved BLS, ultrasonics, scanning probe microscopy, diamond anvil high pressure cells, x-ray diffraction, elastic and inelastic neutron scattering, preparation and characterization of thin films, and photovoltaic studies.

Experimental High Energy Particle Physics

This program of research in high energy physics involves four major activities: The BaBar experiment at the PEP-II B meson facility at Stanford, Future Linear Collider Detector design (for a next generation accelerator), and a new high-energy astrophysics observatory, the Pierre Auger Project. A common theme of the accelerator-based experiments is to investigate interactions of electrons and positrons over a wide range of energies (from 3-1000 billion electron-Volts) to provide a detailed understanding of the so-called “Standard Model.” For example, the goal of the BaBar experiment is a measure of charge and parity (CP) symmetry violation, which is related to the matter-antimatter

asymmetry of the universe. The Auger project will provide insight into the source of the highest energy cosmic rays ever observed. The Colorado State University group participates in the development and construction of particle detectors and plays a major role in the data analysis for each of these experiments.

Theoretical Condensed Matter and Statistical Physics

Opportunities for theoretical studies include: transport in disordered media; far from equilibrium behavior of statistical systems; electromigration; bulk and surface effects of ion bombardment; nonlinear dynamical systems; chaos and fractals; mathematical physics, lattice dynamics of molecular crystals and crystallites using phonon theories; equations of state of condensed phases; phase transitions of bulk solids and adsorbed molecular surfaces; computational physics; physics of fullerides; quantum Hall effects; and quantum spin systems.

PROCEDURES FOR GRADUATE STUDY

The program of study for each graduate student consists of formal course work and, in the case of doctoral candidates and master's candidates choosing the thesis option (Plan A), original research. Each individual program is determined by consultation between the student and the student's graduate committee. Each entering student is assigned a temporary advisor upon arrival at Colorado State University.

During the first year, a student pursuing a degree requiring a thesis or dissertation should become familiar with the various research activities in the department and select an advisor. The student and advisor should select a committee, which will advise the student, assist in the preparation of the program of study, have general supervision over the research and the thesis or dissertation, administer the final examination, and, for Ph.D. candidates, administer the preliminary examination. A student pursuing a Plan B M.S. degree should also select a committee during the first year, which will select journal articles for the final examination and administer the final examination.

The lower-level graduate courses are organized to provide a solid foundation in the core areas of physics at an advanced level and to expedite entry into research. In some cases, formal course work in disciplines other than physics is encouraged in order to achieve the proper breadth for professional flexibility.

The standard course load for full-time graduate students during the first two years of graduate study is 15 credits per semester.

DEGREE REQUIREMENTS

Master of Science—Thesis Option (Plan A)

A student must complete a minimum of 30 semester credits. These must include 18 credits in physics classroom courses at the 500 level or higher and two credits of PH692 (Seminar). The student must also perform research and prepare a thesis. The final examination for the Plan A M.S. Degree is the thesis defense.

Master of Science—Non-thesis Option (Plan B)

A student must complete a minimum of 32 semester credits. These must include 21 credits in physics classroom courses at the 500 level or higher, three additional credits in the physics classroom courses at the 500 level or higher or in PH693 (Current Topics in Physics Research), and two credits of PH692 (Seminar). The final examination for the Plan B M.S. degree is the seminar/examination.

M.S. Final Examination Limit

A maximum of two attempts at final examinations for the M.S. degree is allowed.

Doctor of Philosophy

The primary requirement is a dissertation covering research performed by the student under the supervision of a research advisor. A minimum of 72 semester credits including course work and research is required. These must include the eight core courses: PH571 and 572 (Mathematical Methods for Physics I and II), PH621 (Classical Mechanics), PH641 and 642 (Electromagnetism I and II), PH651 and 652 (Quantum Mechanics I and II), and PH671 (Statistical Mechanics). A minimum grade point average of 3.0 must be achieved for these eight core courses. In addition, a student is required to complete four credits of PH692 (Seminar) and two electives from physics classroom courses at the 500 level or above. PH541 and PH551 cannot be used to fulfill the elective requirements, and at least one of the electives must be outside the student's primary area of research. Request for course substitutes, waivers, or transfer credits should be made in writing to the department Graduate Advisory Committee. The oral preliminary examination includes a formal presentation of the student's proposal for dissertation research, followed by an oral examination administered by the student's graduate thesis committee. The student must pass the Ph.D. preliminary examination at least one year in advance of the final examination. The final examination for the Ph.D. degree is the dissertation defense.

EXAMINATIONS

M.S. Plan A Final Examination

The thesis defense serves as the final examination for the Plan A M.S. degree. It consists of a public presentation and a committee examination. The thesis must report research at the M.S. level in an area of basic or applied physics and demonstrate creative thought and scholarly achievement by the candidate.

M.S. Plan B Final Examination

This final examination consists of an oral presentation and defense. The student must give a graduate level seminar on a research topic or collection of archival scientific papers approved by his or her committee. Following this presentation, the student must respond satisfactorily to questions from the committee on the topic of presentation. The student is expected to demonstrate an understanding of the material at a graduate physics level.

Ph.D. Preliminary Examination

Candidates for the Ph.D. degree are required to take the Preliminary Examination before beginning their fifth academic year semester of graduate study. The student will submit a dissertation proposal to his or her committee. The examination consists of a public presentation followed by an oral examination by the committee to determine if the student has an adequate mastery of the specialized field of the proposed dissertation. The examination primarily will cover the proposed research, but additional subject matter, including general questions on basic physics, may be covered as well. As specified by the general rules of the Graduate School governing the Preliminary Examination, a maximum of two attempts to pass the examination is allowed. Upon passing the Preliminary Examination, a student is admitted to formal candidacy for the Ph.D. program.

Ph.D. Final Examination

The dissertation defense serves as the final examination for the Ph.D. degree. It consists of a public presentation followed by an oral examination by the committee. The Ph.D. dissertation must report original research in an area of basic or applied physics and demonstrate creative thought and scholarly achievement by the candidate.

NORMAL PROGRESS

All students are expected to complete 15 credit hours each academic semester, and maintain a 3.0 average in Ph.D. core courses, until their core requirement is satisfied. (Note that the University requirement is a 3.0 overall average.) Students entering with a bachelor's degree are expected to complete at least two Ph.D. core courses each semester of the first year and to complete their M.S. Degree during the second year. Those continuing for the Ph.D. degree are expected to have an official research advisor by the end of the second year. Students entering with a master's degree are expected to complete any needed core course work during their first year and have an official Ph.D. research advisor by the end of the first year. Normal progress toward a degree is a major factor in the allocation of departmental financial support.