

Williams College
Department of Astronomy
and the
Hopkins Observatory
Williamstown, Massachusetts 01267

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The following report covers activities from July 2001 through August 2002.

1. FACULTY AND STUDENTS

Faculty throughout the period included Jay M. Pasachoff, Field Memorial Professor of Astronomy and Director of the Hopkins Observatory; and Karen B. Kwitter, Ebenezer Fitch Professor of Astronomy and Chair of the Astronomy Department. Marek Demianski was Visiting Professor of Astronomy in 2001-02 while Pasachoff was on sabbatical at the Harvard-Smithsonian Center for Astrophysics. Stephan E. Martin was Instructor in Astronomy and Observatory Supervisor through June 30, 2002, and Steven P. Souza assumed the post on July 1, 2002. Bryce A. Babcock, Staff Physicist, played a major role in the observing expeditions.

For the second straight year, the department enrolled the most astrophysics and astronomy majors ever; there were nine rising juniors in the class of 2004, seven rising seniors in the class of 2003, and nine seniors graduating in the class of 2002. Graduating astrophysics majors were Daniel Bissex, Gabriel Brammer, Shoshana Clark, Bethany Cobb, Rossen Djagalov, Caleb Fassett, David (Mike) Gioiello, and David Glick; William Allen graduated as an astronomy major. Rising seniors are Kathleen Gibbons, Christopher Holmes, Kristen Shapiro, Wei-Li Deng, Megan VanDyke, Naila Baloch, and David Ticehurst. Incoming astrophysics juniors are Paul Crittenden, Jesse Dill, Robertson Follansbee, Matthew Hoffman, Martin Mudd, Lissa Ong, Davis Stevenson and Galen Thorp. Incoming astronomy junior is Sarah Croft.

2. RESEARCH

2.1 Pasachoff

Pasachoff, with students Gabe Brammer '02, Kate Gibbons '03, and Roban Kramer (Keck Northeast Astronomy Consortium [KNAC] Summer Fellow, Swarthmore '03), began the reduction of their eclipse expedition data, which were gathered in Zambia on June 21, 2001, working with Staff Physicist Bryce Babcock and Martin. The data concern the intensity and polarization of the solar corona. Daniel Seaton '01, now at the Harvard-Smithsonian Center for Astrophysics in the TRACE project, participated in the work, making mosaics of eclipse images and combining them with data from Leon Golub's rocket that made [Ni XVII] x-ray images as well as data from the Solar and Heliospheric Observatory (SOHO) spacecraft. Together, the data enable coronal streamers to be traced to their roots on the solar disk. Data from the Large Angle Spectrographic Coronagraph (LASCO) are also being considered.

Brammer used the clean room at the UVCS (SOHO's Ultraviolet Coronagraphic Spectrometer) facility at the

Harvard-Smithsonian Center for Astrophysics (CfA), under the tutelage of Adrian Daw, to test the instrumental polarization in the telescope/CCD system used to observe coronal polarization at the 2001 eclipse. The results, part of his senior thesis, showed a low level of polarization.

The observations, in collaboration with John Kohl and Peter L. Smith of the CfA, are to check on the overlap of polarization measurements made with two SOHO instruments and the Williams eclipse instrument. Images from the eclipse appear at www.williams.edu/astronomy/eclipse, in part the result of work by summer students at Williams College's computer center. The expedition was supported by the NSF, by the Committee for Research and Exploration of the National Geographic Society, by NASA, by the Massachusetts Space Grant, by the W. M. Keck Foundation through the Keck Northeast Astronomy Consortium, and by Sigma Xi. Further support came from the Brandi Fund, the Safford Fund, the Rob Spring '75 Fund, and the Bronfman Science Center, all at Williams.

Seaton pursued the data from the 1999 eclipse that had led to a published paper detecting high-frequency oscillations on coronal loops, and carried out a wavelet analysis. Seaton delivered a paper on the extended subject, joint with Pasachoff, Babcock, and Kevin Russell '00, at the Albuquerque meeting of the American Astronomical Society in June 2002.

