

The Boston University Astronomy Department Annual Report 2012

Chair: Tereasa Brainerd

Administrators: John-Albert Moseley and Laura Wipf



**Signing of the BU-Lowell Observatory Discovery Channel Telescope
scientific partnership agreement**

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Cover photo: Official signing of the scientific partnership agreement between Boston University and Lowell Observatory in the operation of the Discovery Channel Telescope (10/17/2011). Left to right: Dr. Jeffrey Hall (Director of Lowell Observatory), Provost Jean Morrison, and Mr. Willam L. Putnam, II (sole Trustee of 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 8 undergraduates with a major concentration in astronomy, astronomy and physics, or geophysics and planetary sciences. Currently, 49 Boston University undergraduates major in astronomy, a large program among US universities. For non-majors, our recent efforts to improve our general 100-level courses and to provide interesting new course offerings have clearly paid off. Our 100-level enrollments in 2011-2012 were 613, with the largest enrollment classes being AS100 (Cosmic Controversies, enrollment of 170, taught by Prof. Mendillo), AS105 (Alien Worlds, enrollment of 107, taught by Prof. West), and AS109 (Cosmology, enrollment of 87, taught by Prof. Marscher). Our two most popular courses, AS100 and AS105, routinely close to enrollments long before the start of the semester because the classes have reached their maximum capacity. AS105 was named one of the “10 Craziest College Classes” by the Huffington Post and was featured in the “One Class, One Day” series in BU Today.

In our graduate program, we recruited an impressive incoming class of five new students, bringing our total of new and continuing graduate students to 38. Last year six of our graduate students received their PhDs and three received their MAs. The Boston University graduate program in astronomy is also one of the largest in the country.

Members of the Department made several noteworthy scientific contributions in 2011/2012. Limited space precludes a thorough presentation of the entire research portfolio of the Department, and a more in-depth discussion of our collective research accomplishments can be found in the annual reports of the Center for Space Physics and

the Institute for Astrophysical Research. Selected highlights of Boston University astronomy research in 2011/2012, include:

- The detection of a “sloshing spiral” of hot gas in a galaxy cluster
- The demonstration of in-flight pointing stability on a sounding rocket that is comparable to that of the Hubble Space Telescope
- The discovery that magnetic activity in M dwarf stars is greater when the M dwarf has a companion that is a white dwarf

The Astronomy Department had an excellent year in securing research funds through grants to its main research centers: the Center for Space Physics, the Center for Integrated Space Weather Modeling, and the Institute for Astrophysical Research. Last year Astronomy Department researchers secured federal funding through grants totaling \$29.9M, or over \$1,000,000 per faculty member, both among the highest for all units in CAS. Our faculty and research associates authored or co-authored a total of 115 refereed, scholarly papers in the disciplines’ most prestigious journals.

The most exciting development of the past year is the signing of a \$10M agreement between Boston University and Lowell Observatory that guarantees Boston University astronomers access to new research telescope, the Discovery Channel Telescope, in perpetuity. This new optical/infrared 4.3 meter diameter telescope has recently undergone its commissioning phase and first science observations are expected to take place in late winter 2013. This partnership links Boston University not only with Lowell Observatory, but also with one of the key sponsors, Discovery Communications, Inc., which owns the Discovery Channel television station and a number of other telecommunications enterprises that promote scientific education. This project provides opportunities not only for state-of-the-art astrophysical research, but also new outreach and science education programs in the Schools of Education and Communications.

OVERVIEW

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

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

FACULTY, STAFF, AND LEADERSHIP

The Department of Astronomy currently has twenty-four faculty members: fifteen full-time academic faculty, eight research faculty, and one emeritus professor. 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 the profession by serving on advisory committees for NASA and NSF, national observatories, learned societies, and professional journals.

Changes

Professor James Jackson was appointed Associate Dean for Research and Outreach for the College of Arts and Sciences. He began his duties in July 2011.

Professor Tereasa Brainerd was appointed as Astronomy Department Chair. She began her duties in July 2011.

Professor John Clarke was appointed as Astronomy Department Associate Chair. He began his duties in July 2011.

After four years of outstanding service, Ms Laura Wipf resigned her position as Astronomy Department Administrator in Fall 2011 in order to pursue a new position as the Graduate Services Administrator in the Graduate School. In February 2012, Mr. John-Albert Moseley joined the Department as the new Administrator. Mr. Moseley comes to Boston University with nearly 20 years of experience in various academic support roles at Yale University.

