The Boston University Astronomy Department Annual Report 2011

Chair: James Jackson

Administrator: Laura Wipf

The Discovery Channel Telescope

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Cover photo: The Discovery Channel Telescope is a new optical/infrared telescope being built by Lowell Observatory near Flagstaff, Arizona. Boston University has agreed to purchase a large share of observing time on this new facility, and Boston University is currently negotiating a partnership with Lowell to provide access to our astrophysicists.

EXECUTIVE SUMMARY

The Department of Astronomy teaches science to hundreds of non-science majors from throughout the university, and runs one of the largest astronomy degree programs in the country. Research within the Astronomy Department is thriving, and we retain our strong commitment to teaching and service.

The Department graduated a class of 10 undergraduates with a major concentration in astronomy or astronomy and physics. Currently, 47 Boston University undergraduates major in astronomy, a large program among US universities. For non-majors, our efforts to improve our general 100-level courses and to provide interesting new course offerings have clearly paid off. Our 100-level enrollments in 2010-2011 were 609, the largest since 2004.

In our graduate program, we recruited an impressive incoming class of five new students, bringing our total of new and ongoing astronomy graduate students to 45. Eight of our graduate students received their PhDs last year. The Boston University graduate program in astronomy is also one of the largest in the country.

Astronomy Department graduate students and their advisors at the 2011 PhD hooding ceremony.

The Department had several noteworthy scientific achievements in 2010/2011. While space limits preclude a thorough presentation of the entire research portfolio of the department, some representative projects demonstrate the breadth and vitality of our research program. In 2010/2011, Boston University astronomers have accomplished the following:

- The determination of the temperature structure of the Martian atmosphere in its arctic region.
- The discovery of hundreds of new "H II regions," the zones of ionized gas surrounding hot, massive stars, doubling the number known.
- The compilation of the largest catalog of the spectra of low-mass stars ever compiled, with over 70,000 spectra assembled.
- A new view of the structure of the "heliopause," the farthest extent of the sun's influence, which defines the edge of the solar system.

The Astronomy Department had an excellent year in securing research funds through grants to its main research centers: the Center for Space Physics, the Center for Integrated Space Weather Modeling, and the Institute for Astrophysical Research. Last year Astronomy Department researchers secured federal funding through grants totaling $27,186,283, or over $1,000,000 per faculty member, both among the highest for all units in CAS. Our faculty and research associates authored or co-authored a total of 125 refereed, scholarly papers in the disciplines' most prestigious journals.

The College of Arts and Sciences established a new funding scheme for the Astronomy Department, the Center for Space Physics, and the Institute for Astrophysical Research, after a University review of these units. The funding policy continues the scheme implemented last year, which provides for a more equitable sharing of resources among the department and the research centers. In addition, however, the College has agreed to provide additional funding for research staff positions and operations costs, such as telecommunications charges and lab and office renovations. In the 2011-12 academic year, the staff that supports research for the CSP and IAR will be

consolidated into a single unit that will provide essential research support services (proposal development, purchasing, travel, and grant accounting) for the entire department.

The most exciting development of the past year is Boston University's commitment to purchase a major share of an exciting new research telescope, the Discovery Channel Telescope. This new optical/infrared 4.3 meter diameter telescope is nearing completion at Lowell Observatory, and we are actively negotiating the terms of the partnership in this project. This partnership would link Boston University not only with Lowell Observatory, but also one of the key sponsors, Discovery, Inc., which owns the Discovery Channel and a number of other telecommunications enterprises that promote scientific education. This project will provide opportunities not only for state-of-the-art astrophysical research, but also new outreach and science education programs in the Schools of Education and Communications.

OVERVIEW

Among the 37 "stand-alone" departments of astronomy in US universities, by many measures Boston University is unusual. For instance, about half of our faculty members specialize in space physics research. In other universities, space physicists are typically affiliated with physics, engineering, or earth science departments. Such a large concentration of space physicists in an Astronomy Department makes Boston University unique. Furthermore, our graduate program is one of the nation's largest (typically we rank in the top five in terms of the number of graduate students enrolled and PhDs awarded). Finally, our federal grant support is outstanding. In the last several years our annual grant funding and funding per faculty member is typically twice that of our closest peer institution.

The Astronomy Department, through its associate research centers: the Center for Space Physics, the Center for Integrated Space Weather Modeling, and the Institute for Astrophysical Research, enjoys an impressive research record. In space physics, Boston University is a recognized leader in our core areas of space-based instrumentation, space weather, energetic particles in the near-earth environment, magnetospheric physics, and ionospheric physics. In astrophysics, Boston University's key research areas are star formation, galactic astronomy, active galaxies, stellar astronomy, galaxy clusters, and cosmology. One of our particular strengths is in astronomical surveys, particularly of the Milky Way, such as the H II Region Discovery Survey and the Galactic Plane Infrared Polarization Survey. Another important strength is the study of variability of active galactic nuclei and of the light output of stars.

FACULTY, STAFF, AND LEADERSHIP

The Department of Astronomy currently has twenty-four faculty members: sixteen academic faculty and eight research faculty. The full list of the Department's faculty and staff is provided in Appendix A. The astronomy faculty continues to provide outstanding service to the nation and profession by serving on advisory committees for NASA and NSF, national observatories, learned societies, and professional journals.

Retirement

Prof. Ken Janes officially retired after Spring term 2011. After receiving his BS from Harvard, three Master's degrees from Yale, and San Diego, and his PhD from Yale, Prof. Janes has served with distinction at Boston University for 38 years, the longest tenure of any member of the Astronomy faculty. He is best known for his work on "open"

star clusters and the structure of our home galaxy, the Milky Way. Among his many scientific achievements is the discovery of a steady change in the metal content of stars as a function of their Galactic location, the surprising fact that the metal content of stars bears no relationship with their age, and the discovery of five new planets, the most remarkable of which, XO2, orbits a pair of stars rather than a single star. Prof. Janes was a major force in Boston University's partnership with Lowell Observatory in the use of the 2-meter Perkins telescope; not only has he served for over a decade as BU's Liaison with Lowell Observatory, he also designed and built PRISM, the key optical camera and spectrograph that continues to be used as a facility instrument to this day. Prof. Janes was appointed as emeritus professor, and luckily the Department will have the privilege of continuing to enjoy his cheerful demeanor, his gentle humor, and his willingness to serve the Department, the University, and especially its students.