Pasachoff observed the annular eclipse of 14 December 2001, from a site on the Pacific Coast of Costa Rica together with an expedition from the University of Costa Rica. He subsequently observed the annular eclipse of 10 June 2002, from a site at sea south of Puerto Vallarta. Pasachoff worked on organizing the expedition to Ceduna, Australia, for the total solar eclipse of 4 December 2002. In May 2002, he made a reconnoitering trip to Ceduna and Adelaide and made suitable arrangements for the ultimate expedition. In Sydney, he consulted on the subsequent Antarctic eclipse of 22/23 November 2003, which may have to be observed from an icebreaker or adjacent ice.

Pasachoff continued to work with Donald A. Lubowich of the American Institute of Physics and Hofstra College on a series of observations involving cosmic deuterium. Deuterium is a uniquely sensitive tracer of the physical conditions in the era of nucleosynthesis, which began about 1 second after the Big Bang and lasted about 1000 seconds. All the deuterium in the universe was formed during that interval. Brammer, David A. Ticehurst '03 and Kristen Shapiro '03 observed on this project with the 45-m millimeter radio telescope at the Nobeyama Radio Observatory in Japan. Subsequent observations were made on related deuterium topics with the 12-m millimeter radio telescope of the Steward Observatory on Kitt Peak and with the Haystack Radio Telescope in Westford, MA, sometimes on site and sometimes remotely. A number of deuterated molecules were detected,

and the observational results are under analysis. The existing results were described in Brammer's senior thesis.

As a major part of his sabbatical at the Harvard-Smithsonian Center for Astrophysics, Pasachoff resumed work on the solar chromosphere, a long-time interest, by planning high-spatial-resolution observations with the Transition Region and Coronal Explorer (TRACE) spacecraft. He worked with Ed DeLuca and Leon Golub of the CfA. Seaton '01, who is working for the TRACE group at CfA, made preliminary measurements on existing TRACE data, showing the feasibility of the project. Klaus Wilhelm, former head of the SUMER project on SOHO, and Goran Scharmer, of the New Swedish Solar Telescope on La Palma, Canary Islands, have agreed to make joint observations with the Williams group. TRACE provides constant seeing, allowing chromospheric spicules at the solar limb to be followed accurately over time and thus provide an improvement to Pasachoff's earlier observations of spicule dynamics and spectra. Because the mass in spicules is enough to replace the corona in a brief time though coronal mass is not replaced so quickly, solar physicists have accepted that most of the spicules return to lower levels of the solar atmosphere, though they still discuss whether it is on ballistic or magnetically guided trajectories. Studying the registered images of spicules in ultraviolet chromospheric and coronal spectral lines should allow distinguishing between changes in direction of the spicular gas and the advance of an ionization front.

Pasachoff was invited by James L. Elliot of MIT to participate in expeditions to Chile and to Hawaii for the occultations of stars by Pluto predicted for July 20 and August 21. Only once previously, in 1988, was such an occultation observed, and essentially all that is known about Pluto's atmosphere came from that event. The results are to distinguish between two models for Pluto's atmosphere based on the previous occultation: Is there a haze layer in Pluto's lower atmosphere or does the temperature structure differ there from that at higher levels? We would also find out if Pluto's atmosphere has changed since 1988. The important question of whether Pluto's atmosphere will freeze out in the next decade or so, to remain unable to be further investigated for over 200 years as Pluto moves farther from the sun in its 250-year orbit, may also be resolved. And, of course, such a rare opportunity could lead to a radical revision of astronomers' understanding of Pluto's atmosphere and of its relation with the increasingly important class of objects known as Kuiper belt objects.

