Astronomy

College of Letters and Science
Department Office: B 20 Hearst Field Annex, (510) 642-5275

Chair: Imke de Pater, PhD
Department Website: Astronomy (http://astro.berkeley.edu)

Overview

The Department of Astronomy offers undergraduate and graduate instruction in a wide variety of fields, including theoretical and observational astrophysics; infrared, optical, and radio astronomy; galactic structure and dynamics of stellar systems; high-energy astrophysics and cosmology; star and planet formation; and spectroscopy. A considerable amount of research and teaching related to astronomy is done in other units at UC Berkeley, including the Physics Department, Earth and Planetary Science, Space Science Laboratory, and the Lawrence Berkeley National Laboratory. Various professors in the Chemistry, Mathematics, Statistics, and Engineering departments have an active interest in astronomy and are available for consultation.

A variety of instruments is available to students and staff, including two 10-meter telescopes at the Keck Observatory on Mauna Kea in Hawaii; 30-inch, 40-inch, and 120-inch telescopes at Lick Observatory; a 30-inch telescope at Leuschner Observatory (near the campus); and a 16-element millimeter-wave interferometer in Southern California. Laboratories are available for the development of radio, infrared, and optical instruments, and for the precise measurement of images and spectra. Numerical simulations play an increasing role in Astrophysics, and we have a variety of expertise and machines available for this.

The Major in Astrophysics

During the first two undergraduate years, students must, in addition to fulfilling certain specific requirements of the College of Letters and Science, pursue studies that will prepare them for future work in astronomy or in other careers that benefit from an education in a physical science, such as science teaching or technical positions in industry. Specifically, the department requires that during the first two years, and in any case before declaring the major, students take courses that provide a thorough understanding of the following:

1. Basic principles of physics: mechanics, properties of matter, electricity and magnetism, heat, wave motion, sound and light (Physics 7A, 7B, 7C).
2. Basic mathematics: analytic geometry, differential and integral calculus, differential equations, and linear algebra (Math 1A-1B, followed by Math 53 and 54).
3. An introduction to astrophysics (Astronomy 7A-7B) is recommended for the major but not required.

The last two years, leading to the BA degree in astrophysics, are spent in more intensive work, primarily in the fields of astronomy, physics, earth and planetary science, and mathematics. The specific plan of study to be followed by each student is to be worked out in consultation with the departmental advisers for the major, and must include 30 units of upper division work in astronomy and allied fields. For students who are double majors in astrophysics and another science, the upper division requirement is reduced to 24 units.

All students are required to take at least one semester of undergraduate laboratory (Astronomy 120 or 121) and two of the senior-level courses Astronomy 160, C161, C162. Many students pursuing a dual-major of Astrophysics and Physics will be most interested in 160 and C161. Double-majors in Astrophysics and Earth & Planetary Science will be most interested in 160 and C162. With the approval of the undergraduate faculty adviser, outstanding students may take a graduate course in Astronomy.

Honors Program

For honors in astrophysics a student must fulfill the following additional requirements: 1) maintain a grade-point average of at least 3.5 in all courses in astronomy and related fields, and an overall grade-point average of at least 3.3 in the University; 2) carry out an individual research or study project, involving at least three units of H195. The student's project is chosen in consultation with a departmental adviser, and the written report is judged by the student's research supervisor and by a departmental adviser.

For more detailed information about the astrophysics major, please contact the undergraduate student academic adviser.

The Minor in Astrophysics

Petitioning for the Minor. Students may petition for the minor in Astrophysics only after they have completed all required courses for the minor in Astrophysics. Graduating seniors must petition no later than two weeks after the end of the term. To petition students must fill out a "Completion of L&S Minor" form (http://ls-advise.berkeley.edu/fp/00minor.pdf) available from the College of Letters and Science Advising Office in 206 Evans or from the L&S Advising website. Turn in to the Undergraduate Adviser: 1) the completed petition for the minor; and 2) a copy of transcripts (unofficial transcripts are OK) showing your completed astrophysics courses.

The Minor Requirements

The Astrophysics minor program conforms to the College of Letters and Science specifications and consists of the following coursework:

- **Prerequisites:** Physics 7A, 7B, 7C (or equivalent); Math 1A, 1B, 53, 54 (or equivalent). These courses must be taken for a letter grade. Physics 7A-7B-7C must each be passed with a letter grade of "C" or better. Students must achieve a minimum grade point average (GPA) of 2.0 in the seven courses. Astrophysics 7A and 7B are recommended for the minor but not required.
- **Course Requirements:** The minor program consists of two courses: either Astronomy 120 or 121; or 160, C161, or C162; plus three additional upper division courses.

