This report covers the period September 30, 1998 to October 1, 2000.

1. STAFF

The members of the Physics Department involved in astronomical research include the following: Ralph A. Alpher, Distinguished Research Professor, Jonathan Marr, Assistant Professor, A. G. Davis Philip, Research Professor and Visiting Assistant Professors Rebecca Koopmann and Rebecca Surman. Surman has been shifted from visiting assistant professor to a tenure-line assistant professor. Susan Tereby, of Extrasolar Research Inc., has joined Union College as a visiting research professor, beginning the 2000–2001 academic year. Chuck Winrich, recently hired by the Schenectady Museum, will also serve as the manager for the Union College Observatory.

Alpher continued as administrator of Dudley Observatory in 1999. Dudley Observatory moved to new quarters in 1999. Alpher was succeeded by George Wise as administrator of Dudley Observatory in June, 2000. Philip continued as Director of the Shapley Visiting Lectureships Program and as Co-editor of Baltic Astronomy. A Web page for the Shapley Visiting Lectureships Program was set up by Philip and Koopmann in 1999 at the URL of http://www.union/orgs/shapley. Philip continues as a trustee of the Fund for Astrophysical Research and serves on its Theodore Dunham, Jr. Grant Program Committee. He is Secretary and Treasurer of the New York Astronomical Corporation. He is a member of the Astrometric and Photometric Group at Wesleyan University as a Research Associate. This group is headed by Arthur Upgren at Wesleyan University. Koopmann is a Research Consultant at the Institute for Space Observations.

2. INSTRUMENTATION

A 20-inch, Ritchey-Chretien Cassegrain telescope by Optical Guidance System was installed in January, 1999 in the new Olin Building, adjacent to the Science Center. Equipment used with the telescope include: an Apogee AP7 CCD camera (back-illuminated CCD with 512 x 512 24 micron pixels), Optomechanics 10c Spectrograph, Optomechanics 1 x 8 Filter wheel with offset guider. For data analysis, IDL by Research Systems, Inc., is used. The Observatory has been used for an observational astronomy class, monthly open houses for the general public and student projects in emission lines from M 87 and monitoring of cataclysmic variable stars. A high-speed photo-intensified Princeton Instruments PentaMAX CCD Camera (512 x 512, 15 micron pixels) was purchased by the Physics Department and will be mounted onto the telescope in the 2000–2001 academic year. IRAF was obtained for the observatory in September, 2000. A 7.5-foot radio antenna was purchased from Haystack Observatory and will be assembled and mounted in 2000–2001.

3. RESEARCH

3.1 Astrophysics

Rebecca Surman completed her Ph.D. dissertation titled ‘‘Freezeout and Neutrinos in r-Process Nucleosynthesis’’ at the University of North Carolina at Chapel Hill under the direction of J. Engel. The dissertation work involved aspects of the astrophysical r-process, the rapid neutron capture nucleosynthesis process responsible for the formation of approximately half of the elements with A > 70. Results have been published in two articles, listed under Publications. Extensions of this thesis research are now being pursued at Union College. In collaboration with J. Engel at the University of North Carolina, she continued work in the area of r-process nucleosynthesis, the rapid neutron capture nucleosynthesis process responsible for the formation of half of the heavy elements. This work has concentrated on problems with the currently favored site of the r-process, within a Type II supernova. The relatively slow ‘‘classical’’ picture of the r-process is apparently incompatible with the rapidly evolving supernova conditions. She applied the newly calculated beta decay rates of M. Bender (UNC and Oak Ridge National Laboratory) to a series of r-process simulations and found that these new rates can, in some cases, speed the r-process by a factor of two (results published in Phys. Rev. C). In the past year she has worked with two undergraduates on alternate mechanisms for speeding up the r-process, where the signature abundance peaks of the r-process are formed dynamically, rather than in the static equilibrium of the ‘‘classical’’ picture. The paper discussing these results is in preparation.

3.2 Cosmology

Alpher prepared a lengthy review paper which was read by Joe Tenn at a special session of the Astronomical Society of the Pacific during its June meeting in Albuquerque, NM in 1998. Other participants in the session were Allan Sandage, Helge Kragh and Virginia Trimble. He continued to work with Oxford University Press on a book on the history of Big Bang Cosmology, ‘‘Genesis of the Big Bang’’ coauthored by Robert Herman. It will be published late in 2000.