Arrivals

The Astronomy Department conducted a search for new faculty members in Spring 2010, and I am very pleased to report that two outstanding new assistant professors, Paul Withers and Merav Opher, joined the Department this year.

Prof. Paul Withers joined us in September 2010 from a postdoctoral position here at Boston University. Prof. Withers received his BA, MS from Cambridge University and his PhD from the University of Arizona. Prof. Withers specializes in the structure of the atmosphere of other planets and moons, particularly that of Mars.

Prof. Merav Opher joined us in January 2011 from a faculty position at George Mason University. She received her BS and PhD from the University of Sao Paolo. Prof. Opher is best known for her work in the structure of the magnetic fields surrounding the sun and other stars. We are delighted to welcome our new colleagues.

Departure

Prof. Nathan Schwadron left the faculty in August 2010 to take a faculty position at the University of New Hampshire.

Changes

Prof. Jeffrey Hughes has been appointed Associate Dean of the Graduate School in the College of Arts and Sciences. He began his duties in 2010.

Prof. James Jackson has been appointed Associate Dean for Research and Outreach for the College of Arts and Science. He will begin this position in July 2011.

Prof. Tereasa Brainerd was appointed by CAS Dean Sapiro to be the new Astronomy Department Chair. She will begin her duties in July 2011.

RESEARCH AND SCHOLARSHIP

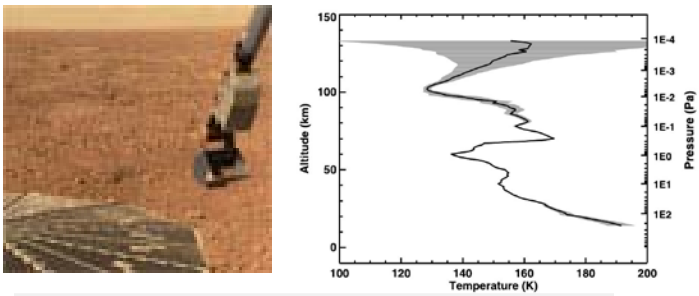
The Department of Astronomy, through its affiliated research units, the Center for Space Physics (CSP), the Institute for Astrophysical Research (IAR), and the Center for Integrated Space Weather Modeling (CISM), has a robust and thriving research program. Every member of the faculty maintains a research program

through external sponsored funding. Publication of scientific results continued at a brisk pace in the top journals of our fields.

Overall Summary

The Department's research accomplishments for 2010-2011 are remarkable. A few research projects are selected to show the breadth and strength of our research program.

The Atmosphere of Mars



Left: the Phoenix Lander on the surface of Mars (image courtesy NASA). Right: the temperature of the Martian atmosphere as a function of height derived by Prof. Withers.

Professor Paul Withers is using information obtained during the flight of spacecraft through the atmosphere of Mars to measure its atmospheric properties, such the variation of its temperature with height. He used onboard accelerometer measurements from the 2008 descent of the Phoenix lander to the Martian arctic to obtain the first such "temperature profile" from the polar atmosphere. Prof. Withers has shown that similar results can be obtained from radio tracking data from spacecraft, which would avoid the need for costly onboard measurements. He will apply this technique on the European/US ExoMars Descent Module, for which Withers was recently named a Co-Investigator, and hopefully also on the 2011 NASA Mars Science Laboratory.

Discovering Ionized Gas around Hot Stars

Prof. Thomas Bania, along with collaborators Loren Anderson (University of West Virginia), Dana Balser (National Radio Astronomy Observatory), and Bob Rood (University of Virginia) are conducting a large survey to designed to discover "H II regions," the zones of ionized gas surrounding very hot, massive stars.

The H II Region Discovery Survey (HRDS) uses the Green Bank Telescope, a large 100-meter diameter radio telescope in West Virginia, to detect "recombination lines" of hydrogen, that unambiguously reveal the presence of very hot, ionized gas. The potential targets were identified by the GLIMPSE infrared survey of the Milky Way Galaxy, which revealed curious "bubbles" of hot gas in space. Bania and his team are now confirming that these bubbles are previously unknown H II regions heated and ionized by an embedded massive star. The 448 H II regions detected by the survey have doubled the number of H II regions known in this part of the Galaxy. Moreover, these are the most distant Galactic H II regions detected to date, and therefore can probe the structure of our home Galaxy, the Milky Way, at great distances.

An infrared image of a complex H II region from the GLIMPSE survey, showing its bubble-like morphology. Such bubbles were the targets for the H II Region Discovery Survey.

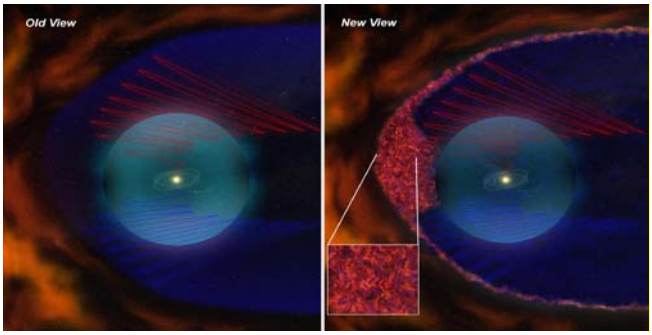
A Map of the Dust in our Stellar Neighborhood

Prof. Andrew West, along with graduate student David Jones and postdoc Jonathan Foster used the largest spectroscopic catalog of low- mass stars ever assembled (over 70,000 spectra) by Prof. West and collaborators to map the distribution of dust clouds in within 6000 light years of the sun. Their study investigated the three dimensional distribution of dust in the Milky Way Galaxy using the smallest of the Milky Way's constituent stars, the M dwarfs. M dwarfs are one of the best tracers of the properties of the nearby Galaxy due to their ubiquity in the Milky Way and the vast collection of data about them in astronomical surveys. By comparing the optical spectra of more than 50,000 M dwarfs to similar-type spectra in dust-free lines-of-sight, Jones, West and Foster were able to map the Galactic dust within almost 2 kiloparscecs (roughly 6,000 light-years) of the Sun.

