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## 1. PERSONNEL

This report covers the period from July 1, 1995 through June 30, 1996. During that interval the staff consisted of C.M. Gaskell, K.C. Leung, E.G. Schmidt, N.R. Simon and D.J. Taylor.

Graduate students K. Lee, S. Snedden, and T. Young worked on their thesis research. Other graduate students are C. Hall and K. Klinkel.

Undergraduates M. Hiller and S. Pebley participated in research projects. Gaskell and Snedden attended IAU Colloquium 159 in Shanghai, PRC.

## 2. FACILITIES

Gaskell and Taylor have continued to work on the new on-campus undergraduate teaching observatory with its 16-inch telescope and CCD camera. The problem of finding a suitable site, was finally solved by locating it on top of a parking garage which is being newly constructed on campus.

## 3. RESEARCH

### 3.1 Variable Stars

Simon and Young continued their study of long-period Cepheids in external galaxies and the calibration of the cosmic distance scale. They found that reasonable differences in the Cepheid distributions in target and calibrator galaxies could lead to distance errors as large as a quarter of a magnitude. When the extragalactic Cepheids were portrayed on an H-R diagram, many of them appeared to be inconsistent with either the theoretical blue edge or standard evolutionary tracks.

### 3.2 Binary Stars

Leung is working on two-dimensional and three-dimensional mass circulation in the atmospheres of contact binaries with Professor Daoqi Zhou of Peking University. Leung and Zhou completed their research on temperature inhomogeneity on the surface of very close non-contact binary stars due to absorption of irradiation.

Leung served as the chairman of the Scientific Organizing Committee of the Third Pacific Rim Conference on Binary Research held in Chiang Mai, Thailand, October 1995 and delivered two invited papers at the meeting. He also presented an invited paper at the UN/ESA conference on Basic Space at Sri Lanka, January 1996.

Leung delivered an invited paper at the 21st Century Chinese Astronomy Conference in Hong Kong, August 1996, and an invited paper at the Astrophysical Conference at the Odessa Observatory, Ukraine in September 1996. He also gave colloquia at the following institutes in 1996: Chiang Mai University, Thailand; Peking University, China; and Shaanxi Astronomical Observatory.

### 3.3 Star Clusters

Young, Schmidt, and Simon are continuing to search for RRc or RRd stars in the poorly studied clusters including NGC6426, NGC5466, NGC6934, and NGC7006. A large number of 300 second exposures in both R and I have been obtained for these clusters.

Data were photometrically reduced using the SUBSTAR/ALLSTAR packages for crowded field photometry of the DAOPHOT/IRAF program on the SPARC 10/40 workstation. The goal of the investigation is to eventually produce values for the absolute magnitudes of the RR Lyrae stars, and thus the cluster distances. The results will be used in Young's investigation into a different scaling technique based on RRc Lyrae information developed by Simon and its validity for certain situations.

### 3.4 Extragalactic

Hall has been building relational databases using the RC/3 and the Veron catalogs. The aim is to investigate the selection effects in using quasars to probe large scale structure of the universe at high red shifts.

### 3.5 Active Galaxies

Gaskell and Snedden continued their participation in the International AGN Watch (IAW). Hiller and Pebley participated in various aspects of the Behlen Observatory observing and data analysis.

Analysis of the intensive December 1993 monitoring of NGC 4151 from X-ray to optical wavelengths was completed and four papers have been accepted for publication in the *Astrophysical Journal*. The combined optical to X-ray observations provide more than an order of magnitude tighter limit on the time lag between the X-rays and the optical emission than had been obtained by previous AGN monitoring campaigns. The region reprocessing X-rays into optical radiation is constrained to be about 0.15 light-days in size. A paper is also in preparation describing *IUE* observations of the bright southern Seyfert Fairall 9. *IUE* and *RO-SAT* observations were obtained of the interesting radio-loud quasar 3C 390.3. The observations were brought to an abrupt conclusion by the failure of a gyro on the *IUE* satellite in March 1996. A first draft of a paper on the optical observations of 3C 390.3 has now been completed. Planned monitoring of Mrk 335 had to be scratched because of the *IUE* gyro failure and the target was switched to NGC 7469. Unfortunately NGC 7469 showed little variability during the period of continuous *IUE* monitoring. Satisfactory *ISO* observations of another quasar, Mrk 279 are being obtained.

Snedden and Gaskell continued their major study of the line profiles of broad emission lines in quasars observed with the *HST*. They are using the *HST* data to do detailed analyses

using both optical and UV spectra in the same objects. They have initially been concentrating on a sample of quasars observed in the optical by G. Stirpe. The most interesting result has been the high  $\text{Ly}\alpha/\text{H}\alpha$  ratio in the high velocity gas. With only one exception, the ratios are equal to, or greater than, the case B value. Since there is probably some slight reddening along the line of sight, the intrinsic values could be greater than case B. On the other hand, for the lower velocity gas in the cores of the lines, the  $\text{Ly}\alpha/\text{H}\alpha$  ratio is in agreement with the predictions of photo-ionization models. Snedden and Gaskell found that the ionization-parameter-sensitive and density-sensitive C III]/C IV ratio was surprisingly constant for the VBLR, ILR and BLR components.

Gaskell continued his study of quasars with broad emission line peaks displaced from the rest frame of the host galaxy ("3C 390.3 objects"). He showed that *all* structure in the Balmer lines of quasars can be explained by the addition of such components. He and Snedden analyzed the statistics of line profile structure in the framework of this explanation. They have also been studying how such structure shows up in the UV/optical line profile ratios. Gaskell continued his study of radial velocity changes in the displaced peaks in 3C 390.3. itself. He published an analysis of very regular changes in the radial velocity of the blue peak over a couple of decades. Further observations by M. Dietrich *et al.* and, most recently, by the IAW, together the historical changes, place interesting constraints on all models of the 3C 390.3 phenomenon.

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