Pasachoff, Souza, and Ticehurst brought their portable 35-cm telescope and rapid-readout CCD to Chile for the July 20 occultation. Ultimately, most locations for that event failed, because of weather and because the path shifted from the predictions. One set of observations from a member of the collaboration, Marc Buie of the Lowell Observatory, succeeded from northern Chile, showing that Pluto's atmosphere had changed from 1988. The expedition for the August 21 event was much more successful. The team of Pasachoff, Babcock, and Ticehurst obtained all the needed data in the visible with the 2.2-m telescope of the University of Hawaii on Mauna Kea. Their 20-min occultation run of 2400 CCD frames at 0.5-s cadence showed a 6-min occultation with fine

structure that is now under study in collaboration with Elliot and other members of the consortium. Nine telescopes on Mauna Kea, Maui, Palomar Mountain, and at the Lick and Lowell Observatories contributed infrared and optical data to the study. Talks were prepared for meetings of the Division of Planetary Sciences of the AAS and for the AAS general meeting, and a paper is under preparation.

Pasachoff continued his collaboration with Roberta J. M. Olson on the overlap of art and astronomy. Olson is at the New-York Historical Society. They gave an invited lecture on "Meteoritics and Visual Metaphors" to the Meteoritic Society meeting in Rome in September 2001. In April, Pasachoff visited the Frick Collection to discuss possible eclipse illumination in a 16th-century painting by Bellini, at the invitation of the director, Samuel Sachs II.

In his eclipse work, Pasachoff was busy not only on scientific tasks but also on educational pursuits relevant to the safe observing of eclipses by local populations, through his roles as Chair of the Working Group on Solar Eclipses of the International Astronomical Union (IAU) (see www.williams.edu/astronomy/eclipses) and as Chair of the Subcommittee on Public Education through Eclipses of the Commission on Education and Development of the IAU (see www.eclipses.info).

2.2 Kwitter

Kwitter and her colleagues continue their studies of planetary nebulae. The chemical composition of these extraordinarily beautiful and complex objects yields important clues as to the nature of the nuclear processing that went on inside the parent star. These stars, which make up the majority of those in our Milky Way Galaxy, have masses between about 0.8 and 10 times the mass of our sun. In addition to the evolutionary history of their progenitors, planetary nebulae as a class offer an opportunity to study the properties of the surrounding interstellar medium and the chemical evolution of the Galaxy as a whole.

Kwitter and R. B. C. Henry of the University of Oklahoma are working on a multi-faceted project to study planetary nebulae as individual objects and as probes of chemical evolution in the Galaxy (and possibly in other galaxies as well). Their work has been funded by an NSF grant. They are studying the abundances of sulfur, chlorine, and argon in planetary nebulae. These elements are particularly interesting because their amounts are not altered by the nucleosynthesis in the progenitor stars, and therefore these amounts should reflect those in the gas out of which the progenitor star formed billions of years ago. This allows us to evaluate predictions of the buildup of these elements over time in the Galaxy and to assess the various contributions, particularly from Type Ia supernovae, which come from the incineration of white dwarf stars too massive to withstand gravitational collapse.

During the summer of 2001, Roger Cohen (Wesleyan '03), a KNAC Summer Fellow, worked with Kwitter on organizing and verifying a dataset of abundances in more than 50 southern planetary nebulae. He presented his results at the annual KNAC Undergraduate Symposium on Research in

Astronomy, and they were published in the *Astrophysical Journal Supplement*.

In the summer of 2002, Matthew Hoffman '04, and KNAC Summer Fellow Mun Keat Chan (Middlebury '03) worked with Kwitter on high-dispersion spectroscopic observations of several planetary nebulae, aimed at determining the abundance of iron in these objects. These students accompanied Kwitter on an observing run at Kitt Peak National Observatory in June 2002. Among their results is confirmation of the heliocentric radial velocity of the halo planetary nebula DdDm-1 (-310 km/sec), and the first measurement of its expansion velocity (16 km/sec). A publication detailing these results is in preparation.

During the summer of 2002, Kwitter worked with students sponsored by the Williams Instructional Technology program to design an interactive web site that will allow viewing and manipulation of her amassed collection of planetary nebula spectra. (The website is <http://cf.williams.edu/public/nebulae/index.cfm>.) Each spectrum reaches from the near ultraviolet (3600 Å) to the near infrared (9600 Å), at moderate spectral resolution. All spectra were obtained at Kitt Peak National Observatory in Tucson, Arizona, where several Williams students assisted in the observations, and at Cerro Tololo Interamerican Observatory near La Serena, Chile. The web site links to images and to atlas information for each object. Kwitter is in the process of designing simple exercises using the spectra to illustrate the nature of planetary nebulae and emission spectra in general. Data for this website come from NSF-funded research.