A color-composite field from the Sloan Digital Sky Survey. The majority of the stars in the field (and in the entire Milky Way) are red, low-mass stars that can be used trace the structure, kinematics and evolution of the Galaxy. The West et al. (2011) spectroscopic sample represents the largest sample of low-mass stellar spectra ever assembled.

A *New View of the Heliopause*

Observations from NASA's Voyager spacecraft, humanity's farthest deep space sentinels, suggest the edge of our solar system may not be smooth, but filled with a turbulent sea of magnetic bubbles. While using a new computer model to analyze Voyager data, Opher and collaborators found the sun's distant magnetic field is made up of bubbles approximately 100 million miles (160 million kilometers) wide. The bubbles are created when magnetic field lines reorganize. The new model suggests the field lines are broken up into self-contained structures disconnected from the solar magnetic field. The consequence is that the heliopause (the last boundary that separates the solar system from the interstellar medium) might be a porus membrane instead of a shield. Energetic particles coming from the galaxy, such as Galactic Cosmic Rays will have an easier access to the heliosheath. However, once inside the sea of bubbles their transport will be impeded until reaching magnetic field lines that connect back to the Sun where they can easily escape towards Earth.



Old and new views of the heliosheath. Red and blue spirals are the gracefully curving magnetic field lines of the old models. In the new view, reconnection (the crossing of magnetic field lines) will create a sea of bubbles that will fill out the heliosheath. (credit: NASA based on Opher etal. 2011

Research Funding

The Astronomy Department is very successful in raising research funds. Compared with other science departments at Boston University, for the past several years the Astronomy Department has had the largest annual grant income ($11.7 M in FY2004, $12.6 M in FY2005, $11.2 M in FY2006, $14.1 M in FY2007, $19.7 M in FY2008, $21.2 M in FY2009, $31.8 M in FY 2010 and $27.2 in FY 2011). This accomplishment is even more impressive considering the small size of our faculty. Indeed, the average grant income raised per

faculty member (both research and teaching faculty) in the Astronomy Department is over $1,000,000.

As has been the case in past years, the majority of our research was supported by grants and contracts from three major federal agencies: the National Science Foundation, NASA, and the Office of Naval Research.

Peer-Reviewed Publications

The Department's faculty, research associates, and students continue to publish in the leading journals of our disciplines and to present their results at national and international meetings. This activity not only disseminates major new research results, but also helps to keep the Department's research prominent within our research communities. Members of the Astronomy Department and its affiliated research centers published 125 articles in refereed journals during the reporting period.

UNDERGRADUATE EDUCATION

Director of Undergraduate Studies:
Professor Dan P. Clemens

Approximately 650 undergraduate students and 30 graduate students per year enroll in astronomy courses. The Astronomy Department has three distinct suites of courses to serve Boston University students:

1. Astronomy for non-science majors. Undergraduate non-science majors at Boston University usually take our 100-level courses to fill the natural science distribution requirement. Since astronomy is rarely part of the high school curriculum, these courses offer an attractive opportunity for students wishing to experience a new field of science.

2. Core Curriculum and University Honors College. The Astronomy Department plays a key role in the Core Curriculum Natural Sciences course CC105 by providing two to three faculty members each year. About 200 students per year enroll in this course. Prof. Michael Mendillo also teaches a seminar on the history of the planet Pluto for the University Honors College.

3. Astronomy for majors. Our 200-400 level courses provide a rigorous technical education for students wishing a career in astronomy or a related field. About 1/3 of our majors go on to graduate school in astronomy or physics. Those who enter the workforce instead have gained important skills in problem solving, mathematics, and physics. Many of these students find jobs where skills in analysis are highly sought.

AS 441 students on a trip to NASA Wallops Flight Facility with Professor John Clarke over Spring Break.

Divisional Studies Courses

In terms of number of students, the department's largest teaching mission by far is to offer courses designed to satisfy College divisional study requirements and similar requirements within the other undergraduate schools and colleges of the University.

We offer six such 100-level courses. Two of these, AS 101: The Solar System, and AS 102: The Astronomical Universe, provide surveys of solar system astronomy and extra-solar system astronomy and carry laboratory credit. The other four, AS 100 Cosmic Controversies, AS105 Alien Worlds, AS 109 Cosmology and AS 117 Cosmic Evolution, are more focused topical courses which do not carry laboratory credit. This year we offered nine sections of these 100-level courses: three sections of AS 101, two of AS 102, and one each of AS

100, AS 105, AS 109, and AS 117. AS 105 was offered for the first time this year, and will be discussed in more detail below.

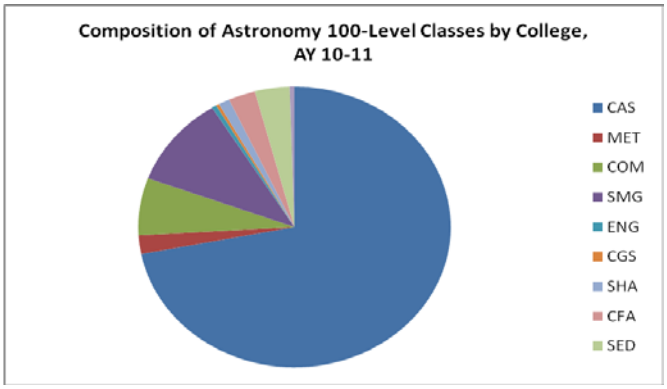


Figure 1 indicates that the total 100-level enrollment was 609 in 2010/2011. Of the students taking these courses, approximately 72% (438) were CAS students and 28% (171) were students from other schools and colleges.