RESEARCH AND SCHOLARSHIP

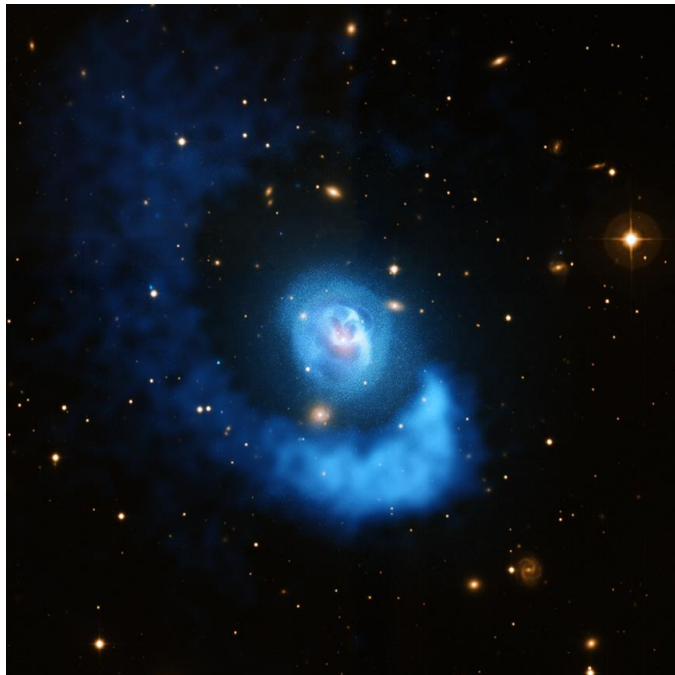
The Department of Astronomy, through its affiliated research units, the Center for Space Physics (CSP), the Institute for Astrophysical Research (IAR), and the Center for Integrated Space Weather Modeling (CISM), has a robust and thriving research program. Every member of the faculty maintains a research program through external sponsored funding. Publication of scientific results continued at a brisk pace in the top journals of our fields.

Overall Summary

The Department’s research accomplishments for 2011-2012 are substantial. Just a few research

projects are highlighted below in order to illustrate the breadth and strength of our research programs. Additional science highlights can be found in the annual reports for the Center for Space Physics and the Institute for Astrophysical Research.

“Sloshing” Gas in Galaxy Clusters



The galaxy cluster Abell 2052 studied by Professor Elizabeth Blanton and her collaborators. (Credit: X-ray (blue): NASA / Chandra X-ray Center / Boston U. / E. Blanton; background visible image: European Southern Observatory/VLT)

Professor Elizabeth Blanton, her students, and collaborators discovered the first evidence of a “sloshing spiral” gaseous structure in the cluster of galaxies known as Abell 2052. In addition to hundreds or thousands of galaxies, galaxy clusters are filled with hot gas that emits X-rays. This gas can be set in motion if there is a large-scale merger between clusters or groups of galaxies. In the case of Abell 2052, an off-center merger of a smaller cluster with the main cluster imparted angular momentum to the hot gas, resulting in a spiral distribution. This huge spiral gaseous structure (almost a million light-years across) was discovered using a very long observation (approximately one week) using NASA’s orbiting Chandra X-ray Observatory. The sloshing has important implications for the evolution of galaxies in the cluster. It redistributes hot, metal-rich gas to larger radii and it slows down the amount of star formation occurring in the cluster central galaxy. A press

release entitled *A Galaxy Cluster Gets Sloshed* appeared in numerous news outlets, and the associated image was selected as a “NASA image of the day” and “National Geographic image of the week.”

PICTURE: The Search for Extra-Solar Planets

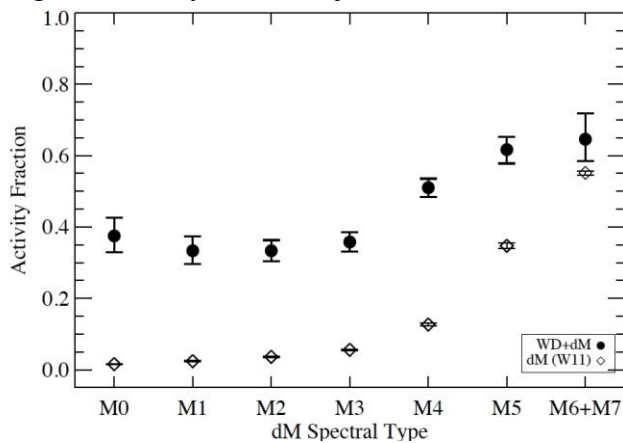


Graduate students testing the PICTURE coronagraph in the lab before assembly and launch.

The PICTURE (Planetary Imaging Concept Testbed Using a Rocket Experiment) sounding rocket was designed to capture a direct, visible-light image of exozodiacal dust in the Epsilon Eridani exoplanetary system. Analogous to the zodiacal dust in our own Solar System, exozodiacal dust is produced and continually replenished by comets and asteroid collisions in an exoplanetary system. These dust grains emit infrared light and they also scatter visible starlight to form the dominant astrophysical background against which exoplanets may be imaged. The Epsilon Eridani system is known to have at least one giant exoplanet, eEri-b, a Jupiter-mass planet in an eccentric 7-year orbit.

