Cover photo: An ultraviolet image of Saturn taken by Prof. John Clarke and his group using the Hubble Space Telescope. The oval ribbons toward the top and bottom of the image shows the location of auroral activity near Saturn’s poles. This activity is analogous to Earth’s aurora borealis and aurora australis, the so-called “northern” and “southern lights,” and is caused by energetic particles from the sun trapped in Saturn’s magnetic field.
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, 54 Boston University undergraduates major in astronomy. Among university astronomy programs our program is among the largest in the US.

In our graduate program, we recruited an impressive incoming class of fourteen new students, bringing our total of new and ongoing astronomy graduate students to 53. Nine 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.

The Department had several noteworthy scientific achievements. The Interstellar Boundary Explorer (IBEX) satellite, whose Science Operations Center was hosted at Boston University by Prof. Nathan Schwadron and his group, discovered a ribbon of high energy neutral atoms in a ring around the sky. The ribbon results from interactions between interstellar gas atoms and the magnetic field at the “heliopause,” the outermost limit of the solar system. Prof. Spence’s CRaTER instrument was placed in orbit around the Moon and successfully measured the cosmic ray radiation in the lunar environment.

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 raised $31,821,720 or about $1,870,000 per teaching faculty, both among the highest for all units in CAS. Our faculty and research associates authored or co-authored a total of 204 refereed, scholarly papers in the disciplines’ most prestigious journals.

The funding of the Astronomy Department, the Center for Space Physics, and the Institute for Astrophysical Research was changed this past year. In previous years, only the research centers received research funding, but last year the Department received a portion of this research funding based on grant activity by its faculty. After thorough study and close collaboration among the Chair and the center Directors, the Department and center budgets were established, and the result was “business as usual” for our researchers.

Boston University continues its partnership 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. An exciting new research telescope, the Discovery Channel Telescope is near completion at Lowell Observatory, and we are actively pursuing a partnership in this project. This partnership would link Boston University with Discovery, Inc., and provide exciting opportunities throughout the University, not only in Astronomy, but also in the Schools of Education and Communications.

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 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. 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.

Prof. Harlan Spence left the Department in January 2010 to take a prestigious new position as Director of the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. Prof. Spence was an outstanding faculty member here. He had a remarkable string of successful projects at Boston University, such as the CRaTER instrument now in orbit around the moon. He will be missed, and we wish him all the best in this new phase in his career.

The Astronomy Department conducted a search for new faculty members in Spring 2010, and I am very pleased to report that two outstanding new professors, Paul Withers and Merav Opher, will be joining the Department next year. Dr. Withers specializes in the structure of the atmosphere of Mars, and Dr. Opher in the structure of the magnetic fields surrounding the sun and other stars. We are delighted to welcome our new colleagues.

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 indicates that the total 100-level enrollment was 441 in 2009/2010. Of the students taking these courses, approximately 72% (316) were CAS students and 28% (125) were students from other schools and colleges.

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 nine 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 Brainerd, 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 two lecturers, Profs. Jackson and Marscher.

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 2009/2010 academic year, 54 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 (42), followed by Geophysics and Planetary Sciences (7) and
Astronomy (5). 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; 8 received BAs in Astronomy and Physics, 2 in Geophysics and Planetary Sciences, and 2 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.

Undergraduate Curriculum
The Department has recognized that in recent years the enrollments in our traditional lab-based survey courses, AS 101 and 202, 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 will offer fewer sections of AS 101 and 102, and develop new, topical 100-level courses. Courses under development are “Alien Worlds,” which will explore the rich variety of planets and moons in our own solar system and the explosion of new information about planets orbiting other stars, and “Cosmic Catastrophes,” which will explore violent events in the Universe, such as asteroid impacts, supernova explosions, and gamma ray bursts. We plan to offer the first of these new 100-level courses in Spring 2011.

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.

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
Acting Director of Graduate Studies: Professor Supriya Chakrabarti
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, Jan Marie Andersen was awarded a highly prestigious National Science Foundation fellowship to study low-mass stars. Susanna Finn won an honorable mention for her poster at the meeting of the American Astronomical Society. 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 6 new students to our graduate student population, resulting in a current total of 39 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 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. Nearly half of the students admitted into our PhD program accepted our offer, nearly twice as many as in a typical year. 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. Nathan Schwadron. Our incoming graduate class numbers fourteen students, ensuring that the size of our
Graduate program will be at its highest level ever. 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. Last year we implemented the last of these changes by offering for the first time a new course, AS 803, “Research Methods in Astronomical Data Analysis,” a 2-credit course introducing graduate students to modern approaches to data analysis in astrophysics and space physics. Prof. Dan Clemens taught this course for the first time in Spring 2009. The course was designed to teach our first-year graduate students basic computer programming skills, elementary image processing, and visualization techniques for astronomical datasets, using the high-level programming language Interactive Data Language (IDL).

Graduate Advising
Advising of graduate students was overseen by Prof. Meers Oppenheim, Director of Graduate Studies (DGS), and Prof. Supriya Chakrabarti, Acting Director of Graduate Studies. 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 Tony Case explains the results of the CRaTER instrument on NECN.

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.

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.

Boston University graduate student Tony Case appeared on NECN to explain the results of the CRaTER instrument as it was placed in orbit around the Moon. 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.