Among the year's highlights in undergraduate teaching was an innovative research experience in Prof. Dan Clemens' AS 102. Prof. Clemens brought a peer-selected group of students to the Perkins Telescope, a research facility Boston University uses in partnership with Lowell Observatory near Flagstaff, Arizona. Students used state-of-the-art research instruments to conduct astronomical instrumentation. A video link was established back to Boston University so that AS 102 classmates could participate, and interact with the students at the telescope. This inspirational experience was a powerful demonstration of the close links between education and research in a great research university.

AS 102 students posing in front of the Perkins Telescope in Flagstaff, Arizona.

The Core Curriculum and University Honors College

In the spirit of promoting a true liberal arts education, the Astronomy Department is committed to providing excellent science education to both science and non-science majors.

Since an increasing number of CAS students choose to meet their science education requirements through the Core, the Department provides a significant commitment to the physical science component of the Core Curriculum, CC105. One of our own faculty members, Professor Alan Marscher, developed CC105 and served as its initial course coordinator for many years. Professor James Jackson has since served for ten years as course coordinator, and has continued the long tradition of Astronomy Department service and leadership in this important program. The Astronomy Department provides as many additional faculty members to this course as our other teaching commitments allow. Typically, the Astronomy Department commits two or three lecturers per year to CC105. This year, Professors Jackson and Marscher staffed the Core Curriculum course.

The University is also offering a new program to provide a broad, interdisciplinary, liberal arts experience in a series of smaller seminar courses through the University Honors College. In Fall 2010, the UHC's first year, Astronomy Professor Michael Mendillo taught a freshman seminar course entitled "The Pluto Saga: How Do You Become a Planet and Stay a Planet?" which considers scientific, social, and religious implications of evidence.

Undergraduates Concentrating in Astronomy

The Department continues to have one of the largest and strongest undergraduate majors programs in astronomy in the country. In terms of bachelor's degrees awarded in astronomy, Boston University ranks fifth in the US with an average of 11 graduates per year, behind U.C. Berkeley (18), Arizona (13), UCLA (12) and the University of Wisconsin Madison (12).

During the 2010/2011 academic year, 47 students (some of whom have declared an additional concentration) were declared as majors in one of the Department's concentrations. The most popular concentration is Astronomy and Physics (33), followed by Geophysics and Planetary Sciences (8) and Astronomy (6).

This year's graduating class consisted of 11 students; 8 received BAs in Astronomy and Physics, 2 in Geophysics and Planetary Sciences, and 1 in Astronomy. As has been the case now for many years, this class represents a significant fraction of the total number of Bachelor's degrees awarded nationally. Current enrollments indicate that we will graduate nine or more undergraduate students a year for the foreseeable future. A list of our graduating class is provided in Appendix B.

Revisions to Undergraduate Curriculum

The Department has recognized that in recent years the enrollments in our traditional lab-based survey courses, AS 101 and 102, are declining, but the enrollments in our non-lab 100 level courses are increasing, especially in the new course AS 100, Cosmic Controversies, and in AS 109, Cosmology. The Department has studied this shift in enrollments and concluded that a major factor is the changing demographics of our undergraduate population. In particular, a larger fraction of pre-med students are fulfilling their lab science distribution requirements in Physics and Chemistry. Thus, the Astronomy Department now offers fewer sections of AS 101 and 102, and has developed new, topical 100-level courses.

Following the success of Prof. Mendillo's course AS100, Cosmic Controversies, begun three years ago, the Astronomy Department offered a new course AS 105, "Alien Worlds," for the first time in Fall 2010. Alien Worlds explores the rich variety of planets and moons in our own solar system and the explosion of new information about planets in our own solar system, as well as the growing number of planets recently discovered to be orbiting other stars. Prof. West had a remarkably successful year, with glowing student evaluations. One of the highlights included a field trip to the Boston Public Library, where students were privileged to see first-hand original editions of the works of Galileo and Copernicus. Another important component to the excitement surrounding the class was the fact that during the semester, astronomers were announcing the discovery of a number of new extrasolar planets. Thus, the course captured the thrill of astronomical discovery.

Astronomy 105 student Julie Kim (SED) examines rock and soil samples from the Moon. The lunar materials were collected by NASA astronauts during the Apollo missions and were loaned to Professor West as part of NASA's educational program.

A new course, AS 137 "Cosmic Catastrophes," which will explore violent events in the Universe, such as asteroid impacts, supernova explosions, and gamma ray bursts is under development. We plan to offer AS 137 for the first time next year in Spring 2012.

Undergraduate Advising

Advising of students concentrating, or intending to concentrate, in one of the majors offered by the department is overseen by the Director of Undergraduate Studies, Professor Dan Clemens.

Since the course schedule for concentrations in astronomy is highly structured, advising must begin with the incoming class, sometimes even before they arrive on campus. Thus, freshman advising during the summer is critically important. We also carefully monitor possible freshman concentrators during the first few

days of classes in the fall to make sure all are taking the appropriate classes. We often recruit and advise highly-qualified students from the Core and our 100-level offerings; we have had growing success in recent years of identifying excellent scholars and introducing them into our program through these courses. Students who decide during their sophomore year to concentrate in astronomy provide us with our biggest advising challenges, but the numbers are small enough that each case can be dealt with carefully on an individual basis. We attempt to assign as many students as possible to their advisor from the previous year. This provides much more continuity for the students, but requires faculty to be more aware of advising issues at all stages of our program. Every faculty member who was here both semesters acted as an undergraduate student advisor.

