Studying Astronomy at Boston University

This is arguably the most exciting time in history to be an astronomer or to study astronomy. Modern observational capabilities using advanced ground-based telescopes and from space together with advanced computers for sophisticated data analysis and model calculations have led to an explosion in our understanding of the universe. We now know the precise ages of the universe and of the solar system. We've discovered hundreds of planets orbiting other stars, and as many new objects orbiting the sun near Pluto. We're exploring the massive black hole at the center of our galaxy and how the sun creates magnetic fields. We know that ordinary matter comprises a small fraction of the mass of the universe, the rest is the mysterious dark matter. And we're exploring new worlds such as Mars, Europa and Titan.

In spite of the relatively small number of astronomy and related majors, Boston University has one of the larger undergraduate programs in astronomy in the US. Usually 10 to 14 students graduate with degrees in Astronomy, Astronomy and Physics, and Geophysics and Planetary Sciences each year. Each class forms a small cohesive group during the four years they study and learn together. The astronomy faculty outnumbers the students in each graduating class allowing frequent and often informal contact between students and professors throughout their study at Boston University.

During their first two years, concentrators in astronomy programs obtain a solid grounding in physics, calculus, and basic astronomy. These courses range in size from 30-150 students for some of the physics and calculus courses, to 15-30 for the astronomy courses. In every course, the class is divided into smaller groups for discussion sections and/or labs. In the astronomy courses, the labs entail night work in the observatory, including CCD imaging of the moon, planets, and deep-sky objects. After this initial coursework, students take advanced courses in astrophysics, as well as (depending on the concentration they choose) in physics, earth science, and other disciplines. A final advanced observational course is required of astronomy and astronomy-and-physics majors. The sizes of these classes are generally much smaller, ranging from 10-20 students.

The Astronomy Department is strong in research as well as education. All astronomy faculty members hold Ph.D. degrees in astronomy or physics from first-rate universities and lead active research programs. Faculty research interests include observational and theoretical studies in galactic and extragalactic astrophysics, star formation and galactic structure, variable stars and star clusters, solar, heliospheric and magnetospheric physics, planetary atmospheres and ionospheres, active galaxies and quasars, high-energy astrophysics, cosmology and relativity, and science education. Many Boston University undergraduate astronomy students are directly involved in these projects.

All majors are encouraged to become involved in research through joining one of the faculty members' research groups. This can be done through UROP (Undergraduate Research Opportunities Program) or through a directed study course. Most students who take advantage of this opportunity find it to be one of their most rewarding academic

experiences at Boston University. In addition to obtaining course credit, many students obtain paying jobs both during the academic year and summer in the professor's research group. This provides not only income, but also valuable experience, not to mention letters of recommendation for graduate studies or postgraduation employment. Some students expand their research experience by completing a senior project which earns them a degree *with distinction.* For examples of research programs see the following pages and the web site at www.bu.edu/astronomy

Facilities for student observing and instruction are maintained at the Coit Observatory on the roof of the College of Arts and Sciences building and elsewhere within the department. The facilities now include a 6½" refractor, a 12" reflector, a robotic 14" Celestron telescope, four 8" reflectors, a solar telescope and spectroscope, a photometer and CCD cameras. The Department also maintains a comprehensive astronomical research library that includes many books for research and general reading, sky atlases, and subscriptions to over 50 scientific and popular journals in astronomy and space science.

Boston University jointly operates the 72-inch Perkins Telescope near Flagstaff, AZ in partnership with the Lowell Observatory. Students regularly travel to this telescope, both for projects in advanced observing classes and for research. While there they also use it for amateur observing and astrophotography.

Concentrators in the astronomy programs and other undergraduate students interested in astronomy are encouraged to join the Boston University Astronomical Society (BUAS). This active student organization engages in a number of academic and social activities, including visits to local observatories, astrophotography contests, observing projects, and lectures on topics of current astronomical interest.

The Department of Astronomy encourages students to become involved in the lively academic, research, and social environment that it provides. The relationship between students and professors is usually very close, with small class sizes, many research opportunities, a friendly atmosphere, and even tutoring for first-year students who need some expert help in their physics, calculus, or astronomy courses. The students also enjoy a good deal of camaraderie among themselves both through the BUAS and the constant informal contact made possible within the programs of the department.

Courses for Astronomy Majors

CAS AS 202 Principles of Astronomy I Coreq: CAS MA 123 (or equivalent). Introduction of astronomical observing; The night sky; observing with telescopes; light and optics; spectra and spectroscopy; birth of modern astronomy; theory of orbital motion; overview of the solar system; extra solar system planets. Lectures and laboratories. Intended primarily for physical science concentrators. 4 cr, 1st sem.

CAS AS 203 Principles of Astronomy II Coreq: CAS MA 124 (or equivalent). The celestial sphere; time and calendars; astronomical instruments and techniques; telescopes and observatories; stellar properties and stellar evolution; the Milky Way galaxy; galaxies and quasars; the universe. Lectures and laboratories. Intended primarily for physical science concentrators. 4 cr, 2nd sem.