PICTURE was launched on October 8th, 2011 from the White Sands Missile Range in White Sands, NM. Although no exoplanet images were obtained, PICTURE’s flight validated the flight-worthiness of the system. The fine pointing system, a key requirement for future planet-imaging missions, demonstrated 5.1 milliarcsecond in-flight pointing stability. Such pointing stability truly outstanding, and is similar to that of the Hubble Space Telescope. Professor Supriya Chakrabarti, Professor Timothy Cook, and graduate student Christopher Mendillo were involved with the PICTURE project.

Magnetic Activity in M dwarf Stars



Graph illustrating that magnetic activity is higher in M dwarf stars when the star has a companion star that is a white dwarf.

Professor Andrew West led a team of researchers, including graduate student Dylan Morgan, who cataloged and analyzed more than 1700 close pairs of binary stars. These stellar pairs, selected from the Sloan Digital Sky Survey, each consists of an M dwarf (dM – less massive than the Sun) and a white dwarf (WD – the remnant core of a star that used up its hydrogen and helium nuclear “fuel”). Such systems are important because the vastly different temperatures of the two components (10,000 K vs. 3000 K) allow for the individual spectra of these unresolved objects (the stars are so close to each other they look like a single star) to be distinguished from each other. The team created an iterative technique that used spectra of the binaries to separate the WD and the dM stars in the binaries, then analyzed the individual components. Using more than 1000 objects, they were able to show that close companions induce more magnetic activity in the dMs than is typically found in single stars. Although this activity is stronger in binary stars than it is in single stars (and gets stronger as the pair separation decreases), it appears to have a finite lifetime that varies as a function of stellar mass. This result has major implications for our understanding of magnetic field generation in stars as well as the potential habitability of planets in orbit around low-mass stars.

Research Funding

The Astronomy Department is very successful in raising research funds. Compared with other science departments at Boston University, for the past several

years the Astronomy Department has had the largest annual grant income (\$11.7 M in FY2004, \$12.6 M in FY2005, \$11.2 M in FY2006, \$14.1 M in FY2007, \$19.7 M in FY2008, \$21.2 M in FY2009, \$31.8 M in FY 2010, \$27.2 in FY 2011, and \$29.9 in FY2012). This accomplishment is even more impressive considering the small size of our faculty. Indeed, the average grant income raised per faculty member (both research and teaching faculty) in the Astronomy Department is over \$1,000,000. A complete list of new and continuing grants can be found in the annual reports for the Center for Space Physics and the Institute for Astrophysical Research.

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

Peer-Reviewed Publications

The Department’s faculty, research associates, and students continue to publish in the leading journals of our disciplines and to present their results at national and international meetings. This activity not only disseminates major new research results, but also helps to keep the Department’s research prominent within our respective communities. Members of the Astronomy Department and its affiliated research centers published 115 articles in refereed journals during the reporting period.

UNDERGRADUATE EDUCATION

Director of Undergraduate Studies:
Professor Dan P. Clemens

Approximately 600 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 in order to fill the natural science distribution requirement. Since astronomy is rarely part of the high school curriculum, these courses offer an attractive opportunity for students wishing to experience a new field of science.

2. Core Curriculum and Kilachand Honors College.

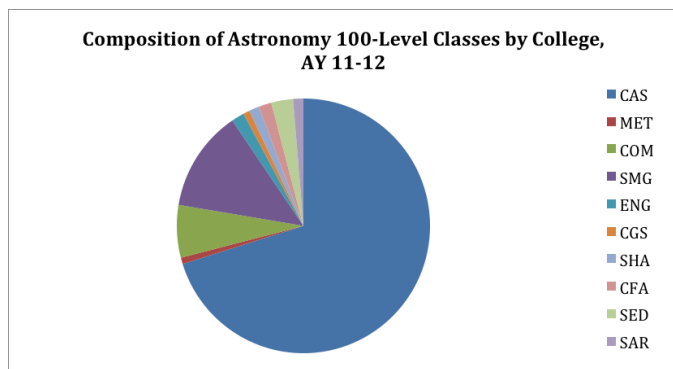
The Astronomy Department plays a key role in the Core Curriculum Natural Sciences course CC105 by providing two or three faculty members each year. About 200 students per year enroll in CC105. Professor Michael Mendillo also teaches a seminar on the history of the planet Pluto for the Kilachand Honors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

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

Divisional Studies Courses

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

We offer six such 100-level courses. Two of these, AS101: The Solar System, and AS102: The Astronomical Universe, provide surveys of solar system astronomy and extra-solar system astronomy and carry laboratory credit. The other four, AS100 (Cosmic Controversies), AS105 (Alien Worlds), AS109 (Cosmology) and AS117 (Cosmic Evolution), are more focused, topical courses that do not carry laboratory credit. In AY11-12 we offered eight sections of these 100-level courses: two sections of AS101, two of AS102, and one each of AS100, AS105, AS109, and AS117.



The chart above illustrates the breakdown by college/school of undergraduates enrolled in 100-level astronomy courses. The total enrollment was 613 in 2011/2012. Of the students taking these courses, approximately 70% (430) were CAS students and 30% (183) were students from other schools and colleges.