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 2009-2010 are remarkable. Some highlights include:

- The Interstellar Boundary Explorer (IBEX) satellite, whose Science Operations Center is hosted at Boston University by Prof. Nathan Schwadron and his group, successfully measured the distribution 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. The results were utterly unanticipated. Unlike any theoretical predictions the distribution of these high-energy atoms appeared as a “ribbon” of emission in a great circle across the sky. The image appeared on the cover of the prestigious journal Science.
-The Cosmic Ray Telescope for the Effects of Radiation (CRaTER), was launched inserted into its final orbit around the moon as part of the Lunar Reconnaissance Observatory (LRO). This project, led by Prof. Spence, measured the intensity of cosmic rays near the Moon. These data will be very useful to assess the potential radiation hazard to future lunar astronauts.

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, $21.2 M in FY2009 and $31.8 M in FY 2010). 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 $1.8 M, far more than for any other CAS department.

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. 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 204 articles in refereed journals during the reporting period. See Appendix F.

FUNDING
For the last decade the Astronomy Department was funded directly by the College of Arts and Sciences, and the Center for Space Physics (CSP) and the Institute for Astrophysical Research (IAR) were funded at a rate determined by the Indirect Cost (IDC) research expenditures. Both CSP and IAR were funded at a rate of 22.5% of the IDC. Last year, however, the funding policy changed. The University lowered the research funding based on IDC return for all research units by 20%. In addition, the IDC-based research funding was shared between the CSP, IAR, and the Astronomy Department, with the CSP and IAR receiving a rate of 10% of the IDC and the Astronomy Department 8% of the IDC. To ensure the success of both the research and the teaching missions, a budget committee was formed to apportion the funds optimally among the stakeholders. After close consultations between the Chair and the CSP and IAR Directors, a budget was established to facilitate the scholarly and pedagogical work of our faculty and staff. The resulting budget (see Appendix E) required the Astronomy Department to contribute to the
administrative costs of the research centers. This arrangement allowed for full support of the CSP and IAR research missions. The University is considering a revision of future research funding mechanisms. We look forward to working with the administration to find an optimal solution. Last year’s cooperative and collegial problem solving between the Department and the research centers, however, demonstrates our ability to respond effectively and positively to organizational changes, and we fully anticipate that whatever policy is ultimately decided, our researchers will continue to thrive in a supportive environment.

FACULTY RETREAT

The Astronomy Department held a faculty retreat in September 2009 at the secluded Essex Convention Center in Essex, MA. The purpose of the retreat was to discuss self-governance and strategic planning in light of the revised funding policy for the department and centers. Cindy Zook, a professional facilitator familiar with scientific organizations, presided over the retreat. The retreat was remarkably successful. The faculty identified several goals, and arrived at concrete plans for implementing these goals. One important outcome of the retreat was the recognition that the department has grown so large that it is difficult to keep track of the department’s broad and diverse research. Accordingly, the Department will hold an annual internal symposium to disseminate research information to our faculty, staff, and students. The first of these symposia will be held in Fall 2010.

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.

A New Research Facility: the Discovery Channel Telescope

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 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.

The most attractive new research facility for our department is to join with Lowell Observatory in the Discovery Channel Telescope, a new 4-meter optical and infrared telescope under construction near Flagstaff, Arizona. 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 would vastly improve
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. Lowell Observatory is actively seeking university partners. Given our long-standing partnership with Lowell for use of the Perkins telescope, Boston University participation in the Discovery Channel Telescope would be a natural progression and a smooth transition in upgrading our research facilities.

A Boston University partnership with the Discovery Channel Telescope would 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. Fruitful discussions among CAS, COM, and SED deans and faculty are underway, and there is growing support and momentum at Boston University for this project. The next step is to work directly with Discovery and Lowell to explore the opportunities in summer 2010 and present plans and opportunities to the University administration in autumn 2010.

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

Chair: Professor James Jackson
Associate Chair: Professor W. Jeffrey Hughes
Director of Graduate Studies: Professor Supriya Chakrabarti
Director of Undergraduate Studies: Professor W. Jeffrey Hughes

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, PhD, 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
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
Nathan Schwadron, Associate Professor of Astronomy. BA, Oberlin College; PhD, University of Michigan, Ann Arbor
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

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, Boston University
# Astronomy Graduate Students During 2009-2010

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingolfur Agustsson</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Jan Marie Anderson</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Elizabeth Bass</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Lauren Blum</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Carol Carveth</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Anthony Case</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Lauren Cashman</td>
<td>AST</td>
<td>TA</td>
</tr>
<tr>
<td>Christopher Claysmith</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Alexander Crew</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Meredith Danowski</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Ewan Douglas</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Edmund Douglas</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Susanna Finn</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Katherine Garcia</td>
<td>CISM</td>
<td>RA</td>
</tr>
<tr>
<td>Paul Howell</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Andrew Jordan</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Ji Hyun Kim</td>
<td>AST</td>
<td>TA</td>
</tr>
<tr>
<td>Kamen Kozarev</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Chad Madsen</td>
<td>AST</td>
<td>TA</td>
</tr>
<tr>
<td>Michael Malmrose</td>
<td>IAR</td>
<td>RA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majd Matta</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Sarah McGregor</td>
<td>CISM</td>
<td>RA</td>
</tr>
<tr>
<td>Christopher Mendillo</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Dylan Morgan</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Jonathan Niehof</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Danielle Pahud</td>
<td>CISM</td>
<td>RA</td>
</tr>
<tr>
<td>Michael Pavel</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>April Pinnick</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Christina Prested</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Patricio Sanhueza-Nunez</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Antonia Savcheva-Tasseva</td>
<td>AST</td>
<td>TA</td>
</tr>
<tr>
<td>Carl Schmidt</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Laura Sturch</td>
<td>AST</td>
<td>TA</td>
</tr>
<tr>
<td>Nicholeen Viall</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Brian Walsh</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Suwicha Wannawichian</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Joshua Wing</td>
<td>IAR</td>
<td>RA</td>
</tr>
<tr>
<td>Pin Wu</td>
<td>CSP</td>
<td>RA</td>
</tr>
<tr>
<td>Monica Young</td>
<td>IAR</td>
<td>RA</td>
</tr>
</tbody>
</table>