2.3 Demianski

Marek Demianski continued his interest in the process of formation and evolution of large scale structure of matter distribution in the universe. In collaboration with A. G. Doroshkevich, Demianski proposed a new approach to the process of structure formation stressing the role of perturbations of the gravitational potential. Predictions of this theory were compared with results of three different numerical simulations. In all these simulations, it was assumed that the average mass density of the universe is dominated by the dark matter. From theoretical considerations and numerical simulations it follows that initially large wall-like condensations appear. Walls are quasistationary structures with a long lifetime. They slowly break into much smaller dense clouds. Demianski and his collaborators analyzed the spatial distribution of Lyman α clouds, which are responsible for formation of absorption lines in the spectra of distant quasars. It turned out that the clouds can be identified with elements of filaments – long cylindrical structures which are formed during the process of fragmentation of walls. Recently they obtained access to data on about 5000 Lyman α clouds and performed extensive statistical analysis. Results of this analysis of redshift distribution of absorbers when compared with results of numerical simulations of the process of structure formation restricted the mass of the dominant family of dark matter particles to 0.6 – 2 keV. In collaboration with a group of astrophysicists from the Universita di Napoli, Demianski analyzed the influence of local non-homogeneities of matter distribution in the universe on light

propagation. Local non-homogeneities can change the distance estimation. This effect has been applied to study gravitational lensing of distant quasars and to estimate the error of the Hubble constant determination from observations of Type Ia supernovae. This analysis has been recently extended to study the influence of local inhomogeneities on observations of time delay in luminosity of images of variable quasars.

Demianski has also been active in the European Planck consortium where he is a Co-principal Investigator in the Low Frequency Instrument program and in the CMBNET program, where he is a Principal Investigator responsible for studying the topological signature of the universe in cosmic microwave background radiation data. In collaboration with Doroshkevich, Demianski showed that recent observations of small scale anisotropy of the cosmic microwave background radiation already quite strongly restricts the size of the elementary cell in the universe. It turns out that if the universe is multiply connected then the size of the elementary cell cannot be smaller than the diameter of the surface of last scattering.

Demianski supervised two independent study projects, with Sarah Reynolds '02 on possible energy sources of gamma-ray bursts and with Rossen Djagalov '02 on elements of the general theory of relativity and cosmology.

2.4 Martin

Martin participated in the Williams College Eclipse Expedition to Lusaka, Zambia, in June 2001. He supervised an observation carried out during the total solar eclipse to image the solar corona at the same scale and with the same green filter as a filter in a coronagraph on board the Solar and Heliospheric Observatory (SOHO). He was assisted in this observation by Mike Gioiello '02 and Kathleen Gibbons '03. Daniel Seaton '01 participated in the preliminary analysis of these data, and composite images are viewable at: <http://hea-www.harvard.edu/~dseaton/rocket/eit.html>. Martin continued his responsibilities for maintaining some of the World Wide Web pages for courses in the Astronomy department and the observatory, and, sponsored by Brooks/Cole College Publishing, for Pasachoff On-Line, a site devoted to Pasachoff's introductory astronomy textbook, *Astronomy: From the Earth to the Universe* (www.solarcorona.net). The observatory pages contain links to useful astronomy sites and provide a forum for students to display images that they have taken with the observatory's CCD system and photographic cameras as part of their observing projects. There are also pages dedicated to observations made by the Williams College eclipse teams at the total solar eclipses in Aruba, Romania, and Zambia (see <http://www.williams.edu/astronomy/eclipse/>).

