# ASTRONOMICAL RESEARCH AT THE HOPKINS PHOENIX OBSERVATORY

BY

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## ABSTRACT

After trying astrophotography and radio astronomy it was decided that the best way to do meaningful astronomical research at a small private observatory was by doing photoelectric photometry. Being located in the suburbs of a large city does not produce very dark skies, however, the skies are usually clear for a high percentage of the year. Having the observatory located in the back yard of a private residence affords the luxury of observing any time the sky conditions permit. Also modest equipment is all that is needed to do accurate UBV photometry of stars 8th magnitude and brighter. Since beginning in 1980 the HOPKINS PHOENIX OBSERVATORY has published papers on several RS CVn star systems, 31 Cygni, 22 Vul, 18 Tau Per, and has followed the 1982-1984 eclipse of Epsilon Aurigae from its start to the present with over 1000 UBV measurements. In addition the HOPKINS PHOENIX OBSERVATORY has developed several pieces of photometry equipment including the HPO PEPH-101 photometer head and photon counting electronics.

## I. INTRODUCTION

Seeing Doug Hall's article, "The Strange RS Canum Venaticorum Binary Stars," in the February 1979 issue of SKY and TELESCOPE I was inspired to write Doug about helping him do some science with my astronomical equipment. After about a year of frustration, mainly in trying to figure out how to get my photometry equipment built and how to actually do photometry, I received a letter from Russ Genet asking me to join the IAPPP. Through many hundreds of letters Russ guided and encouraged me to the point where I actually had my own photometry equipment and was doing real photometry. As Russ once said, "It takes about a year to get on the air with photometry."

## II. PURPOSE

In 1980 the HOPKINS PHOENIX OBSERVATORY was erected. A Celestron C-8 telescope and home built photometry equipment were installed. With the help of Doug Hall the first project was observing the RS CVn binary lambda Andromendae. In 1983 a paper was published in ASTROPHYSICS and SPACE SCIENCE which included data from the HPO. This was sufficient inspiration to spur me on to a very active role in photoelectric photometry.

## III. THE OBSERVATORY

The original observatory was an 8 foot square wooden frame structure with a sliding aluminum roof. In the fall of 1983 the "new" HOPKINS PHOENIX OBSERVATORY was dedicated to photoelectric photometry. The new HPO is a 14 foot square two story block building. For economical and zoning reasons a sliding roof was again used. The telescope and photometry equipment are located on the second floor while the office, computer equipment, and workshop are on the ground floor. The main reason for the new observatory was an addition to the family who required my office space within our house.

## IV. THE EQUIPMENT

The telescope is a Celestron C-8, which is an 8 inch Schmidt Cassigrain with a fork mount. Originally an analog system was used which had a homemade DC amplifier, homemade high voltage power supply, and Heathkit Chart recorder. As more experience was gained it was decided to switch to a photon counting system. At the same time it was discovered that the original photometer head was far from adequate for the desired programs. This required designing a photometer head that was light and compact for use with the C-8 telescope. That design turned out to be the HOPKINS PHOENIX OBSERVATORY PEPH-101 UBV photometer head. In addition, a new regulated and adjustable high voltage power supply with 3 1/2 digit LED readouts plus an 8 digit photon counter were developed. These units have been in use for over three years and have provided very satisfactory service.

The original computer system was a Sinclair ZX-81 computer (the last I saw these computers advertised they were selling for $19). While it certainly beat doing data reduction by hand, it was soon apparent a more powerful system was needed. A Heathkit H-100 (same as the Zenith Z-100) computer was purchased and assembled. This provided the necessary improved computation speed plus several other functions such as word processing and data communications. A Commodore C-64 has been experimented with as a data acquisition and reduction computer. The price and ease of use of the C-64 makes this system very attractive.

## V. THE OBSERVING PROGRAMS

While the original observing program was RS CVn binary stars, the HOPKINS PHOENIX OBSERVATORY has expanded its observing program to include high speed lunar occultation photometry of spectroscopic binaries. On 9 May 1983 a high speed observation of eta Leonis (HR 3975) was made. Data were obtained through a blue filter with data points integrated and recorded for 1 millisecond every millisecond for 48 seconds (that's 48,000 data points in less than a minute). The telescope was stopped down about 60% due to the high counts from this 3.5 magnitude star.

Long period eclipsing binaries have also been included in the observing program. The first one was Epsilon Aurigae. I succeeded Russ Genet as photoelectric photometry editor of the Epsilon Aurigae Campaign Newsletter in 1982 and have acted as editor and publisher of 10 of the 12 newsletters. After starting to observe Epsilon Aurigae Bob Stencel notified me that the 10 year eclipsing binary 31 Cygni needed observations. The fall 1983 eclipse was observed for 53 nights and the resulting data were published in THE ASTROPHYSICAL JOURNAL 15 June 1984. Since then the 1984 August-September eclipse of 22 Vul and part of the November 1984 eclipse of 18 tau Per have been observed. Observations of Epsilon Aurigae will continue as more out-of-eclipse data are needed. Recent interest in the possible gravitational lensing effect of long period eclipsing binaries has guaranteed a continued observation of these and similar star systems.

# AUTOMATIC PHOTOELECTRIC OBSERVATIONS OF EPSILON AURIGAE

Louis J. Boyd (Fairborn Observatory)
Russell M. Genet (Fairborn Obs. & Wright State Univ.)
Douglas S. Hall (Vanderbilt Univ.)

The Automatic Photoelectric Telescope (APT) at Fairborn Observatory West in Phoenix, Arizona, has been used to make UBV observations of Epsilon Aurigae starting in totality (shortly after the system became operational) and continueing to the present. A sequence of 33 10-second observations have been made once or twice a night on most clar nights. It is planned to continue these observations well into the future to firmly establish the out-of-eclipse photometric behavior of Epsilon Aurigae.

## APPENDIX

Directory to Additional Epsilon Aurigae Eclipse Data

1. George Wallerstein/Univ. Washington: several coude spectrograms obtained at Palomar 5 meter (see attached summary).

2. Dana Backman/Univ. Hawaii and Arizona: 9 FTS tapes, K band, 20,000 to 60,000 resolution, including H-Bracket gamma line, 1/82 through 2/85 (cf. Backman et al. 1985 Ap. J. Submitted).

3. David Lambert/Univ. Texas: red reticon spectra, McDonald Obs.

4. Mirek Plavec/UCLA: coude spectrograms acquired at Lick Observatory at approximately monthly intervals from ingress through egress, some ingress material PDS-scanned.

5. George Lockwood/Lowell Obs. -- see attached list.

6. Yonsei Obs. photoelectric observations -- see attached abstract.

7. Ultraviolet spectra: contact ESA and/or NASA International Ultraviolet Explorer offices (Vilspa, Spain or Greenbelt, Maryland, USA).

8. Bibliographical data: Bibliographical Star Index, Centre de Donnees Stellaires, Strasbourg, France and/or Astronomical Data Center, NASA Goddard Code 600, Greenbelt, Maryland, USA. Listing for 1950-1979 attached (133 references).

9. See also numerous I.B.V.S. issues (Konkoly Observatory, Budapest).

10. Photoelectric Photometry of Epsilon Aurigae, 1982-1985: P. Flin et al. 1985. I.B.V.S. No. 2678.