Amongst the year's highlights in undergraduate teaching was the remarkable success of the AS105 (Alien Worlds). Alien Worlds is a new course that Professor Andrew West developed in order better serve the interests of BU's undergraduate non-science majors. It was offered for only the second time in Fall 2011 and it received rave reviews. Alien Worlds explores the planets within our own solar system, planets that orbit stars other than the sun, the history of space exploration, and the possibility of extraterrestrial life. Alien Worlds was featured in the BU Daily Free Press, and the Huffington Post named Alien Worlds one of the "Ten Craziest College Classes".

The Core Curriculum and Kilachand Honors College

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

Since many CAS students choose to meet their science education requirements through the Core Curriculum, the Department provides a significant commitment to the physical science component of the Core, CC105. One of our own faculty members, Professor Alan Marscher, developed CC105 and he served as the course coordinator for many years. Professor James Jackson has served as course coordinator for CC105 for eleven years, and he has continued the long tradition of Astronomy Department service and leadership in this important program. The Astronomy Department

provides as many additional faculty members to this course as our other teaching commitments allow. Typically, the Astronomy Department commits two or three lecturers per year to CC105. In AY11-12, Professors Jackson and Marscher staffed CC105.

The University is also now offering a program that provides a broad, interdisciplinary, liberal arts experience in a series of smaller seminar courses through the Kilachand Honors College. In Fall 2011, Astronomy Professor Michael Mendillo taught a KHC freshman seminar course entitled “The Pluto Saga: How Do You Become a Planet and Stay a Planet?” for the second year in a row.

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).

The graduating class of AY11-12 consisted of an unusually small class of 8 students; 3 received BAs in Astronomy and Physics, 2 in Geophysics and Planetary Sciences, and 3 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 per year for the foreseeable future. A list of our graduating class is provided in Appendix B.

Undergraduate Advising

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

Since the course schedule for concentrations in astronomy is highly structured, advising must begin with the incoming class, sometimes even before they arrive

on campus. Thus, freshman advising during the summer is critically important. We also carefully monitor possible freshman concentrators during the first few days of classes in the fall to make sure all are taking the appropriate classes. We often recruit and advise highly qualified students from the Core and our 100-level offerings; we have had growing success in recent years of identifying excellent scholars and introducing them into our program through these courses. Students who decide during their sophomore year to concentrate in astronomy provide us with our biggest advising challenges, but the numbers are small enough that each case can be dealt with carefully on an individual basis. We attempt to assign as many students as possible to their advisor from the previous year. This provides much needed 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 on campus during both semesters of AY11-12 acted as an undergraduate student advisor.

GRADUATE EDUCATION

Director of Graduate Studies: Professor Meers Oppenheim

Director of Graduate Admissions: Professor Andrew West

Graduate-level Astronomy

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

Overview

Our graduate program remains vigorous. Of the thirty-nine PhD-granting astronomy programs in the country, ours is above average in terms of the number of students and in the number of PhDs awarded. Our graduate

students continue to win student awards at national scientific conferences as well as highly competitive fellowships. Last year, for example, Christopher Theissen was awarded a Ford Fellowship. In addition, Zachary Girazian and Katherine Fallows were each awarded NESSF graduate fellowships by NASA. 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 hold faculty and leadership positions at major research institutions. This past year, 6 of our students were awarded PhDs and 3 were awarded MAs.

This past year we added 5 new students to our graduate student population, resulting in a total of 38 new and continuing 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 expend considerable effort in attracting the best students to Boston University for their graduate studies. In AY11-12 we were successful in recruiting 5 students of very high quality into our PhD program. The graduate admissions committee was led by Professor Andrew West. A list of the incoming students is provided in Appendix A.

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 DGS continues to monitor students' progress throughout their graduate career, ensuring that they are making significant progress toward their degrees, and are satisfying all departmental, college, and university requirements.

COMMUNITY LIFE

Internal Astronomy Research Symposium

On October 14, 2011 the Astronomy Department hosted an internal science symposium at which all of the different research groups presented talks and poster papers summarizing their latest results. Given how large the research endeavor is within the department, it is difficult for any of us to keep up with all of the exciting science that is going on. The breadth and depth of the research being conducted by members of the Institute for Astrophysical Research and the Center for Space Physics was fully-represented by 16 talks and 26 poster papers. The event was organized by Professors Andrew West and Merav Opher.

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 was financed in part by the Astronomy Department. The lists of speakers in both seminar series are provided in Appendix C.

Musical Events

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

**Twenty-Second Annual
Musical Soirée**



7:00 pm

Friday, March 30, 2012

Tsai Performance Center
685 Commonwealth Ave.

A Spring Tradition

The Boston University Astronomy Department presents a concert of light classical music featuring amateur performers from among our extended family. The concert is free and open to the public. Please come join us.