2.5 Souza

Souza began preparations for the Pluto occultation expeditions, including development of a GPS-based timing system. He participated in the Chile observing expedition for the July 2002 Pluto occultation. He also began renovation of the department's 5-inch Carroll spar solar refractor, with the help of Lissa Ong '04 and John BackusMayes '05. With

Martin, he worked on upgrading the 24-inch DFM telescope, which included having the primary and secondary mirrors realuminized and acquiring an upgraded computer-control package.

2.6 Students

Under the guidance of Martin, the observatory continued to be used in support of the astronomy curriculum. Over 125 introductory astronomy students completed over 600 observations of celestial objects over the course of the academic year. These included sketches, photographs, and CCD images of the sun, moon, planets, nebulae, and galaxies. In addition to other rooftop renovations, two new 2.5-m domes were installed at the observatory, under the supervision of Babcock, to house a 14-inch Celestron Schmidt-Cassegrain and a 5-inch f/14 solar refractor. A new 2.5-m diameter radio telescope was also successfully installed and tested, further extending the department's observing capabilities into the radio spectrum.

Gabe Brammer '02 did an honors thesis under the long-distance supervision of Pasachoff. He worked on millimeter-wave molecular emission and absorption to study the primordial D/H ratio and galactic chemical evolution. Joining Pasachoff at the Harvard-Smithsonian Center for Astrophysics, he used the clean room of the SOHO UVCS experiment to investigate the internal polarization of the experimental equipment used in eclipse observations.

Bethany Cobb '02 worked with Kwitter on a sample of planetary nebula abundances and related properties. She was awarded a National Science Foundation Graduate Fellowship, which she will use to pursue a PhD in astrophysics at Yale.

Several students did off-campus astronomy research in the summer of 2002, supported by the Keck Northeast Astronomy Consortium (KNAC): Martin Mudd '04 worked as a KNAC Summer Fellow with Juan Cabanela at Haverford College; Kristen Shapiro '03 worked at the Space Telescope Science Institute in Baltimore; and Terry-Ann Suer '05 was a KNAC Summer Fellow at Colgate, working with Tom Balonek.

3. LECTURES, CONFERENCES & SERVICE

Williams College joined the Massachusetts Space Grant Consortium, which is headquartered at M.I.T. Other members include Boston University, the Charles Stark Draper Lab, Harvard University, Tufts University, the University of Massachusetts, Worcester Polytechnic Institute, the Marine Biological Laboratory at Woods Hole, the Five College Astronomy Department, Northeastern University, the Boston Museum of Science, and the McAuliffe/Challenger Center.

Pasachoff lectured on eclipses and coronal research at M.I.T. As part of his sabbatical appointment to the faculty of Harvard University as Associate of the Astronomy Department, Pasachoff was a reader of the senior thesis of Alexandru Ene, Harvard '02, who had participated in the 1999 Williams College eclipse expedition.

Pasachoff participated in an international meeting on *Communicating Astronomy*, held at the Canary Islands Insti-

tute for Astronomy and Astrophysics, Tenerife, in March. He gave papers on textbooks and on trade books. Pasachoff continued as Vice-President of the Commission for Education and Development of the International Astronomical Union and as U.S. National Liaison. He participated in deliberations of the Scientific Organizing Committee for plans for the Commission's sessions at the General Assembly of the International Astronomical Union in Sydney, Australia, in July 2003. Pasachoff participated in the American Astronomical Society meetings in Washington, D.C., in January 2002 and in Albuquerque in June 2002. He gave a talk on "The Role of Research in an Astronomy or Astrophysics Major" in the special session on *The Undergraduate Astronomy Major: What and Why?* held at the Washington meeting, as part of a panel discussion. Pasachoff continues on the science board of *World Book* and continues as consulting editor for astronomy of the *McGraw-Hill Scientific Encyclopedia* and *Yearbooks*. He is on the advisory board of the new *Astronomy Education Review* electronic journal. He was a principal of an extensive debate on what should be taught in astronomy courses and whether "traditional astronomy" like phases of the moon and seasons should be minimized, a discussion carried out at the AAS meetings, in the pages of *The Physics Teacher*, and in Pasachoff's article in the *Astronomy Education Review*. See aer.nao.edu. Pasachoff continues as science book reviewer for *The Key Reporter*, the Phi Beta Kappa newsletter. He continues as advisor to the children's magazine *Odyssey*. This interval saw the publication of the *Encyclopedia of Imaging Science and Technology*, for which Pasachoff was an advisor. The sixth edition of Pasachoff's text *Astronomy: From the Earth to the Universe* (Brooks/Cole, 2002) was published (see info.brookscole.com/pasachoff). Souza was coauthor of the *Teacher's Guide and Test Bank*. Pasachoff worked with Martin to post regular updates and press releases on a wide variety of astronomical topics on the Web at www.solarcorona.net. Work began on the second edition of Pasachoff's text *The Cosmos: Astronomy in the New Millennium*, with Alex Filippenko of the University of California at Berkeley as co-author, also transferred to Brooks/Cole on the occasion of Thomson International Publishing's purchase of Saunders College Publishing.

