The Boston University Astronomy Department Annual Report 2009

Chair: James Jackson
Administrator: Laura Wipf

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Cover photo: the Horsehead Nebula, imaged by undergraduate student David Jones using the Perkins 72-inch telescope at Lowell Observatory.

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 twelve undergraduates with a major concentration in astronomy or astronomy and physics, and one with a minor in astronomy. Currently, 43 undergraduates major in astronomy. Among university astronomy programs our program is among the largest in the US.

In our graduate program, we recruited an incoming class of six new students, bringing our total of new and ongoing astronomy graduate students to 40. The Boston University graduate program in astronomy is also one of the largest in the country. After a rigorous review of our graduate program, the curriculum was updated and improved, and several new courses, including a course in professional development, were approved by the College.

The Astronomy Department had a spectacular 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 was our best ever; Astronomy Department researchers raised a remarkable $21,271,716, or about M$1.3 per teaching faculty, both among the highest for all units in CAS. Our faculty and research associates authored or co-authored a total of 90 refereed, scholarly papers in the disciplines' most prestigious journals.

The Department had several noteworthy scientific achievements. The Cosmic Ray Telescope for the Effects of Radiation (CRaTER), an instrument built by PI Harlan Spence and his group to examine the radiation environment near the Moon, was successfully launched and is now collecting data from the lunar orbit. The Interstellar Boundary Explorer (IBEX) satellite, whose Science Operations Center is hosted at Boston University by Prof. Nathan Schwadron and his group, was also successfully launched and is now measuring the properties of high-energy neutral atoms entering local space from beyond the "heliopause," the bubble-like region surrounding the sun and shaped by its magnetic field. Prof. Meers Oppenheim's research on radar observations on meteor trails was featured in the national journal *Physics Today*.

Boston University has renewed its five-year agreement with Lowell Observatory for 50% of the observing time on the 72-inch Perkins Telescope near Flagstaff, Arizona. This telescope provides not only an important research facility for large astronomical projects, but also an important educational facility for our students.

In summary, the Department continues to thrive, serve, lead, and prosper with a strong educational programs and an outstanding research program. We look forward to working with the College to find solutions to the Department's pressing needs for more space and a state-of-the-art research telescope.

FACULTY AND STAFF

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. We are pleased to welcome our newest faculty member, Dr. Andrew West, who will be joining the department in the Fall Semester after completion of his postdoctoral position at MIT. Dr. West brings an exciting new research program on the magnetic activity of stars and the vertical structure of the Milky Way galaxy. 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. To cite just two examples, Prof. Bania helps to select candidates for important positions within the American Astronomical Society, and Prof. Blanton is an on-screen video guide for the museum exhibition "Black Holes: Space Warps and Time Twists," now at Boston's

Museum of Science, which will be displayed throughout the US through 2012. This activity not only keeps our faculty informed of national and international developments, but it also allows us to form and influence national research policies. This high level of external activity demonstrates our stature among the first rank of the nation's research departments.

TEACHING

Approximately 560 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. 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 300 students per year enroll in this course.

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.

4. 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.

UNDERGRADUATE PROGRAMS

Director of Undergraduate Studies:
Professor Wm. Jeffrey Hughes

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 five 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 three, AS 100 Cosmic Controversies, AS 109 Cosmology and AS 117 Cosmic Evolution, are more focused topical courses which do not carry laboratory credit. This year we offered eight sections of these courses: three sections of AS 101, two of AS 102, and one each of AS 100, AS 109, and AS 117. AS 100 (Cosmic Controversies), developed and taught by Prof. Mendillo, is now in its second year. AS 100 focuses on a few key, unresolved issues in modern astronomical research, and is becoming one of our most popular courses. Indeed, enrollments in AS100 have tripled from 24 in its first year to 71 in its second. In addition, we offered two honors sections, which were run as additions to regular courses.

Figure 1: Composition of Astronomy 100-Level Classes by College, AY 08-09

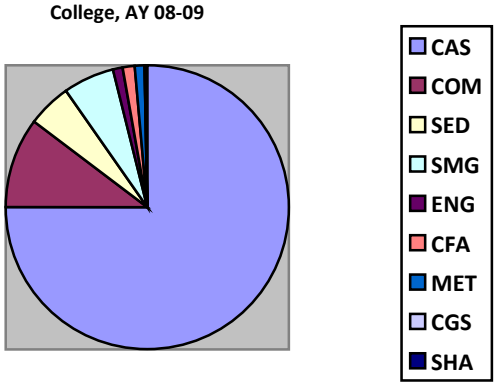


Figure 1 indicates that the total 100-level enrollment was 481 in 2008/2009. Of the students taking these courses,

approximately 75% (361) were CAS students and 25% (120) were students from other schools and colleges.

Undergraduate Students in the Boston University Astronomical Society, BUAS, posing in front of the Coit Observatory on the roof of CAS.

The Core Curriculum

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 eight 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 three lecturers per year to CC105.

This year, Professors Jackson and Marscher staffed the Core Curriculum course. We anticipate another strong representation of astronomy faculty and leadership in CC105 next academic year by providing three lecturers, Profs. Jackson, Marscher, and Brainerd.