We gratefully acknowledge the contributions from our many sponsors:

- The Astronomy Department
- The Center for Computational Neuroscience and Neural Technology
- The Center for Integrated Space Weather Modeling
- The Center for Space Physics
- The Center of Excellence for Learning in Education, Science, and Technology
- The Institute for Astrophysical Research

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Flier for the 22nd Annual Musical Soiree

OUTREACH

Our most prominent outreach effort is our Public Open Nights held every clear Wednesday night in the Coit Observatory on the rooftop of the CAS building. This program is run by our observatory manager, Quinn Sykes along with members of the BU Astronomical Society, and draws hundreds of visitors annually from the Greater Boston area. We stress that the quality of this popular program and other special events are limited by, and indeed ever threatened by, the poor physical state of the Coit Observatory.

In June 2011 Quinn Sykes and a number of senior graduate students hosted a public star party on the harbor deck of Boston's Museum of Contemporary Art. The star party was held in conjunction with the opening of an exhibit that featured astronomy-related art.

Our best-attended outreach event of AY11-12 occurred on Tuesday, June 5, 2012 in conjunction with the transit of Venus in front of the sun. This was an enormous event, attended by more than 300 members of the public. The event was organized by Professor John Clarke and an army of volunteers, including students, staff, and faculty. Although it was not possible to view the event live in Boston because of cloudy conditions, our visitors came to the 5th floor of the CAS building to watch two live web feeds of the event, and to hear a rolling series of short presentations related to the Venus transit that were given by graduate students. Members of the public who stopped by to chat with the faculty and students in the hallway expressed their deep appreciation for the fact that we had organized the event. Despite the clouds, they thoroughly enjoyed the fact that we opened up our department to them to experience this rare astronomical event.

MULTIMEDIA INFORMATION

BU Daily Free Press

<http://dailyfreepress.com/2011/10/31/class-on-alien-worlds-ranked-one-of-%E2%80%98craziest%E2%80%99/>

Huffington Post

http://www.huffingtonpost.com/her-campus/the-10-craziest-college-c_b_966560.html

Astronomy Research Symposium

<http://www.bu.edu/astronomy/events/astronomy-research-symposium>

Venus Transit Open House

<http://www.bu.edu/astronomy/events/venustransit/>

LOOKING TO THE FUTURE

A New Research Facility: the Discovery Channel Telescope

The University's \$10M commitment to join with Lowell Observatory in a scientific partnership in the operation of the Discovery Channel Telescope (DCT) will allow a tremendous leap forward in our ability to carry out cutting edge astronomical research at optical and near-infrared wavelengths. The formal agreement signed by Boston University and Lowell Observatory entitles BU astronomers to the use of at least 40 nights per year, in perpetuity, on the DCT. At a time when all of the national facilities for optical and near-infrared astronomy are heavily oversubscribed, and many are threatened with outright closure due to federal budget constraints, this investment on the part of the University has helped to insure the future of a vigorous ground-based astronomical research program at Boston University. Indeed, having guaranteed access to this state-of-the-art facility will provide our astronomers with important leverage with funding agencies, particularly the National Science Foundation.



The 4.3 meter Discovery Channel Telescope. For scale, note the person standing to the right of the open dome slit.

Long-term, guaranteed access to the DCT will quite literally change the face of the department over the next decade. In 2012, a search for a new faculty member who would be either an instrument builder or a primary user of the DCT was approved. We will be carrying out a search in Spring 2013 in order to identify an outstanding young astronomer to add to our faculty, whose research program will be closely linked to the DCT. In the more distant future, as current senior faculty retire, the DCT will continue to be an important facility for recruiting young faculty. The DCT will also provide outstanding opportunities for graduate dissertations, as well as productive scientific collaborations within the institutions that form the DCT partnership (Lowell Observatory, Boston University, University of Maryland, Goddard Space Flight Center, and University of Toledo as of Spring 2012).

The first science nights on the DCT are expected to occur in early 2013. Initial science programs are expected to include studies of M dwarf stars (Professor Andrew West), searches for distant clusters of galaxies (Professor Elizabeth Blanton), and studies of gravitational lensing and satellite galaxy populations within nearby clusters of galaxies (Professor Tereasa Brainerd). The DCT provides an outstanding platform for new astronomical instrumentation that would be designed and built by Boston University faculty and students. For example, Prof. Clemens is proposing to build FLEXI, a novel multi-object fiber-optic feed that will allow astronomers to measure infrared spectra of 81 different objects simultaneously.

The DCT also provides exciting education and outreach possibilities for students and faculty in our School of Education and College of Communications. Discussions between key BU astronomers and key faculty in SED have already begun, with the goal of developing an astronomy-centered outreach program over the next couple of years.