GRADUATE EDUCATION

Director of Graduate Studies: Professor John Clarke
Director of Graduate Admissions: Professor Andrew West

Graduate-level astronomy. Our graduate program trains the next generation of astrophysicists and space physicists. Because of our department's strong concentration in space physics research, our students are all required to take elementary courses in both astrophysics and space physics. After passing the qualifying exams, a student may choose advanced courses in either field.

Overview

Our graduate program remains vigorous. Of the thirty-nine PhD-granting astronomy programs in the country, ours is above average in terms of the number of students and in the number of PhDs awarded. Our graduate students continue to win student awards at national scientific conferences as well as highly-competitive fellowships from federal agencies. Last year, for example, Jan Marie Andersen was awarded a highly prestigious National Science Foundation Nordic Research Opportunity Grant fellowship to study low-mass stars. A survey of our graduates who earned PhDs in the past decade reveals a remarkable degree of overall professional success. A significant fraction of our PhD recipients already hold faculty and leadership positions at major research institutions. One of the latest examples is Prof. Sigrid Close, a PhD recipient in 2004, who was recently appointed to the faculty at Stanford University.

This past year we added 14 new students to our graduate student population, resulting in a current total of 40 new and incoming students. Every graduate student is fully supported as either a teaching fellow or research assistant for the full 12 months. Teaching Fellows and Research Assistants are listed in Appendix A.

Graduate students Brian Hicks and Chris Mendillo in front of the PICTURE rocket at integration at Wallops Flight Facility.

Graduate Student Recruitment

Graduate student recruitment is critical to maintaining a vigorous graduate program. Competition for the best graduate students among the top schools is intense, and we must expend considerable effort in attracting the best students to Boston University for their graduate study. Our vigorous recruitment this year was highly

successful, with 5 students of very high quality accepting admission offers into our PhD program. This remarkable success in recruiting stems in large part from the enthusiastic participation of our current graduate students in the recruitment process, and from the dedication and hard work of the graduate admissions committee, led by Prof. Andrew West. A list of the incoming students is provided in the Appendix.

Graduate Curriculum

Two years ago we implemented a number of changes to the graduate curriculum, and student evaluations demonstrate that these changes were successful. One important change is to provide a 2-credit professional development course, AS 802, which explores issues that all young scientists face. For example, the course covers how the University is organized, how to apply for grant funding, how to select a research advisor, and how to deal with issues of credit in the student/advisor relationship.

Graduate Advising

Advising of graduate students was overseen by Prof. John Clarke, Director of Graduate Studies (DGS). Incoming graduate students are advised by the DGS, who continues to be their primary advisor until they select a research supervisor, usually no later than their first summer of graduate study. After this selection, the research advisor provides their primary advice. Nevertheless, all graduate student registrations are countersigned by the DGS to ensure that students register for the appropriate courses, especially as they prepare for the written component of the PhD qualifying examination (the "Comps"). The DGS continues to monitor students' progress throughout their graduate career, ensuring that they are making significant progress toward their degrees, and are satisfying all departmental, college, and university requirements.

COMMUNITY LIFE

Colloquium series

Weekly seminar series in both Astrophysics and Space Physics are held throughout the academic year. These are run as graduate seminar courses by members of the department faculty, and this year was financed by the Astronomy Department. The lists of outstanding speakers in both seminar series are provided in Appendix C.

Musical Events

Two annual highlights are our annual musical events performed by members and friends of the Department: "Astronomy Unplugged", an informal, intimate concert of popular contemporary music, and our "Musical Soiree", a formal concert of classical music held each spring in the Tsai Center. These open concerts build *esprit de corps* within the Department and are enjoyed by many more from within the larger BU community.

Prof. Josh Semeter's son, Owen, played "Sonata in D major" by Mateo Albeniz at the 21st Annual Musical Soiree. .

OUTREACH

Our most prominent outreach effort is our Public Open Nights held every clear Wednesday night in the Coit

Observatory. This program is run by our department curator, Quinn Sykes along with members of the BUAS, and draws hundreds of visitors annually from the Greater Boston area. We stress that the quality of this popular program and other special events are limited by, and indeed ever threatened by, the poor physical state of the Coit Observatory.

In addition, the Department hosted an alumni "star party" at the observatory. This sold-out event was very popular; thirty alumni looked through telescopes at beautiful astronomical objects like the Moon, Saturn, Jupiter, and the Orion Nebula

MULTIMEDIA INFORMATION

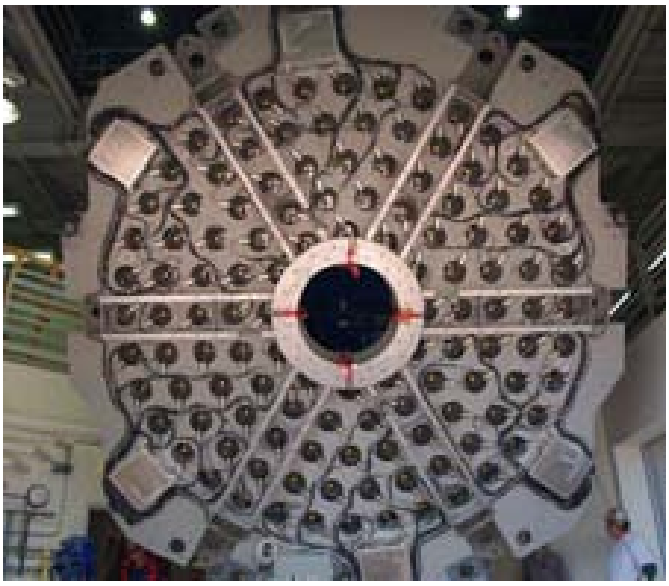
BU Today
Secrets of the Stars:
http://www.bu.edu/today/node/11991
One Class, One Day: Alien Worlds:
http://www.bu.edu/today/node/12679

NASA
Voyager: An Interstellar Journey
http://www.nasa.gov/mission_pages/voyager/heliosphere-surprise.html

LOOKING TO THE FUTURE

A New Research Facility: the Discovery Channel Telescope

With the University's commitment to fund a substantial share in the Discovery Channel Telescope the Department will enter a new phase. The Department has always faced a competitive disadvantage with essentially every other US Astronomy Department by lacking access to a significant research-grade telescope. While we are grateful for the support by the College and University for our 50% share of the 1.8-meter Perkins Telescope, we had always viewed the Perkins as a small, entry-level facility.