3.3 Galaxies

Koopmann continued work on the effects of the cluster environment on the massive star formation properties and morphology of spiral galaxies in the Virgo Cluster, in collaboration with Kenney at Yale University. Part of this work includes a study of NGC 4522, a Virgo Cluster galaxy, which appears to be experiencing an ongoing interaction with the Virgo intracluster medium, as reported in Kenney & Koopmann (1999). Although there is much circumstantial evidence that the intracluster medium has affected the star formation histories of galaxies in clusters (e.g., depleted H I,
truncated H I disks, and truncated star-forming disks coupled with regular stellar isophotes), there are few candidate galaxies in which active intracluster medium-interstellar medium interactions are observed. Thus NGC 4522 offers a rare opportunity to study this environmental process. Several results on NGC 4522 and the Virgo Cluster sample will appear in Kenney & Koopmann (2000, to appear in the ASP Conference Series: Gas & Galaxy Evolution). An atlas of Virgo Cluster galaxies will appear in 2001 (Koopmann, R. A., Kenney, J. D. P., & Young, J., ApJ, accepted). Koopmann, with collaborators Heller and Heller at the Georgia Southern University and Kenney at Yale, is deriving H II region luminosity functions from her Hα images of 63 Virgo Cluster and 30 isolated spirals. Preliminary results indicate that Virgo Cluster spirals tend to have steeper H II region luminosity functions than isolated galaxies.

Cullen Blake, a student from Bethlehem High School, completed an internship in 1999 with Koopmann, analyzing galaxy images via IDL programming. Aaron Reidy, Union '99, completed a senior thesis project on spectroscopy on the Union College 20'' telescope with advisors Marr and Koopmann. Marin Richardson, Union '00, completed a senior thesis project with Koopmann based on comparisons of Virgo Cluster and isolated emission line rotation curves with photometry derived from Hα and R images. Joel Ott, Union '03, followed up this work during a summer 2000 research position. Holly Burnside, Union '01, began a senior thesis project with Koopmann, studying BVR and Hα images of two peculiar Virgo Cluster spiral galaxies.

3.4 Radio Astronomy

Marr is continuing a VLBI study of Gigahertz peaked spectrum sources, radio galaxies with compact (of order ten milli-arcseconds) symmetric structures and composite spectra that turn over sharply at Gigahertz frequencies. Taylor, Marr, Pearson and Readhead (2000) measured the rate of separation of the major components in four compact symmetric objects and determined that the activity producing the radio emission in these objects is young. The ages since the onset of the activity are of the order 1000 years or less. Marr, Taylor and Crawford (2000, submitted to ApJ) mapped the absorption in a canonical Gigahertz-peaked spectrum source 0108 + 388, and found that the spectral turnover is due to free-free absorption by a non-uniform distribution of ionized gas, possibly in an edge-on circumnuclear disk.

3.5 Stellar Astronomy

V. Straizys (ITPA, Lithuania), Philip and R. Boyle (Vatican Observatory Group) are involved in a program setting up the new Strömgvi1 system (a combination of filters from the Vilnius and Strömgren photometric systems). Philip and Boyle have been making Strömgvi1 observations of stars in open and globular clusters with the Vatican Advanced Technology Telescope on Mt. Graham, Arizona. These observations are most advanced in M 3, M 5 and M 92. M 67 is being set up as a standard region. Reports have been made before of a group of underluminous stars found below the horizontal branch of the globular cluster M 92. Reductions of the data obtained with the VATT of the globular cluster M 5 show that this cluster exhibits the same feature. Philip gave a paper on M 92 at the Third Stromlo Symposium in Canberra in August, 1998. Philip has written an article on "Horizontal-Branch Stars" for the new Macmillan Encyclopedia of Astronomy and Astrophysics which will be published at the end of 2000.

3.6 Substellar Objects

Terebey continues her research into how substellar objects form, having proposed that isolated planets and brown dwarfs could arise via ejection from a parent binary star system leading to "runaway" substellar objects (Terebey et al. 1998). Current work involves deep optical imaging of the Rho Ophiuchus star-forming region with the Palomar 5-m telescope to identify substellar candidates down to five Jupiter masses. Questions to be answered are: What is the highest mass a planet can have? What is the lowest mass for a brown dwarf? How do such objects form? These questions are a matter of active debate in the mass regime of 10 to 20 Jupiter masses (0.01–0.02 M☉).

4. MEETINGS

The proceedings of "The Third Conference on Faint Blue Stars," held at Union College in October of 1996, have been published by the L. Davis Press and mailed to all participants at the meeting. The proceedings of the meeting in honor of the ninetieth birthday of Dorrit Hoffleit have been published by the L. Davis Press and mailed to participants by Yale Observatory. Boyce and Philip edited the proceedings of the Joint Discussion, "Electronic Publishing: Now and the Future," held at the Twenty-third General Assembly of the IAU, in Kyoto, Japan in August, 1997. These proceedings have been published in the Transactions of the IAU, Highlights of Astronomy, 14. A meeting, "The Kth Reunion," was held at Case Western Reserve University, May 2–4, 1998. Approximately 40 astronomers attended the two day meeting. The proceedings of this meeting have been published by the L. Davis Press and mailed to participants.

5. PUBLICATIONS


Philip, A. G. D. 1999, Shapley Program Report, BAAS 31, 1263


