The College of Charleston
Department of Physics and Astronomy
Charleston, South Carolina 29424

The following report covers the Department activities from July 1994 through June 1996.

1. FACULTY

Nine of the twelve roster faculty in the Department of Physics and Astronomy as well as two visitors were engaged in astronomy related activities during the period of the report. They included Visiting Assistant Professor Derek Buzasi, Associate Professor Donald M. Drost, Professor Robert J. Dukes (Chairman), Associate Professor David H. Hall, Associate Professor William R. Kubinec, Assistant Professor B. Lee Lindner, Associate Professor Laney R. Mills, Assistant Professor Harold L. Nations, Visiting Instructor Heather Preston, Senior Instructor Terry R. Richardson, and Professor J. Fred Watts. Buzasi and Preston were with us for the 1995-96 academic year. Buzasi was supported in part by NASA grant NAGW-4787. He left in August, 1996 to assume a tenure track position at Valdosta State University. Adjunct instructors Gregory Adams, Kevin Bourque, David Boyd, Tony DuFour, and Robert Pittavino also taught in the program.

D.J. Williams was our laboratory manager and Carol Clarke our administrative assistant. Student assistants were Dirk Aurin, Scott Blair, Anthony Brown, Brittany Camper, Allan Espano, Rose Forsythe, Mitch Freeman, Hannes Greim, Frances Halter, Jennifer Jordan, Steve Lindauer, Jennifer Lockman, Mike McLaughlin, Dennis Maxwell, Rich Mullins, Lars Omberg, Travis Piazza, Marcia Smoak, and Joshua Spruill.

2. INSTRUMENTATION

2.1 On-campus Instrumentation

The main research instrument on-campus is an 0.4 meter DFM Cassegrain telescope. This telescope is used for public viewing, undergraduate and faculty research, and introductory astronomy lab use. It is equipped with a First Magnitude CCD. The department also possesses a 0.4 meter Meade Newtonian reflector which is semi-permanantly mounted in a relatively dark sky location. This has been primarily used for CCD photography. We also have an 0.27 meter Celestron and a 0.25 meter Meade for student use. The bulk of the introductory astronomy labs, however, make use of our collection of twenty-eight 0.2 meter and seven 0.13 meter Celestrons.

2.2 Four College Consortium APT

The Department owns an 0.8 meter Automatic Photometric Telescope (the Four College Consortium APT) which is shared with the Citadel, Villanova University, and the University of Nevada, Las Vegas. The construction and operation of this telescope has been funded by NSF grants AST86-16362, 91-15114, AST95-28586, and USE91-56184. This telescope is located at the Fairborn Observatory APT site. Prior to the summer of 1996 this site was located on Mt. Hopkins. Over the summer it was moved to a new Fairborn Observatory - Tennessee State University site at Washington Camp, AZ. Dukes serves as Principal Astronomer for the telescope and supervises uploading all observation requests.

2.3 Etelman Observatory, University of the Virgin Islands

Department faculty (Drost and Nations) have been working with David Smith of the University of the Virgin Islands in refurbishing the 0.4 meter Cassegrain reflector located at the Etelman Observatory on St. Thomas. The South Carolina Space Grant Consortium helped fund several trips by Drost and Nations to St. Thomas as well as a drive upgrade and several CCD cameras for use at the Observatory. Drost began a year's sabbatical at UVI in May, 1996. An undergraduate physics major (Dirk Aurin) will be joining him in December to spend the calendar year 1997 site testing and conducting photometric observations of solar type stars in an attempt to determine rotation periods.

2.4 Miscellaneous

The department is a member of the National Undergraduate Research Observatory, the North American Small Telescope Cooperative (NASTeC), the Global Network for Automated Telescopes (GNAT), and is an Academic Affiliate of the University Coorporation for Atmospherice Research.

3. EDUCATIONAL ACTIVITIES

Approximately 450 students per year enrolled in the Introductory Astronomy course. Six to seven lecture sections of this year long course plus 15 associated lab sections were held every semester. An additional 80 students enrolled in a variety of upper level astronomy courses. The Department offers a concentration in astronomy within the physics major and a minor in astronomy for students with majors in other fields.

Dukes continued working with Saul Adelman (P.I.) and Patrick Briggs of the Citadel on conducting a series of workshops for teachers funded by the NASA IDEA program. They were assisted by master teachers Kathy Rackley (Buist Academy for Advanced Studies), Jeri Calhoun (Belle Hall Elementary School), Barbara Eager (Springfield Elementary School), and Beth Anthony (Mary Ford Elementary School). Approximately 400 elementary and middle school teachers attended these workshops. Dukes and A. H. Dukes (Hunley Park Elementary School) presented several programs on the use of the Space Telescope Science Institute's Electronic PictureBooks at local and state educator's meetings.

