INDIANA UNIVERSITY

University Graduate School
2006-2007
Academic Bulletin

University Graduate School
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Indiana University
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Astronomy

College of Arts and Sciences
Bloomington

Chairperson
Catherine A. Pilachowski*

Departmental E-mail
astdept@indiana.edu

Departmental URL
www.astro.indiana.edu

Graduate Faculty

(An asterisk [*] denotes membership in the University Graduate School faculty with the endorsement to direct doctoral dissertations.)

Professors
Haldan N. Cohn*, Richard H. Durisen*, Frank K. Edmondson* (Emeritus), R. Kent Honeycutt* (Emeritus), Hollis R. Johnson* (Emeritus), Phyllis M. Lugger*, Stuart L. Mufson*, Catherine A. Pilachowski*

Associate Professors
Martin S. Burkhead* (Emeritus), Constantine P. Deliyannis*

Assistant Professor
Liese van Zee

Senior Scientists
Charles Bower* (Physics)

Graduate Advisor
Professor Richard H. Durisen*, Swain Hall West 319, (812) 855-6921

Degrees Offered

Master of Arts and Doctor of Philosophy. The department also participates in the Ph.D. program in astrophysics.

Research Facilities

Members of the Department of Astronomy use the WIYN (Wisconsin-Indiana-Yale-National Optical Astronomy Observatories) 3.5m and 0.9m telescopes at Kitt Peak National Observatory near Tucson, Arizona, to carry out research in optical astronomy. The advanced-technology 3.5m telescope delivers superb image quality over a wide field and is also optimized for multiobject spectroscopy, including a high-spectral-resolution mode and high-spatial-resolution imaging. Indiana University holds a 17 percent share of the WIYN facility. Two fully robotic telescopes are located in the Morgan-Monroe State Forest 16 miles from campus. These are a 0.4m telescope

that is used for automated CCD photometry and a new 1.25m telescope to be used for automated spectroscopy. A remote observing center in the department is equipped for communication with both the WIYN and local telescopes. The High-Energy Astrophysics Group carries out research with underground, spacecraft, and balloon-borne detectors that are developed within the department. Several instrument development labs and machine shops support the optical and high-energy research programs.

Research in the Department of Astronomy is supported by excellent computer facilities at Indiana University. These include powerful workstations and servers within the astronomy department, for IBM RS/6000 SP shared-memory parallel supercomputers, an IBM P690 SMP supercomputer, a computer automated virtual environment (CAVE), and a high-performance mass storage facility.

Special Departmental Requirements

(See also general University Graduate School requirements.)

Admission Requirements
Good preparation for graduate work in astronomy or astrophysics requires the same training in physics and mathematics needed for a bachelor's degree in physics, plus a familiarity with the subject matter of introductory astronomy or astrophysics courses, such as A221-A222 or A451-452. An undergraduate major in astronomy, astrophysics, physics, or mathematics that has provided such a background is usually required for admission. Any necessary undergraduate courses to strengthen students' backgrounds will not receive graduate credit.

All graduate applicants must submit Graduate Record Examination scores on both the General Test and the Subject Test in physics. Scores should be sent directly to the department, not to the University Graduate School.

Master of Arts Degree

Course Requirements
A minimum of 30 credit hours, including any three astronomy graduate core courses (see below).

Thesis
A thesis may be required at the discretion of the department. Students for whom the thesis requirement is waived must still complete a project that demonstrates research proficiency.

Final Examination
An oral examination must be passed covering general astronomy at the A451-452 level, the core courses applied toward the degree, and the thesis research.

Doctor of Philosophy Degree

Course Requirements
A total of 90 credit hours. Students are required to take six of the following core courses: A505, A520, A540, A550, A570, A575, and A580. Normally, these courses are offered at the rate of three courses per year, and they may be taken in any sequence. The remainder of the graduate program consists of elective courses, seminars on advanced topics, research, and dissertation.

Grades
Grades below B (3.0) in core courses may be counted toward degree requirements only at the discretion of the department.

Minor
Most doctoral candidates in astronomy minor in physics or scientific computing. Other minors may be permitted at the discretion of the department.

Qualifying Examination
In order to be advanced to candidacy, a student must pass a written examination covering the core course material plus general astronomy at the A451-452 level. The examination may be taken no more than twice. The examination is usually offered once a year just prior to the start of the fall semester. In its current form, it consists of one four-hour exam and one three-and-a-half-hour exam covering the material in the core courses and general astronomy knowledge at the undergraduate level.

Candidacy Seminar
The candidacy seminar is an oral presentation to the research committee, usually consisting of a thesis proposal and/or a summary of past research activity. It must be completed within a year of passing the written qualifying examination (typically by the start of the fourth year of residence).

Final Examination
Oral defense of the dissertation.

Courses

The 400-level courses listed here and described in the College of Arts and Sciences bulletin are open to graduate students at the discretion of the department.

A451 Stellar Astrophysics (3 cr.)

A452 Extragalactic Astrophysics (3 cr.)

A453 Topical Astrophysics (3 cr.) P: Calculus, P301 or equivalent. Topics in astrophysics not covered extensively by other courses. The topic will vary depending on instructor. Possible topics include the solar system, celestial mechanics, astrobiology, stellar interiors, stellar atmospheres, stellar populations, galaxy dynamics, and cosmology. May be repeated once with a different topic for a maximum of 6 credit hours.

A505 Principles and Techniques of Observational Astronomy (4 cr.) P: Consent of instructor. Principles and techniques of astronomical data acquisition and reduction. Practical experience in CCD photometry, spectroscopy, and astronomical applications of electronic detectors.

A520 The Interstellar Medium (3 cr.) P: Consent of instructor. Structure and dynamics of the interstellar medium; review of observations and theory of interstellar gas, dust, and radiation.

A540 Stellar Atmospheres (3 cr.) P: Consent of instructor. Structure of atmospheres and formation of spectra.

A550 Stellar Interiors (3 cr.) P: Consent of instructor. Physical properties of stellar material; structure and evolution of stars.

A570 Galactic Dynamics (3 cr.) P: Consent of instructor. Principles of stellar dynamics. Analytic and computer methods. Applications to the galaxy and its star clusters.

A575 Structure and Evolution of Galaxies (3 cr.) P: Consent of instructor. Structure and evolution of galaxies, large-scale clustering of galaxies, active galactic nuclei, and quasars.

A580 Physical and Observational Cosmology (3 cr.) P: Consent of instructor. Observational basis for current cosmological theory. Early universe evolution, cosmic microwave background radiation, formation of cosmic structure.

A590 Graduate Reading Course (cr. arr.) Independent reading in astronomy and astrophysics.

A770 Seminar in Astrophysics (1-4 cr.) Selected topics of current research interest in astrophysics; includes topics such as stellar astrophysics, interstellar matter, planetary physics, high-energy astrophysics, and extragalactic astrophysics.

A780 Seminar in Astronomy (cr. arr.) Selected topics of current research interest in astronomy, such as observational techniques, instrumentation, galactic and extragalactic astronomy, and cosmology. May be repeated. S/F grading.

A890 Introduction to Research (cr. arr.) Literature and methods of astronomical research.

A899 Research (cr. arr.) Observational and theoretical investigations of current problems.

Astrophysics
G630 Nuclear Astrophysics (3 cr.)
G650 High Energy Astrophysics (3 cr.)
G750 Topics in Astrophysical Sciences (1-3 cr.)