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 2008/09 academic year, 43 students (some of whom have declared an additional concentration) were declared as majors in one of the Department's concentrations, and many additional students who expressed a strong interest in astronomy were being advised by an astronomy faculty member. The most popular concentration is Astronomy and Physics (30), followed by Astronomy (7) and Geophysics and Planetary Sciences (6). These numbers are distributed fairly evenly over the freshman to senior classes and remain comparable with last year's distribution.

This year's graduating class consisted of 12 students; 9 received BAs in Astronomy and Physics, 1 in Geophysics and Planetary Sciences, and 1 in Astrophysics and Space Science (through the BA/MA program). 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.

Undergraduate Curriculum

The Department has recognized that many non-majors would be interested in a 100-level course that covers both the solar system (now taught in AS 101) as well as stars and galaxies (now taught in AS 102). Accordingly, to fill this need, Prof. Mendillo has crafted a new course, AS100 "Cosmic Controversies," that deals with several exciting open questions in modern astronomy. In only

its second year, AS 100 has tripled its enrollments to 71 students and is rapidly becoming one of our most popular courses.

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 Jeffrey Hughes.

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.

OBSERVATORY AND FACILITIES

Observatory Improvements

The disparity between our national departmental prominence and the poor quality of our teaching observatory continues to be embarrassing, with negative impacts on recruitment efforts and alumni relations. Although in 2006 we undertook some badly needed cosmetic improvements to the observatory, including new interior walls, floor, and ceiling, we are nevertheless a long way from an acceptable facility. The metal walls behind the new drywall are corroded, and the exterior walls are rusted and peeling.

The observatory dome disguised as a baseball for the Red Sox Opening Day.

Every Wednesday night we open the observatory to the public to view astronomical objects through our telescopes, and the face we present to the public is one of abject poverty. Many high schools and community colleges have better telescope facilities than ours. We will once again ask the University's assistance in bringing the quality of our teaching observatory up to modern standards. We do thank the College for providing significant financial support in helping us upgrade our teaching telescope facilities.

GRADUATE PROGRAM

Director of Graduate Studies: Professor Meers Oppenheim
Director of Graduate Admissions: Professor Nathan Schwadron

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, Nicholeen Viall won an outstanding paper award at the annual American Geophysical Union conference, and Susanna Finn won an honorable mention for her poster at the meeting of the American Astronomical Society. Moreover, graduate students

Loren Anderson and Rittaban Chaterjee were awarded research grants from the National Radio Astronomy Observatory and NASA, respectively. 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.

This past year we added seven 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 Student Nicholeen Viall performs while Systems Administrator David Bradford accompanies her on piano at the Annual Musical Soiree.

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 successful. Our incoming graduate class numbers six students, ensuring that the size of our graduate program nevertheless remains at a near-record high level.

Professor Nathan Schwadron led our graduate recruitment effort this year, and the entire department (faculty, students, and staff) participated significantly in meeting with visiting graduate students and educating them about the strengths and values of our program. Prof. Schwadron led an outstanding effort in actively recruiting several top applicants and converting them into incoming students. A list of the incoming students is provided in the Appendix.

Graduate Curriculum

In 2006, the Department appointed a committee to review its graduate curriculum. The committee's recommendations were approved by the faculty and in 2007/08 we began to implement some of their initial recommendations. In 2008/09, the new curriculum was reviewed and approved by the College. These revisions consist of three major changes:

1. *The Astronomy Department will offer three new graduate courses*. Two of these, AS 802 and AS 803 will now be required. The three new courses are:

   - **AS 786: The Sun and Heliosphere**. Since many of our graduate students go on to research topics in space physics relating to the sun's interaction with interplanetary space, a course covering the important aspects of solar and heliospheric physics is in high demand. Prof. Nathan Schwadron developed this new course, which was offered for the first time in Spring 2008.

   -**AS 802: Graduate Research and Scholarship**. This is a 2-credit professional development course required of all incoming graduate students. Developed by Prof. Jeffrey Hughes and taught last year by Prof. Supriya Chakrabarti, this course covers practical and ethical issues facing graduate students to help prepare them for a research career.

   -**AS 803: Research Methods in Astronomical Data Analysis**. AS 803 is a 2-credit course introducing graduate students to modern approaches to data analysis in astrophysics and space physics. Using the high-level programming language Interactive Data Language (IDL), students will learn basic computer programming skills, elementary

image processing, and visualization techniques for astronomical datasets.

2. *The course content of three of our advanced graduate courses will be revised*:
    a. AS 751, now called "Galactic Astronomy and the Interstellar Medium," will now be called "the Interstellar Medium." The Galactic astronomy content will be moved to AS 753.
    b. AS 753, now called "Stars and Stellar Systems," will be renamed "Normal Galaxies and the Milky Way," and will emphasize the recent revolution in our understanding of normal galaxies. The stellar astronomy content now covered in AS 753 will be taught as needed as a special seminar.
    c. AS 759, now called "Galaxies and Cosmology," will be renamed "Cosmology." The current material on normal galaxies will be moved into AS 753, and the material on cosmology will be expanded.