Kubinec has been working on using cooperative learning activities in the introductory astronomy sequence. Some of

these involve science policy questions and have been developed with Jeffrey Rosendhal of NASA Headquarters Office of Space Science.

The Department continued hosting regular open houses for the public on the third Saturday of every month during the academic year. Additional special programs for precollege groups were held on Friday evenings. Special events were held at various off-campus locations. Members of the Department have participated in the Charleston County Parks and Recreation Worlds of Wonders Family Science Series. The Low-Country Star-Gazers amateur group uses our on-campus facilities for their monthly meetings.

Work was completed on a curriculum development project funded by NSF grant USE91-56184 to Dukes. Other faculty involved were Kubinec, Nations, and Richardson. Adjunct instructor David Boyd tested many of the observational activities and former student Alan Johnson did most of the programming. This project involved rewriting the computer simulation ''The Indoor Telescope'' which was originally programmed for Apple II computers for the Macintosh. Additional labs were developed based on a variety of commercial software. Finally, work was continued on investigating means of involving non-majors in undergraduate research.

Nations, working with Wragg, Watts, and Mills, continued activity on their NSF-ILI funded (DUE93-52760) project to use CCD cameras in both the astronomy and physics curriculum. A major thrust of this project is the incorporation of digital imaging in physics labs as well as its use in astronomy. Several labs were developed for the junior optics course. Five CCD's and accompaning mobile workstations have been purchased to date.

4. VISITORS

During the period we were fortunate to have the following visitors give colloquia in the Department:

David Crawford (Kitt Peak National Observatory)

Laurence Marschall (Gettysburg College and Harvad-Smithsonian Center for Astrophysics)

Jeffrey Rosendhal (Office of Space Science, NASA Headquarters)

Rosanne di Stefano (Harvard-Smithsonian Center for Astrophysics)

5. UNDERGRADUATE AND FACULTY RESEARCH

Dukes has continued observing pulsating B stars with the APT. Together with Laney Mills and Walter Fitch of Steward Observatory, he has continued work on the non-radial pulsator 53 Persei. They have now analyzed six seasons of data and have identified 3 frequencies plus a coupling term which is the sum of the two strongest frequencies. Kubinec, in conjunction with Dukes and Saul Adelman at the Citadel, has continued his work on a similar star, 3 Vulpeculae. Dukes and Mills with the assistance of Jennifer Jordan, an undergraduate major, have begun analyzing observations of the Beta Cephei type stars, Beta Canis Majoris and Alpha Virginis (Spica).

Dukes has also continued work on Cepheid strip variables. He supervised Lars Omberg, a Governor's School of Science and Mathematics Summer Scholar, in analyzing APT data for the peculiar Cepheid V473 Lyrae.

Under his supervision another Summer Scholar, Ron White, analyzed APT data for the Delta Scuti star, 4 Canes Vanactorium. A junior physics major, Alan Espano, worked with observations of the multimode Cepheids CO Aurigae, VX Puppis, and EU Tauri. Joshua Spruill, a physics major, analyzed observations of another multimode Cepheid BQ Serpens as his senior research.

Dukes together with Jennifer Jordan and Frances Halter, junior physics majors, began a study of the scientific value of automated photometry. Preliminary results were presented by Halter and Jordan at both the annual meeting of the South Carolina Academy of Science and the College of Charleston Scientific Research Poster Session.

Dukes, with Mitch Freeman, a Fine Arts undergraduate, analyzed APT observations of the *Be* stars Zeta Tauri and Psi Persei which were obtained as part of a multi-longitude campaign. Freeman presented a report on this work at the annual meeting of the South Carolina Academy of Science and the College of Charleston Scientific Research Poster session.

Harold Nations has managed the College Observatory (assisted by David Boyd). They have continued their extensive work with CCD imaging program. This also utilized the 0.4 m Meade reflector located on Edisto Island. Unfortunately, Mr. Boyd has accepted a position out of the area causing the College to lose his valuable services. The Meade has temporarily been relocated to a site near Aiken, SC where Mr. Boyd is investigating establishing a collaboration with the Ruth Patrick Science Center.

Nations has also continued work on his Research Corporation grant which is funding the construction of two low resolution fiber optic spectrographs. One of these is for the College of Charleston and the other for the National Undergraduate Research Observatory (NURO). Kevin Kan, a physics senior, completed his undergraduate research by working with Nations on this project. Nations spent the summers of 1994 and 1995 in Flagstaff working on this project. A undergraduate physics major, Hannes Greim, accompanied him in 1995.