# Incoming Graduate Students

<table>
<thead>
<tr>
<th>Name</th>
<th>Undergraduate Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erin Arai</td>
<td>Wesleyan University</td>
</tr>
<tr>
<td>Dolon Bhattacharyya</td>
<td>Ethiraj College for Women</td>
</tr>
<tr>
<td>Kathryn Fallows</td>
<td>Colgate University</td>
</tr>
<tr>
<td>Zachary Girazian</td>
<td>San Diego State University</td>
</tr>
<tr>
<td>Sadia Hoq</td>
<td>Boston University</td>
</tr>
<tr>
<td>David Jones</td>
<td>Boston University</td>
</tr>
<tr>
<td>Christina Kay</td>
<td>U. of California, Berkeley</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Undergraduate Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicholas MacDonald</td>
<td>Saint Mary's University</td>
</tr>
<tr>
<td>Jordan Montgomery</td>
<td>Gordon College</td>
</tr>
<tr>
<td>Rachel Paterno-Mahler</td>
<td>Claremont</td>
</tr>
<tr>
<td>Terri Scott</td>
<td>New York University</td>
</tr>
<tr>
<td>Jillian Tromp</td>
<td>Drexel University</td>
</tr>
<tr>
<td>Karen Williamson</td>
<td>Ohio University</td>
</tr>
<tr>
<td>Mark Zastrow</td>
<td>U. of Minnesota</td>
</tr>
</tbody>
</table>
APPENDIX B: 2009/10 Astronomy Graduates

MASTER OF ARTS

<table>
<thead>
<tr>
<th>Name</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipesh Bhattarai</td>
<td>Alan Marscher</td>
</tr>
<tr>
<td>Alexander Crew</td>
<td>Harlan Spence</td>
</tr>
<tr>
<td>Michael Malmrose</td>
<td>Alan Marscher</td>
</tr>
<tr>
<td>Aslihan Unsal</td>
<td></td>
</tr>
</tbody>
</table>

BACHELOR OF ARTS

<table>
<thead>
<tr>
<th>Name</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander Boyd</td>
<td>Astronomy and Physics, with distinction, cum laude</td>
</tr>
<tr>
<td>Mollie Celnick</td>
<td>Geophysics and Planetary Sciences</td>
</tr>
<tr>
<td>Zenas Chan</td>
<td>Astronomy and Physics</td>
</tr>
<tr>
<td>Samuel Chapman</td>
<td>Geophysics and Planetary Sciences; Astronomy</td>
</tr>
<tr>
<td>Ian Cohen</td>
<td>Astronomy and Physics, with distinction</td>
</tr>
<tr>
<td>Sadia Hoq</td>
<td>Astronomy and Physics, with distinction; Economics</td>
</tr>
<tr>
<td>David Jones</td>
<td>Astronomy, magna cum laude</td>
</tr>
<tr>
<td>Angela Latona</td>
<td>Astronomy</td>
</tr>
<tr>
<td>Anthony Lollo</td>
<td>Astronomy and Physics, summa cum laude</td>
</tr>
<tr>
<td>Andrew Menz</td>
<td>Astronomy and Physics</td>
</tr>
<tr>
<td>Nicholas Slowey</td>
<td>Astronomy and Physics, with distinction, cum laude</td>
</tr>
<tr>
<td>Glenn Sugar</td>
<td>Astronomy and Physics, with distinction, summa cum laude</td>
</tr>
</tbody>
</table>
### APPENDIX C: Seminar Series