3. *Two advanced courses will be deleted from the books,* AS 755 "Radio Astrophysics" and AS 761 "Interstellar Chemistry." These courses have not been taught for years and will be retired.

Graduate Advising

Advising of graduate students was overseen by Professor Meers Oppenheim, 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.

Our graduate program is small enough for the faculty collectively, once a year during a fall faculty meeting, to discuss the progress of each graduate student individually. This process allows us to compare assessments and experiences, to identify any potential problems with individual students, and to suggest solutions to the identified problems.

Graduate Student, Sarah McGregor, uses the Solar Laboratory.

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, but organized and financed by the Institute for Astrophysical Research and the Center for Space Physics, respectively. The lists of outstanding speakers in both seminar series are provided in Appendix C.

ALUMNI AFFAIRS/PUBLIC OUTREACH

Two annual public outreach/alumni 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.

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. The attraction of our special events to the general public and alumni stands in stark contrast to our inability to deliver quality programs due to the limitations of our facility, demonstrating the urgent need for a new observatory complex.

In addition, the Department participates in the Homecoming Week festivities by hosting an astronomy lecture and a "star-gazing party" for interested alumni.

The Cosmic Ray Telescope for the effects of Radiation, CRaTER, launching on an Atlas 5 Rocket.

RESEARCH

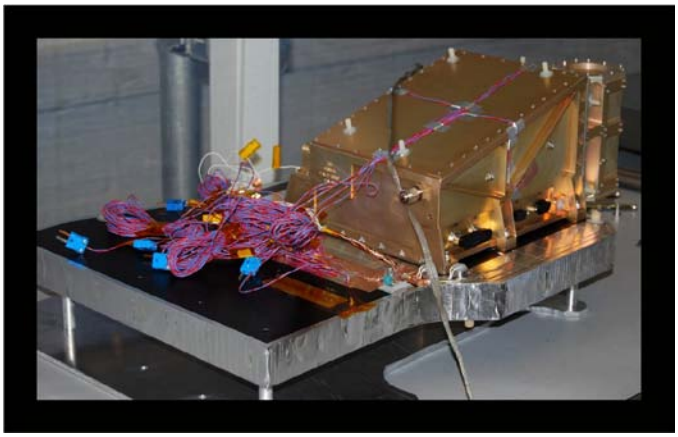
The Department of Astronomy, through its affiliated research units, the Center for Space Physics (CSP), the Institute for Astrophysical Research (IAR), and the Center for Integrated Space Weather Modeling (CISM), has a robust and thriving research program. Every member of the faculty maintains a research 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 2008-09 are remarkable. Some highlights include:

-The **Cosmic Ray Telescope for the Effects of Radiation** (CRaTER), was launched and is now orbiting the moon as part of the Lunar Reconnaissance Observatory (LRO). This project, led by Prof. Spence, will measure the intensity of cosmic rays near the Moon, and assess the potential radiation hazard to future lunar astronauts.

-The **Interstellar Boundary Explorer** (IBEX) satellite, whose Science Operations Center is hosted at Boston University by Prof. Nathan Schwadron and his group, was also successfully launched and is now measuring the properties of high-energy neutral atoms entering local space from beyond the "heliopause," the bubble-like region surrounding the sun and shaped by its magnetic field.



CRaTER just before being mounted onto the spacecraft.

-Boston University has renewed its five-year agreement with **Lowell Observatory** for 50% of the observing time on the 72-inch Perkins Telescope near Flagstaff, Arizona. This important facility allows Boston University guaranteed access to state-of-the-art instrumentation and ample observing time for large, time-consuming projects that would be impossible at national facilities.

-Boston University research on **radar observations of meteor trails** were featured in an article in the national trade journal *Physics Today*. This research, performed by Prof. Meers Oppenheim and his group, uses radar echoes to study the structure and evolution of hot gas trails generated by meteor impacts with the atmosphere.

These highlights are the tip of the iceberg---more research done through the auspices of CISM, CSP, and IAR is described in more detail in their annual reports. Please read these three annual reports for a more comprehensive description.

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 and $21.2 M in FY2009). This accomplishment is even more impressive considering the small size of our faculty. Indeed, the average grant income raised per teaching faculty member in the Astronomy Department is $1.3 M, far more than for any other CAS department.

IBEX launching on a Pegasus rocket.

We are confident that we will continue to win both the large grants similar to CRaTER, IBEX, LCI, and CISM, as well as the smaller "bread-and-butter" grants that sustain our base program.

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. We continue to stress the importance of this diversity as a hedge against the shifting sands of highly competitive federal and private research funds. A full listing of funding received this year can be found in Appendix D.

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 90 articles in refereed journals during the reporting period. A full accounting of these publications is in the CSP, CISM, and IAR annual reports.