APPENDIX A: Faculty, Staff, and Graduate Students

Chair: Associate Professor Tereasa Brainerd

Associate Chair: Professor John Clarke

Director of Graduate Studies: Associate Professor Meers Oppenheim

Director of Undergraduate Studies: Professor Dan Clemens

Department Administrators: Ms Laura Wipf and Mr. John-Albert Moseley

Faculty

Thomas Bania, Professor of Astronomy. AB, Brown University; MS, PhD, University of Virginia

Elizabeth Blanton, Assistant Professor of Astronomy. AB, Vassar College; Ma, MPhil, PhD, Columbia University

Tereasa Brainerd, Associate Professor of Astronomy. BSc, University of Alberta; PhD, The Ohio State University

Kenneth Brecher, Professor of Astronomy. BS, PhD, Massachusetts Institute of Technology

Supriya Chakrabarti, Professor of Astronomy. BE, University of Calcutta; MS, PhD, University of California, Berkeley

John Clarke, Professor of Astronomy. BS, Denison University; MA, PhD, John Hopkins University

Dan Clemens, Professor of Astronomy. Bs, BS, University of California; MS, MS, PhD, University of Massachusetts

Timothy Cook, Associate Research Professor of Astronomy. BA, John Hopkins University, PhD, University of Colorado

Nancy Crooker, Research Professor of Astronomy. BA, Knox College; MS, PhD, University of California, Los Angeles

Theodore Fritz, Professor of Astronomy, Professor of Electrical and Computer Engineering, Professor of Aerospace and Mechanical Engineering. BA, Virginia Polytechnic Institute; MS, PhD, University of Iowa.

Charles Goodrich, Research Professor of Astronomy. BS, PhD, Massachusetts Institute of Technology

W. Jeffrey Hughes, Professor of Astronomy. BSc, PhD, University of London

James Jackson, Professor of Astronomy. BS, Pennsylvania State University; PhD, Massachusetts Institute of Technology

Kenneth Janes, Emeritus Professor of Astronomy. AB, Harvard College; MS, San Diego State University; MA, MPhil, PhD, Yale University

John Lyon, Research Professor of Astronomy. ScB, Brown University; PhD, University of Maryland

Alan Marscher, Professor of Astronomy. BS, Cornell University; PhD, University of Virginia

Michael Mendillo, Professor of Astronomy, Professor of Electrical and Computer Engineering. BS Providence College; MA, PhD, Boston University

Merav Opher, Assistant Professor of Astronomy. BS, PhD, University of Sao Paulo

Meers Oppenheim, Associate Professor of Astronomy. BS, PhD, Cornell University

Jack Quinn, Research Professor of Astronomy. BA, University of Colorado; MS, PhD, University of California, San Diego

George Siscoe, Research Professor of Astronomy. BS, PhD, Massachusetts Institute of Technology

Harlan Spence, Adjunct Professor of Astronomy. BA, Boston University; MS, PhD, University of California, Los Angeles

Andrew West, Assistant Professor of Astronomy. BS, Haverford College; MS, PhD, University of Washington

Paul Withers, Assistant Professor of Astronomy. BA, MS, Cambridge University; PhD University of Arizona

Department Staff

David Bradford, Systems Manager

John-Albert Moseley, Department Administrator

Jeffrey Sanborn, Associate Systems Manager

Quinn Sykes, Observatory Manager

Laura Wipf, Department Administrator

Astronomy Graduate Students During 2011-2012

Name	Affiliation	Title
Susmita Adhikari	AST	TF
Jan Marie Anderson	IAR	RA
Erin Arai	IAR	RA
Elizabeth Bass	CSP	RA
Dolon Bhattacharyya	CSP	RA
Carol Carveth	CSP	RA
Lauren Cashman	IAR	RA
Christopher Claysmith	IAR	RA
Meredith Danowski	CSP	RA
Edmund Douglas	IAR	RA
Kathryn Fallows	CSP	RA
Susanna Finn	IAR	RA
Katherine Garcia	CISM	RA
Zack Girazian	CSP	RA
Dustin Hickey	CSP	RA
Paul Howell	IAR	RA
Sadia Hoq	IAR	RA
Christina Kay	CSP	RA
Kamen Kozarev	CSP	RA

Name	Affiliation	Title
Majd Matta	CSP	RA
Chad Madsen	CSP	RA
Christopher Mendillo	CSP	RA
Jordan Montgomery	AST	TF
Dylan Morgan	IAR	RA
Michael Malmrose	IAR	RA
Rachel Paterno-Mahler	AST	TF
Michael Pavel	IAR	RA
April Pinnick	IAR	RA
Patricio Sanhueza-Nunez	IAR	RA
Antonia Savcheva-Tasseva	IAR	RA
Carl Schmidt	CSP	RA
Terri Scott	IAR	RA
Laura Sturch	IAR	RA
Christopher Theissen	AST	TF
Jillian Tromp	CSP	RA
Brian Walsh	CSP	RA
Karen Williamson	AST	TF
Joshua Wing	IAR	RA

Incoming Graduate Students (Fall 2012)

Name	Undergraduate Institution
Matthew Camarata	Southern Connecticut University
Daniel Feldman	CUNY College of Staten Island
Mason Keck	Oregon State University
Adam Michael	Wesleyan University
Matthew Young	University of New Hampshire