All upper division courses must be taken for a letter grade (thus Astronomy H195, 198 and 199 will not count toward the minor program). A minimum of three upper division courses must be completed at Berkeley. Only one upper-division class may overlap your major and the Astrophysics minor. An overall minimum GPA of 2.0 is required in upper division courses applied to the minor program.

For more information regarding the minor program, please contact the Astrophysics undergraduate academic adviser.

Graduate Programs

The graduate program is aimed at the PhD degree in astrophysics. Entering students need not have majored in astronomy, although some background in astronomy is desirable. A strong background in physics, however, is essential.

In addition to the qualifying examination required by the University, the department requires students to pass a preliminary examination which tests breadth and depth of knowledge of three specialized research areas chosen by the student from a list of about l0. Students choose, with the aid of their adviser, courses in the department which are useful in preparing for the preliminary and qualifying examinations. In addition, students must pass two graduate courses taken outside the department and must acquire one year's teaching experience. The program normally takes five to six years. Additional information on the program is available upon request from the department.

The requirements for the MA degree are 24 units in graduate or upper division undergraduate courses (12 of them in graduate courses) and the preliminary examination.

ASTRON 3 Introduction to Modern Cosmology 2 Units
Department: Astronomy
Course level: Undergraduate
Terms course may be offered: Fall and spring
Grading: Letter grade.
Hours and format: 2 hours of Lecture per week for 15 weeks.
Description of research and results in modern extragalactic astronomy and cosmology. We read the stories of discoveries of the principles of our Universe. Simple algebra is used.
Instructors: Bloom, Davis, Ma

ASTRON 7A Introduction to Astrophysics 4 Units
Department: Astronomy
Course level: Undergraduate
Term course may be offered: Fall
Grading: Letter grade.
Hours and format: 3 hours of Lecture and 1 hour of Laboratory per week for 15 weeks.
Prerequisites: Physics 7A-7B (7B can be concurrent), or consent of the instructor.
This is the first part of an overview of astrophysics, with an emphasis on the way in which physics is applied to astronomy. This course deals with the solar system and stars, while 7B covers galaxies and cosmology. Solar system topics include orbital mechanics, geology of terrestrial planets, planetary atmospheres, and the formation of the solar system. The study of stars will treat determination of observations, properties and stellar structure, and evolution. The physics in this course includes mechanics and gravitation; kinetic theory of gases; properties of radiation and radiative energy transport; quantum mechanics of photons, atoms, and electrons; and magnetic fields.
Students will receive 2 units of credit for 7A after taking 10; 6 units of credit for both 7A-7B after taking 10. Instructors: Chiang, Marcy, Quataert

ASTRON 7B Introduction to Astrophysics 4 Units
Department: Astronomy
Course level: Undergraduate
Term course may be offered: Spring
Grading: Letter grade.
Hours and format: 3 hours of Lecture and 1 hour of Laboratory per week for 15 weeks.
Prerequisites: Physics 7A-7B (7B can be concurrent) or consent of the instructor.
This is the second part of an overview of astrophysics, which begins with 7A. This course covers the Milky Way galaxy, star formation and the interstellar medium, galaxies, black holes, quasars, dark matter, the expansion of the universe and its large-scale structure, and cosmology and the Big Bang. The physics in this course includes that used in 7A (mechanics and gravitation; kinetic theory of gases; properties of radiation and radiative energy transport; quantum mechanics of photons, atoms, and electrons; and magnetic fields) and adds the special and general theories of relativity.
Students will receive 2 units of credit for 7B after taking 10; 6 units of credit for both 7A-7B after taking 10. Instructors: Bloom, Chiang, Marcy, Quataert

ASTRON 10 Introduction to General Astronomy 4 Units
Department: Astronomy
Course level: Undergraduate
Terms course may be offered: Fall, spring and summer
Grading: Letter grade.
Hours and format: 3 hours of Lecture and 1 hour of Discussion per week for 15 weeks. 6 hours of Lecture and 2 hours of Discussion per week for 8 weeks. 8 hours of Lecture and 2.5 hours of Discussion per week for 6 weeks.
A description of modern astronomy with emphasis on the structure and evolution of stars, galaxies, and the Universe. Additional topics optionally