FUTURE PLANS AND DEPARTMENTAL NEEDS

In order to remain competitive with other nationally prominent astronomy and space physics programs, the Astronomy Department has several pressing needs. We sorely need a new observatory complex. Office and lab space is so scarce that we can no longer grow or take on significant new projects. If we are to compete with other departments, we will also need to procure permanent access to a large telescope.

A New Observatory Complex

The physical condition of our on-campus teaching observatory is shamefully poor and completely inconsistent with the national stature and high quality of our educational and research programs.

The Coit Observatory on the roof of the CAS building is arguably the department's most important teaching facility, serving hundreds of students per year. On Wednesday evenings we have for many years opened the observatory to the public and they return with great regularity in large number. This summer we are hosting

an alumni event that will use the observatory. The observatory is necessarily a focal point of any tour of the department by prospective students or others. However, several local area high schools have significantly better observatories than ours.

The appalling state of our observatory presents a public image of squalor that is truly unacceptable to a modern research university. What should and could be a crowning gem for the Astronomy Department, the CAS building, and the College and University, is instead an ongoing embarrassment.

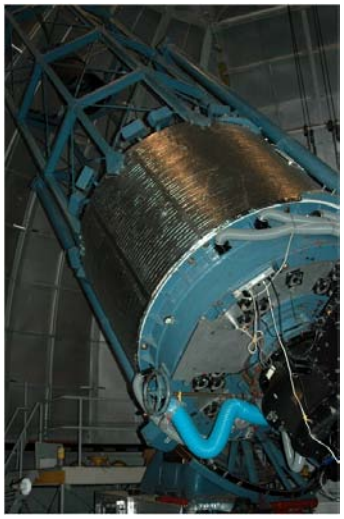
We have made some cosmetic repairs to the observatory (dry wall and paint), but the fundamental problems remain hidden. Behind the drywall the basic structure remains corroded and deteriorating. Our telescopes are antiquated and our equipment substandard. The outside walls remain cracked and peeling. In sum, the observatory is the most public part of the department's facilities yet it is our very poorest face.

If we are to teach astronomy divisional courses with a laboratory component that is to include access to the night sky, and if we are to teach our majors and graduate students modern observational astronomy, then we must build a new observatory. The new observatory should include a museum to house our historically significant antique astronomical telescopes and instruments. We envision also a planetarium/theatre and teaching labs in addition to modern telescopic facilities. This new multi-million dollar facility would be a resource not only for the department, but also for the entire BU community. Moreover, by freeing up departmental space currently used for teaching labs and classrooms, a new observatory would also help to solve our perennial space-shortage problem.

We look forward to working with Administration and Development to resolve the long-outstanding and ever-worsening problem of our presently inadequate observatory. We are eager to work to identify funds and/or donors to make our vision for a new observatory complex a reality. We hope that this visionary project will become a primary need presented to potential donors and a priority for BU capital investments.

Our Physical Space Crisis

The Department faces a severe space shortage. We no longer have adequate room to house our growing research and teaching missions. With the continuing success of our research efforts, we are attracting larger and larger projects to the Department, but we are being forced to cram our personnel into smaller and smaller spaces. As a consequence, during this fiscal year, we have exceeded full capacity. The arrival of three large hardware projects, a return of our graduate program to larger levels, and the conversion of Room 500 into an Access Grid room and Room 502 into a classroom/seminar room has created an office space crisis. We are delaying necessary hires because we have no place to put them. We have no space for storage, or for our growing computer facilities. We have barely adequate space for teaching laboratories, and less than adequate space for teaching computer labs. We have no common areas for scientific interactions. We are beginning to place established researchers in former closets and reception areas. Our on-campus teaching observatory is literally falling apart. More efficient use of our space is no longer an option.



The only small research telescope on which Boston University students and faculty are guaranteed observing time is the Perkins Telescope at Lowell Observatory near Flagstaff, AZ.

We hope that the University will be able to use Photonics, or other facilities, to accommodate our current and future projects. We look forward to help from the University in meeting our pressing need for additional space.

A New Research Facility

While we are extremely grateful for the University's efforts in securing access to the Perkins Telescope, we have always viewed the Perkins as an entry-level facility to allow Boston University to allow us to begin a program in astronomical instrumentation and to secure funding for long-term astronomy projects. Although the Perkins has been exceedingly useful, it still falls well below the standards enjoyed by our competitors. Indeed, all of our peer astronomy departments (and many lower-tiered departments) have access to telescopes superior to the Perkins. Indeed, *essentially every other astronomy department at a research university enjoys regular access to telescopes with over twice the collecting area as the Perkins telescope*.

To remain competitive, Boston University must secure access to high-level, research-grade telescopes. A growing trend in the field is for universities, or consortia of universities, to fund telescopes to provide guaranteed telescope time to their faculty. With the dwindling funding of national telescope facilities, having one's own telescope is the only way to perform the observations necessary to thrive. Furthermore, access to telescopes is a prerequisite for funding astronomical instrumentation. We simply cannot compete unless we gain access to a telescope of our own.

Several new telescopes are being proposed. One of these, the Discovery Channel Telescope, a new 4-meter optical and infrared telescope in Arizona, is particularly appealing. This telescope would provide an excellent new facility that would match the research interests of many of our faculty. Moreover, securing time on the Discovery Channel Telescope, or another similar facility, would vastly improve student and faculty recruitment.