APPENDIX B: 2011/12 Astronomy Graduates

DOCTORATE

Name	Thesis Title
Ingolfur Agustsson	“Satellite Galaxies as Probes of Dark Matter Halos”
Edmund Douglass	“The Galaxy Cluster Environments of Wide Angle Tail Radio Sources”
Susanna Finn	“Molecular Line Observations of Infrared Dark Clouds in the Galaxy”
Elizabeth Fucetola	“Determining Meteoroid Properties Using Head Echo Observations from the Jicamara Radio Observatory”
Katie Garcia-Sage	“Effects of Ionospheric Oxygen on Magnetospheric Structure and Dynamics”
Brian Walsh	“Energetic Particles in the Earth’s Magnetospheric Cusps”

MASTER OF ARTS

Name	Advisor
Sadia Hoq	James Jackson
Chad Allen Madsen	Meers Oppenheim
Terri Lynn Scott	Alan Marscher

BACHELOR OF ARTS

Name	Concentration
Meredith Marie Bartlett	Astronomy and Physics
Navah Farahat	Geophysics and Planetary Sciences, with distinction
Nicholas Roy Ferreri	Astronomy
Kelly Elizabeth Holden	Astronomy
Robert Charles Marchwinski	Astronomy and Physics, with distinction, cum laude
Joshua Lev Mascoop	Astronomy and Physics; Psychology
Alexander Nobel Wynn	Astronomy and Physics
Paul Michael Zablowksi	Geophysics and Planetary Sciences

APPENDIX C: Seminar Series

Space Physics Seminar Series, 2011/2012

Date	Title	Speaker/Affiliation
15-Sep	Non-linear Wave-Particle Interactions in Space Plasmas	Yoshiharu Omura, University of Kyoto
22-Sep	Turbulent Origins of the Sun's Hot Corona and the Solar Wind	Steven Cranmer, Harvard University CfA
29-Sep	MEMS Deformable Mirrors for Astronomical Applications	Thomas Bifano, Boston University
6-Oct	Multi-Spectral Observations of Fine Scale Aurora	Hanna Dahlgren, Boston University
13-Oct	The Number of Terrestrial-Size, Habitable-Zone Planets as Projected from Kepler Mission Transits	Wesley Traub, JPL
20-Oct	All-sky Imaging Studies of the Low and Mid-latitude Ionosphere	Carlos, Martinis, Boston University
27-Oct	Far-Ultraviolet Molecular Spectroscopy of Protoplanetary Disks: New Views from Hubble	Kevin France, CU Boulder
3-Nov	Including the Public in the Data Pipeline: From Motivations to Publications	Pamela Gay, Southern IL Univ. Edwardsville/Astrosphere New Media
10-Nov	Weaving Science Data into Sound and Touch	Natalie Miebach, Independent/Artist
17-Nov	The Kepler Mission: New Light on Stellar Activity	Lucianne Walkowicz, Princeton University
30-Nov	First Detection of Milky Way Hydrogen Lyman-alpha Diffuse Emission from Voyager Measurements	Jean-Loup Bertaux, LATMOS, CNRS/UVSQ/ IPSL France
26-Jan	Gravity Wave Propagation and Influences in the Mesosphere, Thermosphere, and Ionosphere	Dave Fritts, NWRA
2-Feb	Atmospheric Circulation of Eccentric Extrasolar Giant Planets	Nikole Lewis, University of Arizona
9-Feb	Modeling the Three-Dimensional Upper Atmosphere of Titan	Jared Bell, SWRI
13-Feb	Magnetic Reconnection as a Cosmic Particle Accelerator	Jim Drake, University of Maryland
23-Feb	A World in a Grain of Sand – Contemplating Soil Regolith Granular Surficial Deposits (Dirt on Mars)	Michael Hecht, California Institute of Technology/NASA
1-Mar	Collisionless Shocks in the Heliosphere	Harald Kucharek, University of New Hampshire
8-Mar	MESSENGER Observations of Mercury's Dynamic Magnetosphere	James Slavin, University of Michigan
22-Mar	Thunderstorms and Lightning on Saturn	Georg Fischer, University of Iowa
29-Mar	Ionospheric Physics and Stellar Chromospheres	Juan Fontenla, University of Colorado
5-Apr	The Google Space Initiative	Tiffany Montague, Google Space
9-Apr	Turbulent Shocks in Astrophysical Plasmas	Randy Jokipii, University of Arizona
19-Apr	Direct Imaging of Extrasolar Planets	Bruce MacIntosh, LLNL
26-Apr	Magnetosphere-Ionosphere Coupling at Jupiter-like Exoplanets with Internal Plasma Sources	Jon Nichols, University of Leicester
3-May	NASA's Solar System Exploration Paradigm	Jim Green, NASA