Nations took one group of undergraduate students, recruited from his introductory astronomy class, on an observing run at NURO in March, 1995. These students were Frances Halter, Hannes Greim, and Dennis Maxwell. These students returned with glowing reports of their experiences and a much better feeling for the methods of observational astronomical research. Since the trip these students have declared physics majors.

Mills, with some assistance from Dukes, supervised Rose Forsythe's senior research project involving an attempt to find chaotic behavior in the AAVSO observations of the eruptive variable. Forsythe chose this star over the RV Tauri star R Scuti since it more nearly fit the ''dripping faucet model.'' R Scuti has since been shown by others to demonstrate chaotic behavior.

Lindner conducted research regarding the stability of CO_2 ice on the planet Mars. An undergraduate fine arts major, Mitch Freeman, assisted in the analysis. The research

demonstrated the importance of terrain, surface roughness and topography for the stability of Martian ice.

A mission to Mars to measure ozone by balloon-borne sensors has been proposed by Lindner. Also, theoretical studies exploring the ozone needed to sustain life on Mars is being published.

PUBLICATIONS

The publication list includes all papers published or submitted between July 1994 and July 1996.

Carew, J.J., **Drost, D.M.**, Sealey, N.E., & Mylroie,J.E. 1995, ''Refracted Images of Bahamian Islands and Possible Implications Regarding the First Landfall of Christopher Columbus,'' 1995, Bahamas J. of Sci., Vol. 14, 1

Dukes, R.J. & **Kubinec, W.R.** 1994, ''A New B Variable, HD 182865,'' BAAS, Vol. 26, 1447

Dukes, R. J Kubinec, W.R.,**Nations, H.L.**, Adelman, S.J., Smith, D.P., Guinan, E.F., & McCook, G.P. 1995, ''The Four College Consortium APT: The First Four Years,'' in *Robotic Telescopes: Current Capabilities, Present Developments, and Future Prospects for Automated Astronomy*, ed. G.W. Henry & J.A. Eaton, (San Francisco: Astronomical Society of the Pacific Conf. Ser.), Vol. 79, 20-36

Dukes, R.J.,**Kubinec, W.R.**, Kubinec, A.L., & Adelman, S.J. 1995 ''3 Vulpeculae, a 53 Persei Star,'' BAAS, Vol. 27, 482

Dukes, R.J.,**Kubinec, W.R.**, & **Nations, H.L.** 1996, ''Undergraduate Research for Majors and Non-Majors,'' in *Astronomy Education: Current Developments, Future Coordination*, ed. J.R. Percy, (San Francisco: Astronomical Socienty of the Pacific Conf. Ser.), Vol. 89, 195-96

Greim, H. 1996, ''Low Resolution Stellar Spectroscopy with a Fiber Coupled Spectrograph,'' in *Proc.of Tenth National Conference on Undergraduate Research*, ed. R. Yearout, (Asheville, NC: University of North Carolina at Asheville), Vol. II, 1242-1246

Guinan, E. F., **Dukes, R.J.**,**Nations H.L.**,**Buzasi,D.**, & McCook, G. 1995,''51 Pegasi,''IAU Circ. No. 6261, 1

Hiscox, J.A. & **Lindner, B.L.** submitted, J. British Interplanetary Society

Kaye, A.B., Hall, D.S., Patterson, L.R.,**Nations, H.L.**, & Heckert, P.A. 1996, ''1982-1988 Photometry of the Totall Eclipsing Chromospherically Active Binary V792 Herculis = HD 155638,'' AJ, Vol. 111, 1322-1328

Kubinec,W.R.,**Dukes, R.J.**, & Kubinec, A.L. 1994, ''APT Observations of the 53 Persei Star, 3 Vulpeculae,'' BAAS. Vol. 26, 1447

Lindner, B.L.,Iwasaki,K., & Akabane, T. 1994, ''Analysis of Japanese Observations of the Martian Polar Caps,'' BAAS, Vol. 27, 828-829

Lindner, B.L. 1995, ''In Situ Mars Ozone Detector,'' Acta Astronautica, Vol. 35, 137-144

Lindner, B.L. 1995, ''Mars Ozone: Mariner 9 Revisited,'' Icarus, Vol. 113, 213-216

Mills, L.R., & **Dukes, R.J.** 1994, ''Four Years of APT Observations of the Prototypical Star, 53 Persei.'' BAAS, Vol. 26, 1447

Nations, H. L., **Buzasi, D.**, **Greim, H.** 1995, ''Galaxy Redshifts with a $1 Spectrograph?,'' BAAS, Vol. 27, 1389

Nations, H.L., Marschall, L.A., & Stefanik, R. P. 1994, ''Photometric and Spectroscopic Observations of the Newly Discovered RS CVn Binary HD 80492,'' BAAS, Vol. 26, 1462

R. J. Dukes