We recognize that a large investment in astronomy research may require a significant contribution from donors. We would be delighted to work with the College and University to help identify donors and to promote our telescope projects as an important University-wide priority.

APPENDIX A: Faculty, Staff, and Graduate Students

Chairman: Professor James Jackson
Associate Chairman: Professor Kenneth Janes
Director of Graduate Studies: Professor Meers Oppenheim
Director of Undergraduate Studies: Professor W. Jeffrey Hughes
Department Administrator: Ms. Laura Wipf

Faculty

Thomas Bania, Professor of Astronomy. AB, Brown University; MS, PhD, University of Virginia
Sunanda Basu, Research Professor of Astronomy and Space Physics. BSc, Calcutta University (India); AM, Boston University; PhD, Calcutta University (India)
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
Jiasheng Chen, Assistant Research Professor of Astronomy. BS, Peking University; MS, Chinese Academy of Sciences; PhD University of Delaware
John Clarke, Professor of Astronomy. BS, Denison University; MA, PhD, Johns 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 and Space Physics. BA, Johns Hopkins University, PhD, University of Colorado
Nancy Crooker, Research Professor of Astronomy and Space Physics. BA, Knox College; MS, PhD, University of California, Los Angeles
Theodore Fritz, Professor of Astronomy and Space Physics, Professor of Electrical and Computer Engineering, Professor of Aerospace and Mechanical Engineering. BS, Virginia Polytechnic Institute; MS, PhD, University of Iowa
Charles Goodrich, Research Professor of Astronomy and Space Physics. 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 and Space Physics. ScB, Brown University; PhD, University of Maryland
Alan Marscher, Professor of Astronomy, Associate Dean. 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
Meers Oppenheim, Associate Professor of Astronomy. BS, PhD, Cornell University
Jack Quinn, Research Professor of Astronomy and Space Physics. BA, University of Colorado; MS, PhD, University of California, San Diego
Nathan Schwadron, Associate Professor of Astronomy. BA, Oberlin College; PhD, University of Michigan, Ann Arbor
George Siscoe, Research Professor of Astronomy and Space Physics. BS, PhD, Massachusetts Institute of Technology
Harlan Spence, Professor of Astronomy. BA, Boston University; MS, PhD, University of California, Los Angeles

Department Staff

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

Astronomy Graduate Students During 2008-2009

Name	Affiliation	Title
Ingolfur Agustsson	IAR	RA
Jan Marie Andersen	AST	TA
Loren Anderson	IAR	RA
Elizabeth Bass	CSP	RA
Dipesh Bhattarai	AST	TA
Lauren Blum	CSP	RA
Carol Carveth	IAR	RA
Anthony Case	CSP	RA
Edward Chambers	IAR	RA
Ritaban Chatterjee	IAR	RA
Christopher Claysmith	CSP	RA
Alex Crew	CSP	TA
Meredith Danowski	AST	TA
Francesca D'Arcangelo	IAR	RA
Edmund Douglass	IAR	RA
Julia Duval	IAR	RA
Susanna Finn	IAR	RA
Katherine Garcia	CSP	RA
Paul Howell	IAR	RA
Andrew Jordan	CSP	RA

Name	Affiliation	Title
Ji Hyun Kim	IAR	TA
Kamen Kozarev	CSP	RA
Michael Malmrose	AST	TA
Majd Matta	CSP	RA
Sarah McGregor	CSP	RA
Christopher Mendillo	CSP	RA
Jonathan Niehof	CSP	RA
Danielle Pahud	CSP	RA
Michael Pavel	IAR	RA
April Pinnick	IAR	RA
Christina Prested	CSP	RA
Patricio Sanhueza	IAR	PUGF
Carl Schmidt	CSP	RA
Aslihan Unsal	AST	TA
Nicholeen Viall	CSP	RA
Brian Walsh	CSP	RA
Suwicha Wannawichian	CSP	RA
Joshua Wing	IAR	RA
Pin Wu	CSP	RA
Monica Young	IAR	RA

Incoming Graduate Students

Graduate Student	Undergraduate Institution
Lauren Cashman	University of Pittsburgh
Ewan Douglas	Tufts University
Chad Madsen	Boston University
Dylan Morgan	University of Washington
Antonia Savcheva-Tasseva	Massachusetts Institute of Technology
Laura Sturch	Harvey Mudd College

APPENDIX B: 2008/09 Astronomy Graduates

MASTER OF ARTS

Name	Advisor
Kamen Asenov Kozarev	Nathan Schwadron
Sean Alexander Lockwood	Supriya Chakrabarti
Carl Andrew Schmidt	Michael Mendillo
Brian Michael Walsh	Theodore Fritz
Charlotte Hau Yiu Wong	Theodore Fritz
Monica Claudia Brucker Young	Alan Marscher
Carol Jeanette Carveth	John Clarke
Nicholas Patrick Lee	Meers Oppenheim

