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This report covers the interval 1 July 1998–30 June 1999

1. PERSONNEL

Drs. G. C. Clayton, J. S. Drilling, J. Frank, A. U. Landolt, and J. E. Tohline made up the permanent teaching faculty in the Department of Physics and Astronomy's astronomy/astrophysics group. Dr. G. S. Burks continued as an instructor in the department. He resigned in May, 1999 to take a position at Tennessee State University. Dr. A. K. Uomoto, The Johns Hopkins University, and Landolt continued working on the latter's CCD faint standard star project. Dr. Karl Gordon continued as a postdoctoral fellow working with G. Clayton. Gordon left for a postdoctoral position at the University of Arizona at the end of the report year.

Graduate students for the year were Saied Andalib, Eric Barnes, Andrew Brunner, John Cazes, Howard Cohl, Matthew Collier, Paul Fisher, Karl Misselt, Patrick Motl, Kenneth Taylor, and Lynne Valencic. Andalib, Fisher, Cazes and Cohl received their Ph.D. degrees.

Undergraduate students included Ashley Allen and Chris Dolese.

2. RESEARCH

Clayton obtained UV HST/STIS spectra of an R Coronae Borealis star, V854 Cen. The spectra show evidence for CO bands. CO is thought to be instrumental in the dust formation process in RCB stars. IR spectra of CO bands were obtained for several RCB stars at the Kitt Peak and Steward observatories. Clayton and collaborators continued to investigate shells around RCB stars to look for clues to their evolutionary history. Images were obtained at CFHT in Hawaii and at ESO in Chile. One shell around UW Cen was found to vary with time due to changing illumination from the star (Clayton *et al.* 1999, ApJ, 517, L143).

Clayton, Gordon, Valencic, and Misselt continued investigations of starburst galaxies through new observations and modeling. The new observations included IR spectra obtained at the Kitt Peak and Steward observatories. Misselt, along with Gordon and Clayton is improving their radiative transfer code for galaxies with dust to include the IR.

Drilling continued his search for protoplanetary nebulae (with M. Parthasarathy of the Indian Institute of Astrophysics and J. Vijapurkar of the Indian Inter-University Centre for Astronomy and Astrophysics), and extended the system of spectral classification for hot subdwarfs described in last year's annual report to objects from Zone 1 of the Edinburgh-Cape survey (with D. Kilkeny, D. O'Donoghue, and R. Stobie of the South African Astronomical Observatory). Projects completed during the reporting period included first observations of an R Coronae Borealis star with the Space Telescope Imaging Spectrograph: RY Sagittarii near maximum light (G.C. Clayton *et al.* 1999, ApJ, 515,

351) and ultraviolet observations of the hot R Coronae Borealis-type star V348 Sagittarii during a deep minimum (J.H. Hecht *et al.* 1998, ApJ 501, 813).

Frank visited the Max-Planck-Institut für Astrophysik (MPA) in Garching, Germany during May-Aug 1999.

With Patrick McCormick, graduated from LSU in May 1998, now at Microsoft Corp., Frank has continued to investigate the evolutionary effects of irradiation of the companion in a mass transferring binary. Previous studies (McCormick and Frank 1998, ApJ, 500, 923) adopted an ad hoc coupling between the irradiation and angular momentum losses. More recently they have proposed a model in which the irradiation produces an enhancement of the wind from the companion which is directly proportional to the irradiation flux and therefore to the mass transfer rate. Depending on the magnetic braking model adopted, different rates of angular momentum loss are induced and cyclic behavior can occur at all orbital periods. This model may explain the distribution of Cataclysmic Variable subtypes with orbital period.

Frank, in collaboration with Ritter (MPA, Garching) and King (Leicester) have continued work on the spin-up by accretion of long orbital period binary millisecond pulsars. As is well-known, a neutron star must accrete on the order of 0.1 solar masses to be spun up to millisecond periods. While this requirement is easily met for binary orbital periods less than a few days, it turns out to be difficult for long period binaries because the accretion disk in such systems is unstable and undergoes outbursts. Such progenitors are observed as neutron star Soft X-ray transients. The accretion rate during outbursts is highly super-Eddington and most of the material transferred by the giant donor is expelled from the system. An analysis of the possible evolutionary histories indicates that under favorable conditions millisecond pulsars in binaries can be produced for final orbital periods of at most 100–200 days.

Graduate student Patrick McCormick, working with Frank and Tohline has developed a numerical hydrodynamics code capable of following the onset and development of mass transfer in a close binary with unequal mass polytropic components. Current simulations of both stable and unstable mass transfer are possible and examples of these are available on the web (http://www.phys.lsu.edu/astro/movie_captions/motl.binary.html). In future simulations a variety of entropy distributions mimicking main sequence and degenerate donor stars will be simulated.

Landolt continued to gather photometric data at the Cerro Tololo Inter-American and Las Campanas Observatories as he worked on the development of fainter UBVR standard star sequences. These broadband sequences are centered at the celestial equator, around the sky, in a band several degrees wide. The effort has been extended to additional sequences around the sky and centered at declination -50 degrees.

The blue metal-poor star CS 22966-043 had been found by G. W. Preston to be variable in radial velocity, and in light by Landolt. New radial velocities by Preston and photometry by Landolt confirm the period of this SX Phe star, and revise downward to 319 days the orbital period of the spectroscopic binary system, of which the variable is one component. They discovered that the blue metal-poor star CS 29499-057 also appears to be a SX Phe star of small amplitude and short period. These observations have been submitted to the *Astronomical Journal*.

Landolt continued to follow the photometric behavior of several hydrogen-deficient stars, of several FU Ori stars, and of various novae as time permitted.

3. MISCELLANEOUS

Several of the faculty in the Department of Physics and Astronomy, including Burks and Tohline contributed toward



the implementation of a new public/university observatory which was built on the south edge of Baton Rouge. Information about the observatory and its operations may be found on the web at <http://www.phys.lsu.edu/observatory>.

Landolt continued as Secretary of the American Astronomical Society, as Secretary of the US National Committee for the IAU, and on the Board of Governors of the American Institute of Physics. He continued to participate in the AAS Shapley Visiting Professor Program.

Tohline was appointed by the Council of the American Astronomical Society (AAS) to complete a term on the AAS Publications Board. He also continued to serve on the American Institute of Physics' Advisory Committee on Computation in Science and Engineering.

Arlo U. Landolt