The primary mirror cell of the DCT. The pneumatic actuators seen here push and pull the mirror to remove distortions cause by its weight and deformations caused by moving the telescope around the sky.

Negotiations are now underway with Lowell Observatory for a significant share of the DCT. This $50 M is a state-of-the-art research telescope nearing completion at the Happy Jack site near Flagstaff. Its 4.3 meter diameter mirror makes it about 6 times more sensitive than the smaller Perkins telescope. In other words, in the same amount of time, the DCT can detect objects that are 6 times fainter than the Perkins can detect. This is an enormous upgrade and will provide a competitive, state-of-the-art research facility for the Department's researchers. When completed, it will be the 5th largest telescope in the continental United States.

The capabilities of the Discovery Channel Telescope are an excellent match the research interests of many of our faculty. It also provides a platform for Boston University instruments. For example, Prof. Clemens is proposing to build FLEXI, a novel multi-object fiber-optic feed that will allow astronomers to measure infrared spectra of 81 different objects simultaneously. Moreover, securing time on the Discovery Channel

Telescope would vastly improve student and faculty recruitment. The Discovery Channel Telescope was launched by an initial donation by Discovery, Inc. and a personal donation by Discovery's founder, John Hendricks to Lowell Observatory. The telescope is nearly finished, and will begin scientific operations in the next year or two. .

A Boston University partnership with the Discovery Channel Telescope will provide much more than a research facility for astronomers. A partnership with Discovery, Inc. would provide enormous benefits across the University. Discovery seeks a university partner to help foster its scientific education and outreach mission. Accordingly, this partnership provides exciting opportunities for faculty and students in our Schools of Communication and Education.

APPENDIX A: Faculty, Staff, and Graduate Students
Chair: Professor James Jackson
Associate Chair: Associate Professor Tereasa Brainerd
Director of Graduate Studies: Professor John Clarke
Director of Undergraduate Studies: Professor Dan Clemens
Department Administrator: Ms. Laura Wipf

Faculty
Thomas Bania, Professor of Astronomy. AB, Brown University; MS, PhD, University of Virginia
Elizabeth Blanton, Assistant Professor of Astronomy. AB, Vassar College; Ma, MPhil, PhD, Columbia University
Tereasa Brainerd, Associate Professor of Astronomy. BSc, University of Alberta; PhD, The Ohio State University
Kenneth Brecher, Professor of Astronomy. BS, PhD, Massachusetts Institute of Technology
Supriya Chakrabarti, Professor of Astronomy. BE, University of Calcutta; MS, PhD, University of California, Berkeley
John Clarke, Professor of Astronomy. BS, Denison University; MA, PhD, John Hopkins University
Dan Clemens, Professor of Astronomy. Bs, BS, University of California; MS, MS, PhD, University of Massachusetts
Timothy Cook, Associate Research Professor of Astronomy. BA, John Hopkins University, PhD, University of Colorado
Nancy Crooker, Research Professor of Astronomy. BA, Knox College; MS, PhD, University of California, Los Angeles
Theodore Fritz, Professor of Astronomy, Professor of Electrical and Computer Engineering, Professor of Aerospace and Mechanical Engineering. BA, Virginia Polytechnic Institute; MS, PhD, University of Iowa.
Charles Goodrich, Research Professor of Astronomy. BS, PhD, Massachusetts Institute of Technology
W. Jeffrey Hughes, Professor of Astronomy. BSc, PhD, University of London
James Jackson, Professor of Astronomy. BS, Pennsylvania State University; PhD, Massachusetts Institute of Technology
Kenneth Janes, Professor of Astronomy. AB, Harvard College; MS, San Diego State University; MA, MPhil, PhD, Yale University
John Lyon, Research Professor of Astronomy. ScB, Brown University; PhD, University of Maryland
Alan Marscher, Professor of Astronomy. BS, Cornell University; PhD, University of Virginia
Michael Mendillo, Professor of Astronomy, Professor of Electrical and Computer Engineering. BS Providence College; MA, PhD, Boston University
Merav Opher, Assistant Professor of Astronomy. BS, PhD, University of Sao Paulo
Meers Oppenheim, Associate Professor of Astronomy. BS, PhD, Cornell University
Jack Quinn, Research Professor of Astronomy. BA, University of Colorado; MS, PhD, University of California, San Diego
George Siscoe, Research Professor of Astronomy. BS, PhD, Massachusetts Institute of Technology
Harlan Spence, Adjunct Professor of Astronomy. BA, Boston University; MS, PhD, University of California, Los Angeles
Andrew West, Assistant Professor of Astronomy. BS, Haverford College; MS, PhD, University of Washington
Paul Withers, Assistant Professor of Astronomy. BA, MS, Cambridge University; PhD University of Arizona

Department Staff
David Bradford, Systems Manager, BS, Indiana University
Jeffrey Sanborn, Associate Systems Manager, BS, Boston University
Quinn Sykes, Observatory Manager, BS, MS, University of North Carolina, Charlotte
Laura Wipf, Department Administrator, BA, MA Boston University

Astronomy Graduate Students During 2010-2011

Name	Affiliation	Title
Ingolfur Agustsson	IAR	RA
Jan Marie Anderson	IAR	RA
Erin Arai	IAR	RA
Elizabeth Bass	CSP	RA
Dolon Bhattacharyya	AST	TA
Carol Carveth	CSP	RA
Anthony Case	CSP	RA
Lauren Cashman	IAR	RA
Christopher Claysmith	IAR	RA
Meredith Danowski	CSP	RA
Ewan Douglas	CSP	RA
Edmund Douglas	IAR	RA
Kathryn Fallows	AST	TA
Susanna Finn	IAR	RA
Katherine Garcia	CISM	RA
Zack Girazian	CSP	RA
Paul Howell	IAR	RA
Sadia Hoq	IAR	RA
David Jones	AST	TA
Christina Kay	CSP	RA
Kamen Kozarev	CSP	RA
Chad Madsen	AST	TA
Michael Malmrose	IAR	RA