#### Center for Space Physics Seminar Series, 2009/2010

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Speaker/Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Sep</td>
<td>Ionospheric Effects of Intense Lighting Discharges</td>
<td>Robert Marshall, Stanford University</td>
</tr>
<tr>
<td>17-Sep</td>
<td>Anatomy of a Magnospheric Flux Tube</td>
<td>Joshua Semeter, Boston University</td>
</tr>
<tr>
<td>1-Oct</td>
<td>Earth Ring Current: Global Imaging &amp; Global Modeling</td>
<td>Natalia Buzulukova, NASA Goddard</td>
</tr>
<tr>
<td>8-Oct</td>
<td>Probing the Inter-Galactic Medium with the Cosmic Origins Spectograph</td>
<td>James Green, University of Colorado</td>
</tr>
<tr>
<td>15-Oct</td>
<td>Early Results from the LRO Cosmic Ray Telescope for the Effects of Radiation (CRaTER)</td>
<td>Harlan Spence, Boston University</td>
</tr>
<tr>
<td>22-Oct</td>
<td>A Discussion on Exoplanets</td>
<td>Timothy Cook, Boston University</td>
</tr>
<tr>
<td>29-Oct</td>
<td>Nature vs. Nurture: Exploring the reasons behind compositional differences in comet nuclei and the role of solar weathering in driving them.</td>
<td>Walter Harris, University of California</td>
</tr>
<tr>
<td>5-Nov</td>
<td>The Lower Thermosphere and Wave Coupling from Below</td>
<td>Gary Swenson, University of Illinois</td>
</tr>
<tr>
<td>12-Nov</td>
<td>A Powerful New Imager for HST: Performance and Early Results of Wide Field Camera 3</td>
<td>Randy Kimble, NASA Goddard</td>
</tr>
<tr>
<td>19-Nov</td>
<td>Cometary Amino Acids from the Stardust Mission</td>
<td>Jamie Cook, NASA Goddard</td>
</tr>
<tr>
<td>3-Dec</td>
<td>Comparison of Interstellar Boundary Explorer Observations with 3-D Global Heliospheric Models</td>
<td>Nathan Schwadron, Boston University</td>
</tr>
<tr>
<td>21-Jan</td>
<td>6300A Emissions and their Relationship to Magnetospheric Flows</td>
<td>Larry Kepko, NASA Goddard</td>
</tr>
<tr>
<td>28-Jan</td>
<td>Reconnection in Three-Dimensional Models of Coronal Mass Ejections</td>
<td>Terry Forbes, University of New Hampshire</td>
</tr>
<tr>
<td>4-Feb</td>
<td>Oort Cloud Formation - The Role of the Sun's Birth Cluster</td>
<td>Hal Levinson, Southwest Research Institute</td>
</tr>
<tr>
<td>11-Feb</td>
<td>Space Weather Effects on Navigation</td>
<td>Patricia Doherty, Boston College</td>
</tr>
<tr>
<td>18-Feb</td>
<td>Connections Between Large-Scale Plasma Sheet Transport, Region 2 Coupling to the Ionosphere, and Substorm Dynamics</td>
<td>Larry Lyons, UCLA</td>
</tr>
<tr>
<td>4-Mar</td>
<td>Further Observations of Magnetic Reconnection in the Solar Wind</td>
<td>Mike Stevens, Boston University</td>
</tr>
<tr>
<td>18-Mar</td>
<td>Interaction of High-Power HF Radio Waves with the Geospace</td>
<td>Evgenya Mishin, AFRL</td>
</tr>
<tr>
<td>1-Apr</td>
<td>The Solar Dynamics Observatory, Our New Eye on the Sun</td>
<td>Phil Chamberlin, NASA GSFC</td>
</tr>
<tr>
<td>8-Apr</td>
<td>HST Imaging of Fomalhaut: Direct detection of an exosolar planet and Kuiper Belt around a nearby star</td>
<td>Paul Kalas, Berkeley</td>
</tr>
<tr>
<td>15-Apr</td>
<td>The Cassini-Huygens Mission to the Saturn System: Recent Results</td>
<td>Tom Cravens, University of Kansas</td>
</tr>
<tr>
<td>29-Apr</td>
<td>Progress on the Murchison Widefield Array Project</td>
<td>Colin Lonsdale, MIT</td>
</tr>
<tr>
<td>Date</td>
<td>Title</td>
<td>Speaker/Affiliation</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>8-Sep</td>
<td>Active Galactic Nuclei in Clusters of Galaxies: Cooling Flows, Feedback, and High-z Systems</td>
<td>Elizabeth Blanton Boston University</td>
</tr>
<tr>
<td>15-Sep</td>
<td>The Quasar Continuum: New Connections</td>
<td>Martin Elvis Smithsonian Astrophysical Observatory</td>
</tr>
<tr>
<td>29-Sep</td>
<td>Gamma-Ray Bursts: A New Probe of the High-Redshift Universe</td>
<td>Edo Berger Harvard University</td>
</tr>
<tr>
<td>6-Oct</td>
<td>Open Clusters: Their Role in the Galaxy</td>
<td>Eileen Friel Lowell Observatory</td>
</tr>
<tr>
<td>8-Oct</td>
<td>Probing the Inter-Galactic Medium with the Cosmic Origins Spectrograph</td>
<td>James Green University of Colorado</td>
</tr>
<tr>
<td>20-Oct</td>
<td>Exoplanets and their Odd Orbital Inclinations</td>
<td>Joshua Winn MIT</td>
</tr>
<tr>
<td>28-Oct</td>
<td>Retired A Stars and their Planets</td>
<td>John Johnson University Hawaii</td>
</tr>
<tr>
<td>3-Nov</td>
<td>Our 15 Million Nearest Neighbors: M Dwarfs &amp; the Local Milky Way</td>
<td>John Bochanski MIT</td>
</tr>
<tr>
<td>12-Nov</td>
<td>A Powerful New Imager for HST: Performance and Early Results of Wide Field Camera 3</td>
<td>Randy Kimble NASA-Goddard Space Flight Center</td>
</tr>
<tr>
<td>17-Nov</td>
<td>X-ray Jets and Evolution of Extragalactic Radio Sources</td>
<td>Aneta Siemiginowska Smithsonian Astrophysical Observatory</td>
</tr>
<tr>
<td>1-Dec</td>
<td>The Stratospheric Observatory for Infrared Astronomy ,SOFIA: Status and Science overview</td>
<td>B.-G. Anderson NASA-Ames Research Center</td>
</tr>
<tr>
<td>8-Dec</td>
<td>Planet Forming Disks</td>
<td>David Wilner Smithsonian Astrophysical Observatory</td>
</tr>
<tr>
<td>1-Feb</td>
<td>Scattered, Extinguished and Emitted: Three Views of Star-forming Dust</td>
<td>Jonathan Foster Boston University</td>
</tr>
<tr>
<td>8-Feb</td>
<td>Discovery and Characterization of Transiting Extrasolar Planets</td>
<td>Peter McCullough CfA &amp; STScI</td>
</tr>
<tr>
<td>16-Feb</td>
<td>Searching for the Secrets of Massive Star Birth</td>
<td>Crystal Brogan NRAO</td>
</tr>
<tr>
<td>22-Feb</td>
<td>The Life Cycle of Matter in the Magellanic Clouds: Insights from the Spitzer SAGE Surveys</td>
<td>Margaret Meixner CfA &amp; STScI</td>
</tr>
<tr>
<td>1-Mar</td>
<td>Massive Young Star Clusters and the Stellar Upper Mass Limit</td>
<td>Don Figer Rochester Institute of Technology</td>
</tr>
<tr>
<td>15-Mar</td>
<td>Probing the Assembly of Massive Galaxies via Quasar Hosts at z=4</td>
<td>Kim McLeod Wellesley College</td>
</tr>
<tr>
<td>22-Mar</td>
<td>Transformations in Massive Binary Stars</td>
<td>Doug Gies Georgia State University</td>
</tr>
<tr>
<td>29-Mar</td>
<td>The Carnegie Hubble Program (CHP): Determining the Hubble Constant to 2%</td>
<td>Barry Madore Carnegie Observatories</td>
</tr>
<tr>
<td>5-Apr</td>
<td>Titan’s Methane Weather</td>
<td>Henry Roe Lowell Observatory</td>
</tr>
<tr>
<td>12-Apr</td>
<td>The Origin &amp; Evolution of Stellar Spins</td>
<td>Kevin Covey Cornell University</td>
</tr>
</tbody>
</table>
## APPENDIX D: Sponsored Project Funding