BACHELOR OF ARTS

Name	Concentration
Jessica Kate Donaldson	Astronomy and Physics, *summa cum laude*
Anthony Francis Falsetti III	Astronomy
Karen Godfrey	Geophysics and Planetary Sciences
Christopher John Havlin	Geophysics and Planetary Sciences
Katherine Jameson	Astronomy and Physics, with distinction
David Li	Astronomy and Physics
Chad Allen Madsen	Astronomy and Physics, *cum laude*
Emily Rachel Manne-Nicholas	Astronomy and Physics, with distinction, *cum laude*
Joseph James Megnia	Astronomy
Alice Rose Olmstead	Astronomy and Physics, with distinction, *magna cum laude*
Laura Sybil Storch	Astronomy

APPENDIX C: Seminar Series

Institute for Astrophysical Research Seminar Series, 2008/2009

Date	Title	Speaker
Sept. 9	"Probing Deeply Into the Inner Jets of Blazars"	Alan Marscher, BU/IAR
Sept. 23	"The Rotational Evolution of Low-Mass Stars"	Soren Meibom, Center for Astrophysics
Oct. 7	"New Clues About Inflation, Dark Matter, and Dark Energy"	Max Tegmark, MIT
Oct. 21	"Young Planets in Visible and Infrared Light: Spots' Tricks"	Lisa Prato, Lowell Observatory
Oct. 28	"Exoplanet Frontiers: Multiple-Planet Systems, Solar System Analogs, and Planets Around M-Dwarfs"	Jason Wright, Cornell University
Nov. 4	"Fainter and Closer: New High-Resolution Imaging Capabilities at the WIYN Telescope	Elliot Horch, Southern Connecticut State University
Nov. 18	Joint IAR/CSP Seminar: "The Drama of Copernicus: How He Was Convinced to Publish his Crazy Idea"	Dava Sobel, Author
Nov. 25	"Intermediate and High-Velocity "Clouds" A New Look at an Old Problem"	Gerritt Verschuur, University of Memphis
Dec. 2	"The Origin and Evolution of Astrophysical Magnetic Fields"	Ellen Zweibel, University of Wisconsin
Dec. 9	"SEGUE-1, SEGUE-2, and the Future of Large Scale Surveys of the Galaxy"	Tim Beers, Michigan State University
Jan. 20	"Hypervelocity Stars and Massive Black Holes"	Warren Brown, CfA
Jan. 27	"GPIPS and other fun with the Perkins Telescope"	Dan Clemens, IAR
Feb. 10	"From Foreground Trash to Bountiful Treasure: Galactic Stratigraphy, Magnetic Activity and the Kinematics of M dwarfs in the Sloan Digital Sky Survey"	Andrew West, MIT
Feb. 17	"Eruptive Mass Loss in Massive Stars and Precursors to the Most Luminous Supernova Explosions"	Nathan Smith, UC Berkeley
Feb. 23	"The History of Star Formation of Early-Type Galaxies"	Riccardo Schiavon,Gemini
Feb. 24	"Magnetic Activity on CV Secondaries: Nature or Nurture?"	Stella Kafka, CalTech
Mar. 6	"Stellar Tracers: Probing Physics and Galactic Structure"	Peter Frinchaboy, University of Wisconsin
Mar. 17	"The Galactic Center"	Cornelia Lang, University of Iowa
Mar. 24	"Dark Energy or Modified Gravity?"	Ed Berschinger, MIT
Mar. 31	"The CHAMPS Mopra Molecular Line Survey"	Peter Barnes, University of Florida
Apr. 7	"LMT"	Peter Schloerb, University of Massachusetts
Apr. 14	"BLAST"	Gregor Tucker, Brown University
Apr. 28	"The Recent Star Formation Histories of Nearby Galaxies"	Evan Skillman, University of Minnesota