This past year Kwitter was elected to a three-year term as a member of the Observatories Council of the Association of Universities for Research in Astronomy (AURA). She continued to serve on the Space Sciences panel for the National Research Council Associateship Programs Review. The NRC is the principal operating agency of the National Academy of Sciences and National Academy of Engineering, and awards postdoctoral and senior associateships at national facilities. Kwitter also reviewed manuscripts for several astronomy journals. In addition she continued as a member on two committees of the American Astronomical Society: the selection committee for the Annie Cannon Award, of which she was chair; and the Committee on the Status of Women in Astronomy. She is also on the Advisory Board of the *Encyclopedia of Astronomy and Astrophysics*, published by the Institute of Physics.

In November 2001, Kwitter attended IAU Symposium #209 on "Planetary Nebulae: Their Role in the Universe,"

held in Canberra, Australia. In addition, Kwitter attended the meeting of the American Astronomical Society in Washington, D.C., in January 2002.

Kwitter was the organizer of the 12th annual Keck Northeast Astronomy Consortium Symposium on Student Research in Astronomy, held at Williams in November 2001. More than 120 faculty and students from the eight Keck schools (Colgate, Haverford, Middlebury, Swarthmore, Vassar, Wellesley, Wesleyan and Williams) were in attendance, and 33 students presented their research results. Kwitter also served as editor of the meeting procedures.

4. OFF-CAMPUS PRESENTATIONS

Pasachoff :

“Moon-Struck: Artists Rediscover Nature and Observe” (with R.J.M.O. Olson). Paper delivered at “Earth-Moon Relationships,” the 400th Anniversary Conference of the Galilean Academy of Sciences, Letters and Arts, Padua, Italy, 2000. Published as a book by that name by Kluwer, C. Barbieri and F. Rampazzi, eds., 2001, 303-341, with color versions of #1-9, 14-18, 20-22, and 24 on a CD-ROM

“Deuterium Near and Far in the Milky Way” (with D.A. Lubowich and J. Ostenson). Delivered at the Audouze-Truran Conference on “Cosmic Evolution,” Institut d’Astrophysique, Paris, 2000

“Menzel and Eclipses,” Donald H. Menzel Centennial Symposium, “Donald H. Menzel: Scientist, Education, Builder”

“Public Education in Developing Countries on the Occasions of Eclipses,” Astronomy for Developing Countries, IAU special session at the 24th General Assembly

“Eclipse/SOHO Joint Observations of Solar Eclipses,” (with Kevin Russell, Daniel B. Seaton, Bryce A. Babcock, and Stephan Martin). May 2001 joint meeting of the Solar Physics Division of the AAS

“Donald H. Menzel: Scientist, Educator, Builder,” (with O. Gingerich, D. Layzer, R.W. Noyes, W.H. Parkinson, and B. Welther), May 2001 joint meeting of the Solar Physics Division of the AAS and the American Geophysical Union

“Meteoritics and Visual Metaphor,” (with R. J. M. Olson). Invited paper for the September 2001 meeting of the Meteoritics Society, Rome