Name	Affiliation	Title
Majd Matta	CSP	RA
Sarah McGregor	CISM	RA
Christopher Mendillo	CSP	RA
Jordan Montgomery	AST	TA
Dylan Morgan	IAR	RA
Jonathan Niehof	CSP	RA
Danielle Pahud	CISM	RA
Rachel Paterno-Mahler	AST	TA
Michael Pavel	IAR	RA
April Pinnick	IAR	RA
Christina Prested	CSP	RA
Patricio Sanhueza-Nunez	IAR	RA
Antonia Savcheva-Tasseva	AST	TA
Carl Schmidt	CSP	RA
Terri Scott	AST	TA
Laura Sturch	AST	TA
Jillian Tromp	CSP	RA
Brian Walsh	CSP	RA
Suwicha Wannawichian	CSP	RA
Karen Williamson	AST	TA
Joshua Wing	IAR	RA
Monica Young	IAR	RA
Mark Zastrow	CSP	RA

Incoming Graduate Students

Name	Undergraduate Institution
Susmita Adhikari	Indian Institute of Tech.
Zachary Curtis	Michigan State University
Dustin Hickey	Colby College
Christopher Theissen	UC San Diego
Michael Valdez	MIT

APPENDIX B: 2010/11 Astronomy Graduates

DOCTORATE

Name	Thesis Title
Ingolfur Agustsson	"Satellite Galaxies as Probes of Dark Matter Halos"
Monica Young	"Probing Quasar Accretion Physics with Optical and X-Ray Spectroscopy"
Anthony Case	"Galactic Cosmic Ray Variations at the Moon"
Andrew Jordan	"Probing the Small-Scale Structure of the Interplanetary Medium with High Time Resolution Galactic Cosmic Ray Observations"
Sarah McGregor	"On Tracing the Origins of the Solar Wind"
Jonathan Niehof	"Diamagnetic Cavities and Energetic Particles in the Earth's Magnetospheric Cusps"
Christina Prested	"Heliospheric_Energetic Neutral Atoms and Their Parent Plasma"
Suwicha Wannawichian	"Auroral Emissions and Electromagnetic Interactions Between Jupiter and Saturn and Their Satellites"

MASTER OF ARTS

Name	Advisor
David Jones	Andrew West
Alexander Crew	Harlan Spence
Ji Hyun Kim	Ken Janes

BACHELOR OF ARTS

Name	Concentration
Fernando Alvarado-Blohm	Geophysics and Planetary Sciences
Yee Lam Elim Cheung	Astronomy and Physics, with distinction, cum laude
Brandon Harrison	Astronomy and Physics
Natalie Hernandez	Astronomy and Physics
Christopher Janiszewski	Astronomy and Physics
Julie Moreau	Astronomy and Physics
Richard Obrecht	Geophysics and Planetary Sciences
Robert Pratt	Astronomy and Physics
Jeffrey Russo	Astronomy and Physics, cum laude
Hally Stone	Astronomy and Physics
Nora Watson	Astronomy

APPENDIX C: Seminar Series

Center for Space Physics Seminar Series, 2010/2011

Date	Title	Speaker/Affiliation
9-Sep	Star Shade	Webster Cash, University of Colorado
16-Sep	Water Ice and Organics on the Surface of the Asteroid 24 Themis	Humberto Campins, University of Central Florida
23-Sep	The HST Campaign of Auroral Imaging of Jupiter and Saturn	John Clarke, Boston University
30-Sep	Effects of Solar Electro-Magnetic and Particulate Radiations on the Nearth-Earth Space Environment	Abas Sivjee, Emry-Riddle
7-Oct	Estimating Upper Thermospheric Density and Temperature From Optical and Radar Data	Lara Waldrop, University of Illinois
14-Oct	Missions to Titan, the Enigmatic Moon of Saturn	Patricia Beauchamp, JPL
21-Oct	Scanning Forests with Lidar from the Ground Up	Alan Strahler, Boston University
28-Oct	Investments in our Future: Exploring Space through Innovation and Technology	Robert Braun, NASA
4-Nov	Lunar Dust Fountain and Martian Dust Storms: Challenges in Solar Power Production and Manned Exploration	Malay Mazumder, Boston University
11-Nov	Atmosperic Tides: Linking Deep Tropical Convection to Ionosphere-Thermosphere Variability	Jeff Forbes, University of Colorado
18-Nov	Theory of the Alfvenic Aurora	Robert Lysak, University of Minnesota
2-Dec	The Smallest and Fastest Aurora	Betty Lanchester, Southhampton, UK
27-Jan	Tales from the Outer Solar System	Michael Brown, California Institute of Technology
3-Feb	Enceladus' Plume: Perspectives from Simulations and Observations	Carol Paty, Georgia Tech
10-Feb	Observations of the space shuttle's main engine exhaust plume: Rapid poleward transport, diffusion and mesospheric cloud formation	Michael Stevens, Naval Research Laboratory
17-Feb	Mercury's Complex Exosphere: Intriguing Observations from the Three MESSENGER Flybys	Ron Vervack, The Johns Hopkins University Applied Physics Laboratory
24-Feb	A New Look at the Moon with LRO, LCROSS, & LAMP	Randy Gladstone, SWRI
3-Mar	Understanding magnetospheric plasma for its own sake, and for the benefit of the satellite engineering community	Timothy Guild, The Aerospace Corporation
10-Mar	Planets Near and Far: exploring new worlds with spacecraft radios and telescopes	Kerri Cahoy, MIT
24-Mar	Movie-maps of magnetic-storm disturbance	Jeffrey Love, USGS
31-Mar	Multi--sensor measurements of irregularities in the low--latitude ionosphere/thermosphere system	Jonathan Makela, University of Illinois
7-Apr	Characterisation of Exoplanets: The Next Step	Alan Aylward, UCL London
14-Apr	On interplanetary shocks driven by coronal mass ejections	Natchimuthuk Gopalswamy, GSFC
28-Apr	Recent Analyses of in-situ Thermospheric Measurements	James Clemmons, The Aerospace Corporation
5-May	Seeking Europa's Ocean	Robert Pappalardo, JPL

