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This report covers the period 1 July 2001 - 30 June 2002.

I. PERSONNEL

The academic staff consisted of R. Earle Luck, Worcester R. and Cornelia B. Warner Professor of Astronomy, Director and Chair; Heather Morrison, Assistant Professor, and Christopher Mihos, Associate Professor. Emeritus Professor William P. Bidelman continues to be an active presence in the department. Lawrence M. Krauss, Ambrose Swasey Professor of Physics and Chairman of the Physics Department and Glenn Starkman, Associate Professor of Physics hold a secondary appointments in the Department of Astronomy.

In Fall 2001 Dr. Paul Harding joined the permanent staff of the Observatory. He assumes primary responsibility for the Burrell Schmidt. The research and technical staff was comprised of Dr. John Feldmeier, Research Associate (working with Prof. Mihos), Dr. Ulrike Heiter (working with Prof. Luck), Dr. Denise Hurley-Keller, Research Associate (working with Prof. Morrison), and Charles Knox, Technical Specialist. The part time staff consisted of William Claspy, Library Assistant and Linda Day, Departmental Assistant.

On 3 December 2001, C. Bruce Stephenson, Worcester R. And Cornelia B Warner Professor Emeritus of Astronomy passed away.

II. INSTRUMENTATION

The Case Western Reserve University Burrell Schmidt telescope located at Kitt Peak National Observatory continued to be used primarily by CWRU. During the course of the year major mechanical modifications have been made to the telescope to enhance its ability for surface photometry.

Refurbishment of the 0.9 meter reflector at the Nassau Station of the Warner & Swasey Observatory continued during the year with the design, fabrication, and installation of a new secondary mount.

III. RESEARCH

Publications which appeared during the report period are listed in Sec. V. The following is a summary of work in progress or unpublished.

A) Chemical Abundance Studies in Stellar Atmospheres

(R. E. Luck and U. Heiter)

In collaboration with Prof. Sergei Andrievsky and Dr. Valery Korotin (Odessa State University, Odessa, The Ukraine) Prof Luck continues a study involving Cepheid abundances and which deals with consistency, questions of stellar evolution, and galactic metallicity gradients.

A large scale study of abundances of nearby stars has been initiated with significant progress in the observational phase being made within the past year. This study will provide vital information on the spectral characteristics of these stars by obtaining high-resolution, high signal-to-noise spectroscopic data on a significant fraction of the stars within 15 parsecs, and by sampling the population within 100 parsecs. The parent sample for this program is those stars in the Hipparcos Parallax Catalog which are within 100 pc of the Sun.

Ulrike Heiter continued her studies of the influence of convection treatments on the structure of ATLAS9 model atmospheres, in collaboration with astronomers from the Vienna, Paris and Rome observatories. Results have been published in Heiter et al. (2002) and D'Antona et al. (2002). She has also obtained high resolution spectra for a sample of metal poor F type stars for an abundance study conducted in collaboration with E. Paunzen (Vienna), I. Kamp (Leiden) and I. Iliev (Bulgaria). In addition, spectroscopic data for A stars with circumstellar shells and _ Bootis spectroscopic binary stars are being analyzed. Further research activities include participation in spectroscopic campaigns for variable stars - the Scuti star FG Vir in Jan. 2002 (Zima et al. 2002) and the _ Cephei star _ Eridani in Nov. 2002, organized by G. Handler (Vienna) and C. Aerts (Leuven).

These studies utilize high-resolution high-signal to noise data obtained at McDonald Observatory of the University of Texas, Austin.

B) Studies of Galaxy Structure and Evolution

(H.L. Morrison)

A wide-field kinematic survey of M31's disk, bulge and halo using planetary nebulae has been completed in collaboration with Hurley-Keller, Harding (CWRU) and Jacoby (WIYN observatory). This has shown that M31's bulge, with an R**1/4 luminosity profile which extends out to 20 kpc on the minor axis, dominates kinematically out to these distances as well: most PNe show rotational support similar to the kinematics of the bulge close to the center. There are only a few PNe with the pressure- supported, non-rotating kinematics seen in the Milky Way's halo.

The ″Spaghetti″ survey for giants in the galactic halo has now identified 56 K giants with distances from 10 to 80 kpc. We see substructure due to the Sagittarius dwarf and also due to other satellites which have been disrupted. As the sample of outer halo giants grows we plan to use them to investigate the structure of the Galaxy's dark halo as well.