**Funding Received on New or Continuing Grants by Astronomy Faculty/Senior Research Associates in FY10**

<table>
<thead>
<tr>
<th>PI</th>
<th>Agency</th>
<th>Number</th>
<th>Title</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bania</td>
<td>NSF</td>
<td>2157-5</td>
<td>Galactic Chemical Evolution: The 3-Helium Project</td>
<td>$110,578</td>
</tr>
<tr>
<td>Bania</td>
<td>NRAO</td>
<td>1002-5</td>
<td>GBT Student Observing for Loren Anderson</td>
<td>$12,841</td>
</tr>
<tr>
<td>Baumgardner; Martinis</td>
<td>National Science Foundation</td>
<td>1014-5</td>
<td>Boston University - Scientific, Educational, and Logistical Preparations for AMISR Relocation to Argentina (Subcontract via NorthWest Research Associates, Inc.)</td>
<td>$63,341</td>
</tr>
<tr>
<td>Blanton</td>
<td>NASA</td>
<td>1237-5</td>
<td>X-Ray Cluster Environments of Radio Sources</td>
<td>$94,195</td>
</tr>
<tr>
<td>Chakrabarti</td>
<td>National Science Foundation</td>
<td>1311-5</td>
<td>CEDAR: Quantitative Assessment of Proton Aurora Using State-of-the-art Models</td>
<td>$120,331</td>
</tr>
<tr>
<td>Chakrabarti</td>
<td>NASA</td>
<td>2426-5</td>
<td>Planet Imaging Concept Testbed Using a Rocket Experiment (PICTURE)</td>
<td>$73,861</td>
</tr>
<tr>
<td>Chakrabarti</td>
<td>NASA</td>
<td>8763-5</td>
<td>Planet Imaging Concept Testbed Using a Rocket Experiment (PICTURE)</td>
<td>$1,322,860</td>
</tr>
<tr>
<td>Clarke</td>
<td>NASA</td>
<td>1413-5</td>
<td>Evolution of the 2009 Single Impact on Jupiter (Subcontract via Space Telescope Science Institute)</td>
<td>$23,998</td>
</tr>
<tr>
<td>Clarke</td>
<td>NASA</td>
<td>2690-5</td>
<td>Imaging Saturn’s Equinoctial Auroras (Subcontract via Space Telescope Science Institute)</td>
<td>$64,401</td>
</tr>
<tr>
<td>Clarke; Cook</td>
<td>NASA</td>
<td>2378-5</td>
<td>A Sounding Rocket UV Measurement of the D/H Ratio in the Upper Atmosphere of Venus and Relation to the Historic Escape of Water</td>
<td>$438,096</td>
</tr>
<tr>
<td>Clemens</td>
<td>NSF</td>
<td>2903-5</td>
<td>Completing The Galactic Plane Infrared Polarization Survey (GPIPS)</td>
<td>$183,292</td>
</tr>
<tr>
<td>Cook</td>
<td>NASA</td>
<td>2682-5</td>
<td>Interstellar Medium Absorption Gradient Experiment Rocket (IMAGER)</td>
<td>$1,252,344</td>
</tr>
<tr>
<td>Cook</td>
<td>NASA</td>
<td>9923-5</td>
<td>A Rotational Shearing Interferometer for Planet Detection</td>
<td>$454,000</td>
</tr>
<tr>
<td>Crooker</td>
<td>National Science Foundation</td>
<td>1382-5</td>
<td>SHINE: Studies of the Heliospheric Magnetic Field and Slow Solar Wind</td>
<td>$245,339</td>
</tr>
<tr>
<td>Name</td>
<td>Organization</td>
<td>Grant Number</td>
<td>Title</td>
<td>Budget</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Crooker</td>
<td>National Science Foundation</td>
<td>9201-5</td>
<td>SHINE: Studies of ICME-CME Connections and Implications for Heliospheric Topology</td>
<td>$332,441</td>
</tr>
<tr>
<td>Dimant; Oppenheim</td>
<td>National Science Foundation</td>
<td>2488-5</td>
<td>NSWP: Improving Quantitative Modeling of High-Latitude Electrojet Conductives During Magnetic Storm and Substorm Time</td>
<td>$80,610</td>
</tr>
<tr>
<td>Fritz</td>
<td>NASA</td>
<td>1038-5</td>
<td>Virtual Observations (Subcontract via University of Maryland, Baltimore County)</td>
<td>$8,068</td>
</tr>
<tr>
<td>Fritz</td>
<td>Department of Defense/ Air Force</td>
<td>1371-5</td>
<td>The Loss Cone Imager (LCI) for the DSX Program (Task 1)</td>
<td>$233,000</td>
</tr>
<tr>
<td>Fritz</td>
<td>NASA</td>
<td>2456-5</td>
<td>The Cluster RAPID Investigation 2008-2011</td>
<td>$475,000</td>
</tr>
<tr>
<td>Fritz</td>
<td>Department of Defense/ Air Force</td>
<td>8888-5</td>
<td>The Loss Cone Imager (LCI)</td>
<td>$2,954,516</td>
</tr>
<tr>
<td>Fritz</td>
<td>Department of Defense/ Air Force</td>
<td>9581-5</td>
<td>The Loss Cone Imager (LCI) - HST Supplement</td>
<td>$1,650,426</td>
</tr>
<tr>
<td>Hughes</td>
<td>National Science Foundation</td>
<td>1026-5</td>
<td>STC: Center for Integrated Space Weather Modeling - Student Travel Support for 2009 Directors Meeting</td>
<td>$24,375</td>
</tr>
<tr>
<td>Hughes</td>
<td>National Science Foundation</td>
<td>0000-0</td>
<td>STC: Center for Integrated Space Weather Modeling (CISM)</td>
<td>$4,000,000</td>
</tr>
<tr>
<td>Jackson</td>
<td>NASA</td>
<td>2673-5</td>
<td>Galactic Structures Using 2Mass Data</td>
<td>$108,613</td>
</tr>
<tr>
<td>Janes</td>
<td>NSF</td>
<td>9080-5</td>
<td>Old Star Clusters: Stellar Activity and Galactic Structure</td>
<td>$34,216</td>
</tr>
<tr>
<td>Jorstad</td>
<td>NASA</td>
<td>1041-5</td>
<td>Correlation Between Gamma-Ray Variations and Disturbances in the Jets of Blazars</td>
<td>$99,998</td>
</tr>
<tr>
<td>Marscher</td>
<td>NASA</td>
<td>2472-5</td>
<td>Comprehensive Multiwaveband Monitoring Program of Gamma-Ray Bright Blazars</td>
<td>$233,994</td>
</tr>
<tr>
<td>Marscher</td>
<td>NASA</td>
<td>1120-5</td>
<td>Snapshots of the Spectral Energy Distribution of Blazars</td>
<td>$20,000</td>
</tr>
<tr>
<td>Marscher</td>
<td>NSF</td>
<td>2856-5</td>
<td>The Most Compact Regions of Relativistic Jets in Active Galactic Nuclei</td>
<td>$602,138</td>
</tr>
<tr>
<td>Mendillo</td>
<td>NASA</td>
<td>2090-5</td>
<td>Mars Ionospheric Disturbances</td>
<td>$286,623</td>
</tr>
</tbody>
</table>