CAS AS 311 Planetary Physics Prereq: CAS MA 124 and CAS PY 212 or PY 252. Celestial mechanics, tides, resonances. Physical processes which affect atmospheres, surfaces, interiors of planets, and their satellites. Comets, asteroids, meterorites, and Kuiper belt objects. Formation and evolution of the solar system. Extra-solar planets. 4 cr, 1st sem.

CAS AS 312 Stellar and Galactic Astrophysics Prereq: CAS MA 124, CAS PY 212 or PY 252. Basic physics of radiation; spectral analysis; distances, motions, and physical properties of stars; stellar interiors and atmospheres; stellar evolution; clusters of stars; the interstellar medium; content, structure, and rotation of the Milky Way galaxy. 4 cr, 2nd sem.

CAS AS 401, 402 Senior Distinction Work Prereq: approval of Honors Committee. 4 cr each, 1st & 2nd sem.

CAS AS 413 Extragalactic Astrophysics and Cosmology Prereq: CAS AS 312 and CAS PY 355 or equivalent. Galaxies and galaxy clusters; the extragalactic distance scale and the Hubble Law; quasars and active galactic nuclei; metrics and general relativity; distances and luminosities in cosmology. Origin of the universe: the Big Bang, cosmic background radiation, and inflation. (Offered alternate years.). 4 cr, 1st sem.

CAS AS 414 Solar and Space Physics Prereq: CAS PY 355 and CAS PY 212 or 252. The sun and solar wind: solar magnetic fields, sunspot cycle, active sun, corona. Interaction of the solar wind with planets and comets. Planetary magnetospheres and ionospheres. Aeronomy. Solar system plasma physics. Magnetic storms and space weather. 4 cr, 2nd sem.

CAS AS 441 Observational Astronomy Prereq: CAS AS 312. Astronomical techniques. Photometry, spectroscopy, photography, CCD imaging, and interferometry. Statistical methods for data reduction and analysis. Strong laboratory component. Use of computers. 4 cr, 2nd sem.

CAS AS 491, 492 Directed Studies in Astronomy Prereq: consent of instructor and approval of CAS Academic Advising Office. Devoted to an intensive study of a particular aspect of astronomy, often working with a member of the faculty on a specific research project. Variable cr, 1st & 2nd sem.

Life after Graduation:
What can I do with a Degree in Astronomy?

Many university students are interested in astronomy, but worry that an astronomy degree is a sure path to unemployment, or, at best, to a career totally unrelated to science. While the number of astronomy and space science jobs is limited, the number of qualified people seeking those jobs is also limited. Furthermore, a degree in a physical science means that the graduate has developed the concise mathematical analytical problem solving skills that high technology companies and others desperately need. Employment prospects vary according to the state of the economy and government funding of research, but historically Boston University astronomy graduates have been successful in obtaining challenging and rewarding positions. Below we discuss the astronomy programs at Boston University, some of the career opportunities available to our graduates, and examples of Boston University alumni who hold jobs in this exciting field and other fields.

The Department of Astronomy provides a range of courses and programs for students planning careers in astronomy, space science, or related fields. The astronomy and physics concentration involves a rigorous course in physics and calculus in addition to astronomy. This prepares a student for graduate study leading to a masters and/or Ph.D. degree in astronomy, astrophysics, physics, or other technical fields. The concentration in astronomy is less intense in physics and calculus, yet still provides a student with a solid foundation in the physical sciences. The geophysics and planetary sciences concentration is a multidisciplinary program including astronomy, earth science, physics, and calculus. Thus many students in this concentration enroll in graduate programs in planetary geology.

A BA degree in astronomy, astronomy and physics, or planetary and space sciences prepares students for careers in science education, science management, scientific computing, scientific instrumentation, or science writing (some of which may require one or two years of graduate study). Qualification for such fields is enhanced when students work in the research groups of astronomy professors as work-study, student employment, and/or directed study participants. The wide range of research being conducted within the department and its allied research centers provides ample opportunity for undergraduates to gain research experience.

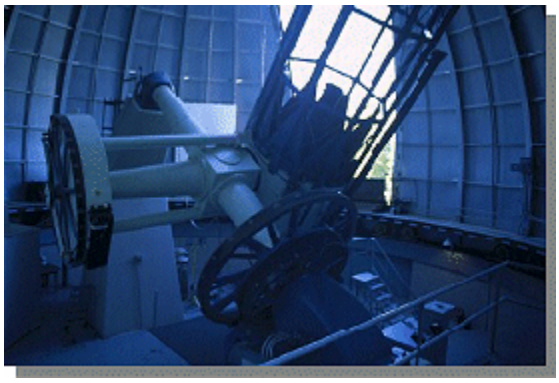
The many alumni with whom we have maintained contact hold a wide variety of professional positions. Several have been data assistants at NASA's Space Telescope Science Institute in Baltimore and at the Harvard-Smithsonian Center for Astronomy in Cambridge; a number were commissioned as officers in the armed services (through ROTC), one of whom obtained an MA degree in oceanography at the Navy's Marine/Oceanography School in Monterey; some switched fields to economics, traffic engineering, and other fields in which they used the problem solving skills learned as astronomy majors. Others include scientific computer programmers (one of whom started his own business programming and setting up Web pages for companies), a team member

on a telescope construction project at the Naval Research Laboratory, an accountant at the Boston Museum of Science, a data analysis and instrument programmer for NASA's AXAF X-ray space observatory, a senior research associate in Boston University's Center for Space Physics, and a few other recent graduates that work in the Center (e.g., one is an instrument designer using CAD programming for satellite and rocket projects).