Institute for Astrophysical Research Seminar Series, 2010/2011

Date	Title	Speaker/Affiliation
13-Sep	Seeing the Unseeable: The Orientations of Galaxies Inside their Dark Matter Halos	Tereasa Brainerd, Boston University
20-Mar	MHD Turbulence in Molecular Clouds	Mark Heyer, UMASS
27-Mar	Frontier Planets: Wide Separation Giants and Hot Super-Earths	Ruth Murray-Clay, Harvard
18-Oct	Galaxy Groups from $0 < z < 1$: Evolution in Action	Laura Parker, McMaster University
25-Oct	Nuclear Star Clusters and Black Holes	Anil Seth, Harvard
1-Nov	The Last Eight-Billion Years of Intergalactic CIV and SiIV Evolution	Kathy Cooksey, MIT
8-Nov	The Formation and Evolution of Black Hole Seeds	Priyamvada Natarajan, Yale University
15-Nov	All the Low Mass Objects – Where Do They All Come From?	Fred Walter, SUNY at Stony Brook
22-Nov	Infrared Surveys of the Magellanic Clouds: From Galaxy Evolution to Planets	Alberto Bolatto, University of Maryland
29-Nov	Kinematics of Jets in Active Galactic Nuclei	Matt Lister, Purdue
6-Dec	Cosmic Explosions, Hot Dust, and the Infrared Instruments That Observe Them	Ori Fox, NASA GSFC
24-Jan	Current Issues in Understanding Extragalactic Relativistic Jets	Markos Georganopoulos, University of Maryland
31-Jan	Stellar Archaeology: New Science with Old stars	Anna Frebel, Harvard
7-Feb	Galactic Winds and Their Cosmological Implications	Sylvain Veilleux, University of Maryland, College Park
14-Feb	Occultation Studies of the Outer Solar System	Michael Person, MIT
22-Feb	High Velocity Outflows in Post-starburst Galaxies: the smoking gun for quasar feedback?	Christy Tremonti, University of Wisconsin, Madison
28-Feb	Clouds and Chemistry in the Atmospheres of HR8799b and 2M1207b	Travis Barman, Lowell Observatory
7-Mar	The Formation of Stochastic Spiral Arms in Disk Galaxies	Elena D'Onghia, Harvard
21-Mar	Simulations of Massive Star Formation	Mark Krumholz, University of California, Santa Cruz
28-Mar	Stellar feedback during star formation	Héctor Arce, Yale University
4-Apr	Multiwavelength Studies of Fermi-LAT Blazars	Manasvita Joshi, Boston University
11-Apr	Stellar Interiors	Matt Browning, Canadian Institute for Theoretical Astrophysics
21-Apr	Sub-mm CO lines	Tom Wilson, Naval Research Laboratory
25-Apr	Star Formation on Galactic Scales	Tim Paglione, CUNY
2-May	The Early Stages of Massive Star Formation	Claudia Cyganowski, Harvard

APPENDIX D: Accounts Income Expenditures

Operating Budget (20-201)

Category	Amount	Percent of FY11 Income
Operating Budget	$55,342	100%
Total Income	**$55,342**	**100%**

Category	Amount	Percent of FY11 Expenditures
Supplies	$14,087	22%
Telecom	$6,024	10%
Postage	$73	0%
Contracted Services	$3,108	5%
Reproduction and Printing	$1,664	3%
Books & Periodicals	$99	0%
Travel	$12,538	20%
Meeting Expenses	$10,695	17%
Unclassified	$806	1%
B&G	$12,340	20%
Computer Software	$1,100	2%
Scholarships	$419	1%
Total Expended	**$62,953**	**100%**

IDC Return (20-201-1021-9)

Category	Amount	Percent of FY11 Income
FY10 IDC forward	$43,398	21%
8% IDC	$158,924	79%
Total Income	**$202,322**	**100%**

Category	Amount	Percent of FY11 Expenditures
Instructors	$6,140	4%
Supplies	$1,031	1%
Contracted Services	$1,331	1%
Travel	$1,015	1%
Meeting Expenses	$928	1%
Scholarships	$2,368	1%
Sanborn Salary	$49,006	29%
FY10 4th qrtr IDC to CSP and IAR	$44,250	26%
IAR IDC operating	$6,000	3%
CSP IDC operating	$20,835	12%
Opher Start-up	$20,000	12%
BUSAT	$10,000	6%
Photonics IDC	$8,778	5%
Total Expended	**$171,682**	**100%**

Computer Equipment Account (20-201-1162-9)

Category	Amount	Percent of FY11 Income
FY10 Forward	$11,464	19%
1021-9 Transfer Funds	$47,719	81%
Income	**$59,183**	**100%**

Category	Amount	Percent of FY11 Expenditures
Admin Support	$46,166	79%
Supplies	$321	1%
Fringe	$11,623	20%
Total Expended	**$58,111**	**100%**

University Honors College Account (019-420)

Category	Amount	Percent of FY11 Income
UHC	$10,000	100%
Total Income	**$10,000**	**100%**

Category	Amount	Percent of FY11 Expenditures
Instructor Payroll	$7,000	70%
Admin Support	$650	7%
Supplies	$181	2%
Contracted Services	$391	4%
Unclassified	$1,774	18%
Total Expended	**$9,997**	**100%**