22
<table>
<thead>
<tr>
<th>Name</th>
<th>Funding Body</th>
<th>Project Number</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mendillo</td>
<td>NASA</td>
<td>2183-5</td>
<td>Large Scale Variability in Space and Time of Electron Content (TEC) Storm-Time Enhancements Driven by Penetration Electric Fields</td>
<td>$269,266</td>
</tr>
<tr>
<td>Mendillo</td>
<td>Department of Defense/Navy</td>
<td>2348-5</td>
<td>Instrumentation for a North-South American Conjugate Observatory to Track Radio Disrupting Ionospheric Disturbances (DURIP)</td>
<td>$194,065</td>
</tr>
<tr>
<td>Mendillo</td>
<td>NASA</td>
<td>2463-5</td>
<td>Comparison of Cassini Observations with the Saturn-Thermosphere-Ionosphere-Model (STIM)</td>
<td>$299,911</td>
</tr>
<tr>
<td>Mendillo</td>
<td>Department of Defense/Navy</td>
<td>2667-5</td>
<td>Inter-Hemispheric Studies of Ionospheric Irregularities</td>
<td>$291,814</td>
</tr>
<tr>
<td>Mendillo</td>
<td>NASA</td>
<td>2741-5</td>
<td>A Comprehensive Multi-Process Saturn-Thermosphere-Ionosphere-Model (STIM)</td>
<td>$220,000</td>
</tr>
<tr>
<td>Mendillo</td>
<td>National Science Foundation</td>
<td>9535-5</td>
<td>Imaging Science and Modeling Investigations of the Upper Atmosphere</td>
<td>$1,035,911</td>
</tr>
<tr>
<td>Mendillo; Martinis</td>
<td>NASA</td>
<td>2994-5</td>
<td>Altitude-Latitude Ion-Neutral Coupling Using CINDI and C/NOFS and Conjugate Ground-Based Optical Diagnostics</td>
<td>$96,803</td>
</tr>
<tr>
<td>Oppenheim</td>
<td>National Science Foundation</td>
<td>2029-5</td>
<td>CEDAR: Meteor Plasmas - Theory, Simulations, and Observations</td>
<td>$60,000</td>
</tr>
<tr>
<td>Oppenheim</td>
<td>National Science Foundation</td>
<td>2892-5</td>
<td>CEDAR: Meteor Plasmas - Theory, Simulations, and Observations</td>
<td>$11,950</td>
</tr>
<tr>
<td>Oppenheim</td>
<td>Department of Defense/AFOSR</td>
<td>2919-5</td>
<td>First Kinetic of Simulations Equatorial Spread-F: Analysis of Kilometer-to-Meter Scale Irregularities</td>
<td>$128,429</td>
</tr>
<tr>
<td>Schwadron</td>
<td>NASA</td>
<td>9548-5</td>
<td>Earth-Moon-Mars Radiation Exposure Module (EMMREM)</td>
<td>$826,242</td>
</tr>
<tr>
<td>Schwadron</td>
<td>NASA</td>
<td>9817-5</td>
<td>The Student Interstellar Boundary Explorer Program (IBEX) (Phase E) (Subcontract via Southwest Research Institute)</td>
<td>$1,700,542</td>
</tr>
<tr>
<td>Siscoe</td>
<td>National Science Foundation</td>
<td>2603-5</td>
<td>Solar Wind-Magnetosphere-Ionosphere Coupling</td>
<td>$99,114</td>
</tr>
<tr>
<td>Spence</td>
<td>NASA</td>
<td>2641-5</td>
<td>MMS Energetic Particle Detector (EPD) (Phase B/C/D) (Subcontract via Southwest Research Institute)</td>
<td>$448,051</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>--------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Spence</td>
<td>NASA</td>
<td>2824-5</td>
<td>Dynamic Response of the Environment at the Moon (DREAM)</td>
<td>$15,079</td>
</tr>
<tr>
<td>Spence</td>
<td>NASA</td>
<td>8834-5</td>
<td>Cosmic Ray Telescope for the Effects of Radiation (CRaTER)</td>
<td>$2,319,142</td>
</tr>
<tr>
<td>Spence</td>
<td>NASA</td>
<td>1111-5</td>
<td>Phase B/C/D: Radiation Belt Storm Probes - Energetic Particle Composition, and Thermal Plasma (RBSP-ECT) (Amendment #12) (Subcontract via Johns Hopkins University Applied Physics Laboratory)</td>
<td>$900,000</td>
</tr>
<tr>
<td>Spence</td>
<td>NASA</td>
<td>2222-5</td>
<td>Phase B/C/D: Radiation Belt Storm Probes - Energetic Particle Composition, and Thermal Plasma (RBSP-ECT) (Amendment #13) (Subcontract via Johns Hopkins University Applied Physics Laboratory)</td>
<td>$6,200,000</td>
</tr>
<tr>
<td>Wilson</td>
<td>NASA</td>
<td>2358-5</td>
<td>The Sodium Exospheres of the Moon and Mercury: Adsorption, Photodesorption and Photoionization</td>
<td>$140,000</td>
</tr>
<tr>
<td>Withers</td>
<td>NASA</td>
<td>2197-5</td>
<td>Atmospheric Density/Temperature Profiles and TES Temperatures/Pressure Data to Provide Atmospheric Density/Temperature Profiles for MSL EDL (Subcontract via Jet Propulsion Laboratory)</td>
<td>$50,222</td>
</tr>
<tr>
<td>Withers</td>
<td>NASA</td>
<td>2325-5</td>
<td>Analysis of SPICAM Stellar Occultation Data</td>
<td>$204,614</td>
</tr>
<tr>
<td>Withers</td>
<td>NASA</td>
<td>2412-5</td>
<td>Development of a Mars Ionosphere Model with Time-Dependent Solar Forcing for Studies of Solar Flare Effects</td>
<td>$171,489</td>
</tr>
<tr>
<td>Withers</td>
<td>NASA</td>
<td>2468-5</td>
<td>Simulations of the Effects of Extreme Solar Flares on Technological Systems at Mars</td>
<td>$357,219</td>
</tr>
<tr>
<td><strong>Total new and continuing grant funding:</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$31,821,720</strong></td>
</tr>
</tbody>
</table>
### APPENDIX E: Accounts Income Expenditures