In addition, there are many examples of graduates who went on to obtain higher-level degrees and rewarding careers. Among recent alumni who obtained master's degrees, two are professors at colleges in Georgia and Nevada, another is a mission planner at NASA for the Rossi X-ray Timing Explorer satellite, and another is an education officer at the Hayden Planetarium of the Boston Museum of Science. Many others received their Ph.D.'s and are now scientists at observatories or university or college professors.

Students with B+ or higher averages in their physics, mathematics, and astronomy courses can usually gain admittance into a first-rate graduate program in astronomy. Such students nearly always obtain financial assistance in the form of fellowships, or research or teaching assistantships. These financial awards usually amount to full tuition remission plus a monthly stipend to cover living expenses. As opposed to most forms of undergraduate aid, graduate school assistance is based on merit rather than financial need.

If past experience is a good guide, a degree in Astronomy, Astronomy-and-Physics, or Planetary and Space Sciences from Boston University is very practical indeed.



Further details about undergraduate programs and research in astronomy at Boston University can be found at our web site: http://www.bu.edu/astronomy/

Or contact:
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Department of Astronomy
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725 Commonwealth Avenue
Boston, MA 02215
Tel: (617) 353 2625

Astronomy Faculty and Research Interests

Thomas Bania, Professor: PhD, University of Virginia. Radiospectroscopy; galactic structure and the interstellar medium

Elizabeth Blanton, Assistant Professor: PhD, Columbia University. High-energy astrophysics, optical and near IR astronomy; clusters of galaxies, radio galaxies

Tereasa Brainerd, Associate Professor: PhD, Ohio State University, Theoretical astrophysics; cosmology; computational astrophysics; galaxy formation & evolution; astrophysical applications of gravitational lensing

Kenneth Brecher, Professor: PhD, Massachusetts Institute of Technology. Neutron stars; high-energy astrophysics; cosmology and relativity; historical astronomy

Supriya Chakrabarti, Professor: PhD, University of California, Berkeley. Experimental astrophysics; spectral imaging; astrophysics from space; planetary atmospheres; interplanetary, interstellar and intergalactic media

John Clarke, Professor: PhD, Johns Hopkins University. Planetary atmospheres; UV astrophysics; FUV instruments for remote observations

Dan Clemens, Professor: PhD, University of Massachusetts. Galactic structure; interstellar medium; star formation; infrared and optical astronomy

Timothy Cook, Research Associate Professor: PhD, University of Colorado. UV and soft x-ray instruments; tomography; interstellar and intergalactic medium; remote sensing

Nancy Crooker, Research Professor: PhD, University of California, Los Angeles. Solar wind, space weather, and solar wind – magnetosphere coupling

Theodore Fritz, Professor: PhD, University of Iowa. Space plasma physics; rocket and satellite experiments; magnetospheric physics; substorms; charged particle composition

W. Jeffrey Hughes, Professor: PhD, Imperial College, University of London. Space physics, solar wind-magnetosphere-ionosphere coupling and dynamics, space weather

James Jackson, Professor: PhD, Massachusetts Institute of Technology. Radio, infrared and submillimeter astronomy; interstellar medium; star formation; the Milky Way

Kenneth Janes, Professor: PhD, Yale University. Observational optical astronomy; galactic astronomy and stellar photometry; star clusters; planet searches

John Lyon, Research Professor: Computational space plasma physics, magnetospheric physics; numerical simulation and computational magnetohydrodynamics

Alan Marscher, Professor: PhD, University of Virginia. Quasars, active galaxies; high energy astrophysics; galactic and extragalactic astronomy

Michael Mendillo, Professor: PhD, Boston University. Space physics; planetary atmospheres; observations and models

Meers Oppenheim, Associate Professor: PhD, Cornell University. Computational and theoretical space plasma physics; dynamics of the E-region ionosphere; particle-wave interactions in the auroral ionosphere and magnetosphere; physics of meteor trails

Nathan Schwadron, Associate Professor: PhD, University of Michigan. Solar wind, coronal and heliospheric magnetic field, energetic particle sources, cometary x-rays

George Siscoe, Research Professor: PhD, Massachusetts Institute of Technology. Space physics including solar wind, magnetospheres, and space weather

Andrew West, Assistant Professor: PhD, University of Washington. Kinematics, distribution and magnetic activity of low-mass stars; metallicity, structure and evolution of the Milky Way thin disk; magnetic field generation in M and L dwarfs