C) Studies of Galaxy Structure & Evolution

(C. Mihos)

Studies of merger-driven galaxy evolution continue using both theoretical and observational approaches. Dynamical modeling of mergers have shown that the peculiar bifurcations of gas and stars observed in tidal tails of several merging galaxies can be explained naturally through the different radial and angular momentum distribution of gas and stars in disk galaxies, and do not rely on complex hydrodynamic

interactions between tidal gas and a hot starburst wind or intergalactic medium. With Holley-Bockelmann (CWRU) studies of tidal tails have been used to place constraints on the radial truncation of stellar disks. Disk truncation radii smaller than 3 exponential scale lengths (as have been advocated in some recent studies) appear hard to reconcile with the observed tidal tails in prominent interacting galaxies such as the Antennae or NGC 7252.

The evolution of galactic nuclei in galaxy mergers is also being studied in a variety ways using the Hubble Space Telescope. An imaging and spectroscopic study of NGC 6240 reveals a complex superwind generated by the merger-induced starburst, and little evidence for a previously-hypothesized off-center massive black hole. We are also using a combination of broad- and narrow-band imaging and low- and high-resolution spectroscopy to study the properties of the nuclei of the Toomre sequence of merging galaxies. This project seeks to characterize the relationship between gas inflow, starburst activity, galactic superwinds, and the evolution of galactic nuclei. Collaborators on these projects include van der Marel (STScI), Boker (STScI), Laine (STScI), Gerssen (STScI), Hibbard (NRAO), and Zabludoff (Arizona). With Holley-Bockelmann (CWRU), Sigurdsson (PSU), Hernquist (Harvard), and Norman (JHU), work continues on the dynamical evolution of elliptical galaxies harboring central massive black holes. New numerical techniques have been developed to allow for the self-consistent modeling of triaxial ellipticals on scales ranging from the parsec to kiloparsec scale, studying both the scattering of stars by the central black hole and the subsequent global evolution of the host galaxy. We find that the presence of a modest stellar density cusp in the elliptical galaxy nucleus (similar to those detected by HST) mediates somewhat against the fast global evolution seen in previous dynamical studies (which used much shallower central density cusps). Orbital analysis of these dynamical models continues to probe for the dynamical criteria which determines whether black hole induced evolution occurs at a rapid or slow pace.

Studies of the evolution of galaxy clusters and cluster galaxies also continue on several fronts. With Feldmeier (CWRU), Morrison (CWRU), and Harding (Arizona), we are using the KPNO 2.1m to search for and quantify the nature of the diffuse intracluster starlight in galaxy clusters. We are probing a variety of environmental density, from rich clusters to poor groups, to try and correlate ICL properties with the local environment. Concurrently we are using numerical models of cluster formation and evolution (in collaboration with Dubinski [CITA]) to make predictions for how the ICL varies as a function of cluster age and dynamical environment. Through this combination of observational data and dynamical modeling we hope to place constraints on the dynamical evolution of clusters and cluster galaxies, as well as the distribution of dark matter in clusters.

On the educational front, work on the java-based astrophysics laboratory continues (available at `http://burro.astr.cwru.edu/JavaLab/`). This laboratory includes projects which allow students to simulate interacting galaxies, study the orbits of stars in galaxies, use observations of galaxy clusters to deduce the amount of dark matter in clusters, and do mass-modeling of spiral galaxies using their rotation curves. These javalabs are aimed both at non-science and technical majors, and have been incorporated into the astronomy curricula at a wide range of colleges anduniversities.

D) Stellar Evolution

W. P. Bidelman

Emeritus Professor Bidelman presented a paper (The Observatory, in press) at the Seattle conference on ‘‘ Stellar Abundances and Nucleosynthesis’’ in March 2002. In this he suggested that the Ap and Am stars are both examples of moderately hydrogen- deficient stellar atmospheres, and hence that the current abundance analyses of these objects may be substantially in error. He further suggested that the apparently single magnetic Ap stars are a consequence of stellar merger of interacting B- and A-type close binaries in the fairly recent past.

IV. MISCELLANEOUS

The series of free public lectures, ″Frontiers of Astronomy″, continued under the joint sponsorship of Case Western Reserve University, the Cleveland Museum of Natural History, and the Cleveland Astronomical Society. Visitors who spoke this year were Dr. C. Hogan (Univ. Washington), Dr. A. Wootten (Nat’l Radio Astronomy Observatory), Dr. M. Hanson (Univ. Cincinnati), Dr. G. Ferland (Univ. Kentucky) and Dr. W. Cochran (Univ. Texas). It is a pleasure to acknowledge the support of the Space Telescope Science Institute, the National Science Foundation, NASA, various private benefactors, and numerous friends and colleagues.

V. BIBLIOGRAPHY

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