Astrophysics Seminar Series, 2011/2012

Date	Title	Speaker/Affiliation
12-Sep	Active-Galaxy Jets: An Exhausting Business	Diana Worrall, University of Bristol
19-Sep	Understanding Dynamical Galaxy Clusters: Combining Observations and Simulations	Elke Roediger, Jacobs University Bremen
26-Sep	Cosmology and Astrophysics with Galaxy Clusters	Daisuke Nagai, Yale University
3-Oct	Mass Segregation in Clustered and Isolated Star-Forming Environments	Helen Kirk, Harvard-Smithsonian CfA
17-Oct	Fifty Years of Stargazing: Stellar Cycles at Lowell Observatory	Jeff Hall, Lowell Observatory
24-Oct	The Origin of Retrograde Hot Jupiters	Smadar Naoz, Harvard-Smithsonian CfA
31-Oct	The Milky Way as a Grand Design Spiral	Tom Dame, Harvard-Smithsonian CfA
7-Nov	Planet Formation in Dusty Disks Around Young Stars	Catherine Espaillat, Harvard-Smithsonian CfA
21-Nov	The Co-Evolution of Galaxies and Black Holes	Kevin Schawinski, Yale University
28-Nov	The Green Bank Telescope H II Region Discovery Survey	Tom Bania, Boston University
5-Dec	Decoding the Schmidt Law: What can we know about star formation?	Barry Madore, OCIW
12-Dec	Stellar Forensics with Supernovae and Gamma Ray Bursts	Marayam Modjaz, New York University
23-Jan	Ultra-faint Galaxies Around the Milky Way	Marla Geha, Yale University
30-Jan	Cosmic Evolution and the Arrow of Time	Eric Chaisson, Harvard-Smithsonian CfA
6-Feb	Star Formation Rates in Molecular Clouds and the Nature of the Extragalactic Scaling Relations	Charles Lada, Harvard-Smithsonian CfA
13-Feb	Magnetic Reconnection as a Cosmic Particle Accelerator	Jim Drake, University of Maryland
27-Feb	Coronal Heating and Solar Wind Models: Tests with Solar Probe Plus and Solar Orbiter	Marco Velli, JPL
5-Mar	Seyfert Galaxies	Chris O'Dea, Rochester Institute of Technology
19-Mar	Double, Double Toil and Trouble, Fire Burn and Cauldron Bubble – Goings On in Cool Core Clusters	Stefi Baum, Rochester Institute of Technology
26-Mar	Baryons in Galaxies and the Intergalactic Medium: Tracers of Galaxy Evolution	Jessica Rosenberg, George Mason University
2-Apr	At the Edge of the Solar System: Learning How Stars Interact with their Surrounding Media	Merav Opher, Boston University
9-Apr	Turbulent Shocks in Astrophysical Plasmas	Randy Jokipii, University of Arizona
23-Apr	Dissecting Supernova Remnants	Laura Lopez, MIT
30-Apr	Sloshing, Bubbles, and Active Galactic Nuclei in Clusters of Galaxies (Up Close and Far Away)	Elizabeth Blanton, Boston University
2-May	The Early Stages of Massive Star Formation	Claudia Cyganowski, Harvard

APPENDIX D: Accounts Income Expenditures**Operating Budget (20-201)**

Category	Amount	Percent of FY12 Income
Operating Budget	\$59,506	100%
Total Income	\$59,506	100%

Category	Amount	Percent of FY12 Expenditures
Work Study	\$5,406	9%
Supplies	\$8,829	15%
Telecom	\$5,169	9%
Postage	\$116	0%
Contracted Services	\$6,542	11%
Reproduction and Printing	\$746	1%
Books & Periodicals	\$275	0%
Travel	\$18,703	32%
Meeting Expenses	\$10,371	18%
Unclassified	\$1,500	3%
Facilities	\$853	1%
IS&T	\$795	1%
Minor Equipment	\$207	0%
Cash Discount	-\$6	0%
Total Expended	\$59,506	100%

IDC Return (20-201-1021-9)

Category	Amount	Percent of FY12 Income
FY11 IDC forward	\$32,692	20%
8% IDC	\$132,798	80%
Total Income	\$165,490	100%

Category	Amount	Percent of FY12 Expenditures
Minor Equipment	\$2,406	2%
Supplies	\$17,126	11%
Contracted Services	\$193	0%
Travel	\$7,183	5%
Meeting Expenses	\$3,582	2%
Facilities	\$180	0%
IS&T	\$64	0%
Telecom	\$32	0%
Unclassified	\$174	0%
CSP IDC operating	\$74,314	49%
IAR IDC operating	\$45,853	31%

Reproduction and Printing	\$804	0%
Total Expended	\$151,911	100%

University (Kilachand) Honors College Account (019-420)

Category	Amount	Percent of FY12 Income
UHC	\$10,000	100%
Total Income	\$10,000	100%

Category	Amount	Percent of FY12 Expenditures
Instructor Payroll	\$7,000	70%
Display and computer in 521	\$3,000	30%
Total Expended	\$10,000	100%