Center for Space Physics Seminar Series, 2008/2009

Date	Title	Speaker
Sept. 11	Winds, Aurora, Temperature, and Composition of Planetary Atmospheres from High Resolution Infrared Spectroscopy	Theodor Kostiuk NASA Goddard Space Flight Center
Sept. 18	What Everyone Should Know About Inner Magnetospheric Physics	Jerry Goldstein Southwest Research Institute, San Antonio
Sept. 25	The Power of Photons - Super Sodium Tails in the Solar System	Michael Mendillo Boston University
Oct. 2	Tales of Meteor Trails: Lessons from Radar Observations and Theory	Meers Oppenheim Boston University
Oc.t 9	STEREO Imaging of the Sun and the Inner Heliosphere During Solar Minimum	Angelos Vourlidas Naval Research Laboratory
Oct. 16	Solar Wind Interaction with the Atmosphere of Venus in the Light of Fresh Data from Venus Express	Hannu Koskinen University of Helsinki
Oct. 23	Ionospheric Outflow and Magnetosphere-Ionosphere Coupling	William Lotko Dartmouth University
Nov. 6	The Remote Atmosperic Ionospheric Detection System: New Science from the ISS	Andrew Stephan Naval Research Laboratory
Nov. 13	The Drama of Copernicus: How He Was Convinced to Publish his Crazy Idea	Dava Sobel
Nov. 19	New Horizons: Exploring the Solar System's Third Zone	Alan Stern Southwest Research Institute
Dec. 4	Unraveling Mira's Mysterious Tail	Don Neill Caltech
Jan. 15	Seminar Series Preview	Michael Mendillo Boston University
Jan. 22	Hydrated Minerals on Mars and their Geologic Environments: Implications for the History of Water	Jack Mustard Brown University
Jan. 29	The Weird Ionosphere of Titan Revealed by Cassini	Marina Galand Imperial College
Feb. 5	Progress on Understanding Magnetic Reconnection Using Observations from Earth's Magnetospheric Cusps	Stephen Fuselier Lockheed Martin
Feb. 12	Are Fluctuations in the Ionosphere Linked to Sudden Warming in the Stratosphere?	Larisa Goncharenko Haystack Obs/MIT
Feb. 19	Solar Wind - Thermosphere Coupling: A Newly Discovered Breathing Mode of the Upper Atmosphere	Jeff Thayer University of Colorado
Feb. 26	Convection, Magnetism and the Inner Turmoil of Stars	Mark Miesch HAO/NCAR
Mar. 5	Gravity Waves in Planetary Atmosphere	Katia Matcheva University of Florida
Mar. 19	Space Law	Rosanna Sattler Posternak Blankstein & Lund
Mar. 26	Meteors: Watch Out!	Margaret Campbell-Brown University of Western Ontario
Apr. 2	New Stuff About the Heliosphere	Joe Giacalone University of Arizona
Apr. 9	Psychological and Psychiatric Issues in Space	Nick Kanas University of California
Apr. 13	The role of H3+ in planetary atmospheres	Steven Miller, Univ. College London
Apr. 23	Energy Crisis at Saturn: The Role of Thermosphere-Ionosphere Coupling	Ingo Mueller-Wodarg Imperial College
May. 21	Hemispheric Asymmetries	Aaron Ridley, Univ. Michigan

APPENDIX D: Sponsored Project Funding

Funding Received on New or Continuing Grants by Astronomy Faculty/Senior Research Associates in FY09

PI	Agency/Number	Title	Amount
Bania	2640 NSF/GBT*	NRAO GBT Student Support	$12,820
Basu	ONR 9536-5	Multi-Technique studies of Ionspheric Plasma Structuring	$74,432
Blanton	2746 SAO*	Shocks, Ripples and Bubbles: A Very Deep Observation of Abell 2052	$154,209
Brainerd	9578 NASA Subcontract	HIPO: High Speed Imaging Photometer for Occultations (Subcontract from Lowell Obs.)	$41,850
Chakrabarti	NASA 2722-5*	JPL Additional Tasks: Planet Imaging concept test bed using a rocket experiment (PICTURE)	$61,000
Chakrabarti	NASA 2426-5	Planet Imaging Concept Testbed Using a Rocket Experiment (PICTURE) Supplement	$100,000
Clarke	STSci/Aura 2690-5*	Imaging Saturn's Equinoctal Auroras (Subcontract via Space Telescope Science Institute)	$64,401
Clarke	STSci/Aura 2822-5*	HST Observations of Titan's Escaping Atmosphere in Transit and in Emission	$92,179
Clarke	STSci/Aura 2923-5*	Observing Saturn's High Latitude Polar Auroras	$72,150
Clarke/Cook	NASA 2378-5	Sounding Rocket UV Measurement of the D/H Ratio in the Upper Atmosphere of Venus and Relation to the Historic escape of Water.	$246,545
Cook	NASA 2682-5*	The M101 Interstellar Medium Absorption Gradient Experiment Rocket (IMAGER)	$268,543
Cook	NASA 9923-5	A Rotational Shearing Interferometer for Planet Detection.	$142,000
Crooker	NSF 6573-7*	International Heliophysical Year (IHY) Chapman Conference on Universal Heliophysical Processes	$18,522
Crooker	NSF 9201-5	SHINE: Studies of ICME-CME Connections and Implications for Heliospheric Topology	$80,324
Dimant	NSF 2488-5*	NEWP: Improving Quantitative Modeling of High-Latitude Electrojet Conductives During Magnetic Storm and Substorm Time	$78,283
Fritz	NASA 2456-5*	The Cluster RAPID Investigation 2008-2011	$104,367