“TRACE Observations of the 15 November 1999 Transit of Mercury” (with G. Schneider and L. Golub). AAS Division of Planetary Sciences meeting, New Orleans, November, #10.02

“The Role of Research in an Astronomy or Astrophysics Major,” Special session on “The Undergraduate Astronomy Major: What and Why?” held at the 199th AAS meeting, Washington, DC, January 2002, #154.04

“The Chemical Composition at the Edge of the Galaxy” (with D.A. Lubowich, T.J. Millar, R. Roberts, G.B. Brammer, and C. Henkel). 199th AAS meeting, Washington, DC, January 2002, #58.04

“Further Analysis of Short-Period Waves for Coronal Heating from the 1999 Eclipse” (with D.B. Seaton, B.A. Babcock, and K. D. Russell). 200th AAS meeting, Albuquerque, June 2002, #88.04

“Coronal Heating, Mapping, and Polarization: The Williams College Expedition,” delivered at the “Eclipses and the Solar Corona” meeting at l’Institut d’Astrophysique, Paris

“The Working Group on Eclipses of the IAU,” delivered at the “Eclipses and the Solar Corona” meeting at l’Institut d’Astrophysique, Paris

“The Sun and Solar Eclipses,” M.I.T.

“Communicating Astronomy: Textbooks,” Astrophysical Institute of the Canary Islands, March 2002

Kwitter:

“Sulfur, Chlorine, and Argon Abundances in Galactic Planetary Nebulae” (with R.B.C. Henry). IAU Symposium #209, November 2001

“Sulfur, Chlorine and Argon Abundances in a Southern Sample of Planetary Nebulae” (with J.B. Milingo, and R.B.C. Henry). IAU Symposium #209, November 2001

5. STUDENT OBSERVING & PLANETARIUM

Student roof TA’s responsible for operating the telescopes, participating in observing research projects, and assisting introductory students with assignments, included Gabriel Brammer ’02, Bethany Cobb ’02, David Ticehurst ’03, Galen Thorp ’04, David M. (Mike) Gioiello ’02, Joshua Earn ’04, Lissa Ong ’04, Max Niederste-Ostholt ’02, Robert Gonzalez ’03, Rossen Djagalov ’02 and Kristen Shapiro ’03.

The Milham Planetarium was run by Gabriel Brammer ’02, David M. (Mike) Gioiello ’02, Christopher Holmes ’03, Max Niederste-Ostholt ’02 and Galen Thorp ’04. The show was “It’s O Right Zambia: The June 2001 Solar Eclipse Expedition.” Summer shows were given by the summer research students.

6. COLLOQUIA

Henry Roe ’97, University of California at Berkeley, “Weather Report from Another Planet: New Developments at Titan’s South Pole”

Jonathan Arons ’65, University of California at Berkeley, “Magnetars in the Metagalaxy: The Origin of ‘Cosmic Baseballs’ (Ultra High Energy Cosmic Rays)”

Claire Max, Lawrence Livermore National Laboratory, “Adaptive Optics: Sharper Eyes on the Sky”

Mark Trodden, Syracuse University, “Modern Cosmology and the Building Blocks of the Universe”

7. POSTGRADUATE PLANS OF MAJORS

William S. Allen II: teaching at Worcester Academy; Daniel T. Bissex: pursuing career in music; Gabriel B. Brammer: Data Analyst at STScI, then graduate school; Shoshana C. Clark: teaching in Honduras; Bethany E. Cobb: PhD program in Astronomy at Yale University; Rossen L. Djagalov: fellowship to study comparative literature in Moscow; Caleb I. Fassett: unknown; David Gioiello III: unknown; David M. Glick: unknown.

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- Lubowich, D. A., **Jay M. Pasachoff**, and J. Ostenson 2001, "Deuterium Near and Far in the Milky Way," delivered at the Audouze-Truran Conference on Cosmic Evolution, Institut d'Astrophysique, Paris, 2000; published in *Cosmic Evolution*, E. Vangioni-Flam, R. Ferlet, and M. Lemoine, eds., World Scientific, pp. 63-64
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