#### Operating Budget (20-201)

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>Percent of FY10 Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Budget</td>
<td>$52,887</td>
<td>58.1%</td>
</tr>
<tr>
<td>Salary Release</td>
<td>$26,559</td>
<td>29.2%</td>
</tr>
<tr>
<td>FY09 Capital Equip. Funds</td>
<td>$11,576</td>
<td>12.7%</td>
</tr>
<tr>
<td><strong>Total Income</strong></td>
<td><strong>$91,022</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
<th>Percent of FY10 Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplies</td>
<td>$18,460</td>
<td>20.1%</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>$6,845</td>
<td>7.5%</td>
</tr>
<tr>
<td>Mail Services</td>
<td>$286</td>
<td>0.3%</td>
</tr>
<tr>
<td>Contracted Services</td>
<td>$12,999</td>
<td>14.2%</td>
</tr>
<tr>
<td>Reproduction &amp; Printing</td>
<td>$1,066</td>
<td>1.2%</td>
</tr>
<tr>
<td>Books &amp; Periodicals</td>
<td>$16</td>
<td>0.0%</td>
</tr>
<tr>
<td>Travel</td>
<td>$20,319</td>
<td>22.1%</td>
</tr>
<tr>
<td>Meeting Expenses</td>
<td>$15,089</td>
<td>16.4%</td>
</tr>
<tr>
<td>Dues &amp; Memberships</td>
<td>$250</td>
<td>0.3%</td>
</tr>
<tr>
<td>Unclassified Expenses</td>
<td>$594</td>
<td>0.6%</td>
</tr>
<tr>
<td>Capital Equipment</td>
<td>$12,191</td>
<td>13.3%</td>
</tr>
<tr>
<td>B &amp; G</td>
<td>$2,799</td>
<td>3.0%</td>
</tr>
<tr>
<td>Computer Software &amp; Databases</td>
<td>$900</td>
<td>1.0%</td>
</tr>
<tr>
<td><strong>Total Expended</strong></td>
<td><strong>$91,815</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