Fritz	NASA 2512-5*	The Cluster RAPID Investigation 2008-2011: University of Colorado Boulder Subcontract	$60,000
Fritz	NASA 2513-5*	The Cluster RAPID Investigation 2008-2011: Aerospace Corporation Subcontract	$20,000
Fritz	NASA 2514-5*	The Cluster RAPID Investigation 2008-2011: UMass Lowell Subcontract	$149,998
Fritz	AFOSR 8888-5	The Loss Cone Imager (LCI)	$162,838
Fritz	DOD/ AFOSR 9581-5	The Loss Cone Imager (LCI). HST and Cost-to-Complete (Supplement) (in conjunction with the Photonics Center)	$1,486,196
Goodrich	NASA 1240-8	NASA IPA Agreement	$159,881
Hughes	NSF 9763-5	STC: Center for Integrated Space and Weather Modeling	$4,000,000
Jackson	2459 NSF*	Infrared Dark Clouds	$209,090
Jackson	2673 NASA*	Galactic Structures Using 2Mass Data	$104,343
Jackson	2793 SAO*	SAO: Long-Term M-W-R Telescope Survey for Dense, Star-Forming Gas Clouds in the Milky Way	$2,079
Janes	2398 NSF*	REU Supplement: Old Star Clusters: Stellar Activity and Galactic Structure	$7,873
Jorstad	2477 NASA*	Searching for the Connection between X-ray and Gamma-ray Variability and Jet Activity in Blazars	$36,800
Jorstad	2564 NASA*	High Resolution Mapping of the Gamma-Ray Emission Regions in Blazar Jets	$82,997
Marscher	2238 NASA	Probing the Relativistic Jets of Active Galactic Nuclei with Multiwaveband Monitoring	$37,394
Marscher	2472 NASA*	Comprehensive Multiwaveband Monitoring Program of Gamma-Ray Bright Blazars	$233,994
Marscher	2529 NASA*	PSD Break, Jet Scale and Black-Hole Mass of the FR II radio Galaxy 3C III	$63,600
Mendillo	ONR 2348-5*	Instrumentation for a North-South American Conjugate Observatory to Track Radio Disrupting Ionospheric Disturbances (DURIP)	$194,065
Mendillo	NASA 2741-5*	A Comprehensive Multi-Process Saturn-Thermosphere-Ionosphere-Model (STIM)	$120,000

Mendillo	ONR 2667-5*	Inter-Hemisphereic Studies of Ionospheric Irregulators	$133,176
Mendillo	NASA 2463-5*	Comparison of Cassini Observations with Saturn-Thermosphere-Ionosphere-Model (STIM)	$147,557
Mendillo	NSF 9535-5	Imaging Science and Modeling Investigations of the Upper Atmosphere	$275,000
Mendillo	NASA 2183-5	Large Scale Variability in Space and Time of Total Electron Content (TEC) Storm-Time Enhancements Driven by Penetration Electric Fields	$99,047
Merkin	NASA 2388-5	Impants on ionospheric heavy ion outflows on magnetospheric dynamics and regions	$110,641
Oppenheim	NSF 2029-5	CEDAR:Meteor Plasmas-Theory, Simulations, and Observations	$60,000
Oppenheim/ Dimant	NSF 8866-5	Simulations and Theory of Small Scale E-Region Turbulence	$96,000
Schwadron	NASA 9817-5	The Student Interstellar Boundary Explorer Program at Boston University (IBEX)	$318,960
Schwadron	NASA 9548-5	Earth-Moon-Mars Radiation Exposure Module (EMMREM)	$202,686
Siscoe	NSF 2603-5*	Solar Wind-Magnetosphere-Ionosphere Coupling	$96,577
Siscoe	NSF 2187-5	Summer School for Heliophysics	$66,049
Smith	NSF 2192-5	A New Era in Ground-Based Optical Aeronomy at Millstone Hill	$127,988
Smith	NSF 9929-5	CEDAR:Multi-Diagnostic Investigations of Upper-Atmospheric Dynamics in the Southern Hemisphere.	$40,456
Spence	NASA 2824-5*	Dynamic Response of the Environment at the Moon (DREAM)	$15,079
Spence	NASA 2641-5*	MMS Energetic Particle Detector (EPD) (Phase B) (Subcontract via Southwest Research Institute)	$15,467
Spence	NASA 8834-5	Cosmic Ray Telescope for the Effects of Radiation (CRATER)	$1,137,506

Spence	NASA 8849-5	Phase B: Radiation Belt Storm Proves-Energetic Particle Composition, and Thermal Plasma (RBSP-ECT) Subcontract via John Hopkins University Applied Physics)	$8,863,220
Spence	NASA 2641-5	MMS Energetic Particle Detector (EPD) (Phase B) (Subcontract via Southwest Research Institute)	$15,467
Wilson	NASA 2358-5*	The Sodium Exospheres of the Moon and Mercury: Adsorption, Photo-desorption and Photo ionization	$140,000
Withers	NASA 2325-5*	Analysis of SPICAM Stellar Occultation Data	$104,023
Withers	NASA 2468-5*	Simulations of the Effects of Extreme Solar Flares on Technical Systems at Mars	$232,941
Withers	NASA 2710-5*	Analysis of Phoenix Entry Data to Support Future Mars Landers	$76,858
Withers	NASA 2197-5	Atmospheric Density/Temperature Profiles and TES Temperatures/Pressure Data to Provide Atmospheric Density/ Temperature Profiles for MSL EDL (Subcontract via Jet Propulsion Laboratory)	$50,222
Withers	NASA 2325-5	Analysis Of SPICAM Stellar Occulation Data	$104,023
		Total new and continuing grant funding	**$21,271,716**
*** = new grant**			