#### Astronomy IDC Return (20-201-1021-9)

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>Percent of FY10 Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY09 Balance</td>
<td>$25,964</td>
<td>13.5%</td>
</tr>
<tr>
<td>IDC Return 1st/2nd/3rd Qtrs.</td>
<td>$164,993</td>
<td>86.5%</td>
</tr>
<tr>
<td><strong>Total Income</strong></td>
<td><strong>$190,957</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
<th>Percent of FY10 Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Faculty Start-Up</td>
<td>$20,000</td>
<td>13.2%</td>
</tr>
<tr>
<td>Meeting Expenses</td>
<td>$707</td>
<td>0.4%</td>
</tr>
<tr>
<td>AS 866 Instructors</td>
<td>$3,500</td>
<td>2.3%</td>
</tr>
<tr>
<td>Unclassified Expenses</td>
<td>$796</td>
<td>0.5%</td>
</tr>
<tr>
<td>IAR IDC Return 1st/2nd/3rd Qtrs.</td>
<td>$33,750</td>
<td>22.3%</td>
</tr>
<tr>
<td>CSP IDC Return 1st/2nd/3rd Qtrs.</td>
<td>$90,000</td>
<td>59.4%</td>
</tr>
<tr>
<td>Supplies</td>
<td>$1,373</td>
<td>0.9%</td>
</tr>
<tr>
<td>Unrestricted Overages</td>
<td>$1,262</td>
<td>0.8%</td>
</tr>
<tr>
<td>Travel</td>
<td>$433</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Total Expended</strong></td>
<td><strong>$151,820</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
### Astronomy Computer Equipment (20-201-1162-9)

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>Percent of FY10 Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY09 Balance</td>
<td>$10,472</td>
<td>15.1%</td>
</tr>
<tr>
<td>Computer Bills</td>
<td>$58,900</td>
<td>84.9%</td>
</tr>
<tr>
<td><strong>Total Income</strong></td>
<td><strong>$69,372</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
<th>Percent of FY10 Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>$44,963</td>
<td>75.9%</td>
</tr>
<tr>
<td>Contracted Services</td>
<td>$1,300</td>
<td>2.2%</td>
</tr>
<tr>
<td>Fringe Benefit</td>
<td>$12,994</td>
<td>21.9%</td>
</tr>
<tr>
<td><strong>Total Expended</strong></td>
<td><strong>$59,258</strong></td>
<td><strong>100.0%</strong></td>
</tr>
<tr>
<td>9</td>
<td>Anderson, L. D., Bania, T. M., Balser, D. S., &amp; Rood, R. T., “First Results from the Green Bank Telescope H II Region Discovery Survey”, 2010, AAS Meeting #216, #424.02, BAAS, 42, 836</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Author(s)</td>
<td>Title</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Page</td>
<td>Author(s)</td>
<td>Title and Details</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>49</td>
<td>Dimant, Y. S., Oppenheim, M.; Milikh, G. M.</td>
<td>Meteor plasma trails: effects of external electric field, Annalles Geophysicae, V. 27, 11, 2009</td>
</tr>
<tr>
<td>Page</td>
<td>Citation</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Hicks, B.A.\ Cook, T.A. Lane B.F.\ Mendillo, C.B.\ Jung P.\ and Supriya Chakrabarti 2009, ``The Monolithic Achromatic Nulling Interference Coronagraph (MANIC) testbed&quot;, \spie, 7440 74401B.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Jorstad, S.G. &amp; Marscher, A.P., “Connection between Gamma-Ray Variations and Disturbances in the Jets of Blazars,” 2010, BAAS, #215, #225.02</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>Jorstad, S.G., &amp; Marscher, A.P., “Correlation between Parsec-Scale Jet Behavior and Gamma-Ray Light Curves of Blazars,” 2010, AAS HEAD meeting, BAAS #11, #30.03</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>Oppenheim, Meers M., Sugar, G., Slowey, N. O.; Bass, E.; Chau, J. L.; Close, S., Remote sensing lower thermosphere wind profiles using non-specular meteor echoes, Geophysical Research Letters, V. 36, I. 9, CitID L09817, 2009 (featured as a search and discovery article in Wilson, Mark; Meteor trails track upper atmospheric winds, Physics Today, vol. 62, issue 6, p. 16)</td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>Pinnick, A., Clemens, D. P., &amp; Pavel, M., &quot;Using Synthetic Polarization Images to Test and Validate the Automated Data Analysis Pipeline for the Galactic Plane Infrared Polarization Survey (GPIPS)&quot;, 2010, American Astronomical Society Meeting #215, #438.02, BAAS, 42, 392</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Citation</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Author(s)</td>
<td>Reference</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>Page</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Citation</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>199</td>
<td>Withers, Prediction of uncertainties in atmospheric properties measured by radio occultation experiments, Advances in Space Research, 46, 58-73 (2010).</td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>Young, M., Elvis, M., Risaliti, G., &amp; Marscher, A., “Understanding the Relation between Optical and X-ray Emission in Quasars,” 2010, AAS HEAD meeting, BAAS #11, #7.01</td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>Young, M., Elvis, M., Risaliti, G., &amp; Marscher, A., “Understanding the Relation between Optical and X-ray Emission in Quasars”, poster paper at the 20th New England Regional Quasar and AGN Meeting</td>
<td></td>
</tr>
</tbody>
</table>