SCANNER OBSERVATIONS OF SOME CLOSE BINARY SYSTEMS

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ABSTRACT. Using our intermediate bandwidth photometric scanner, we have obtained light curve data at a range of spectral intervals for a number of close eclipsing binary systems. This paper reports briefly on the instrumentation system, the data obtained for two of the variables AE Phe and ϵ CrA, and a preliminary modelling of the light curves.

1. INTRODUCTION

Eclipsing binary stars are a fertile ground for astronomers. There is considerable interest, in particular, in close binary systems, where many questions concerning their interaction and evolution are still topical. Photometric studies of many of these systems can and are undertaken with small telescopes using either the Johnson UBV (plus extensions) or the Strömgren uvby filter systems. However, both of these systems have drawbacks. The broad band nature of the Johnson system leads to a significant distortion of the monochromatic fluxes, while the Strömgren interference filters obtain data at only a few spectral intervals. With the aim of producing more complete spectral information on some close binary systems, we have used a photometric scanning system that yields intermediate bandwidth data over an extended spectral range.

2. THE VUW SCANNER

Wavelength selection in the scanning photometer is provided by a continuously rotating filter wheel, incorporating a variable circular filter wedge (OCLI, Santa Rosa California). The wedge occupies one 180 degree segment of the filter wheel and passes light with a mean wavelength varying between 380nm and 720nm, and an effective passband of approximately 18nm. Three UV interference filters and a narrow Hβ filter complete the set. The filter wheel is rotated by a stepper motor (200 steps per revolution) at about two revolutions per second, and digitized light intensity data is accumulated under computer

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control by way of a cooled RCA 31034A photomultiplier tube operated in single photoelectron counting mode. This photometric system has been used to obtain spectral data on a number of pulsating Delta Scuti stars (Trodahl and Sullivan, 1977, Sullivan and Trodahl, 1978) and a variety of bright southern 'standards' (Trodahl, Sullivan and Gibb, 1981). The advantages of this photometric system are clear: spectral data are obtained at a larger number of better defined wavelength regions, compared with the standard systems. However, one pays for this in terms of reduced photometric accuracy for a given observing time. This results from a combination of factors, including a low filter transmittance (30%) and continuous rotation of the filter wheel. With the aim of evaluating this system for eclipsing binary stars, we have observed a number of bright southern objects.

3. BINARY STAR OBSERVATIONS AND ANALYSIS

Using the Mt John Observatory (Lake Tekapo, NZ) 61 cm photometric reflector in combination with our scanning photometer, we have obtained data on the W UMa variables AE Phe and ϵ CrA over the period 1983 - 1985. Observations of individual stars consist of approximately 500 aggregated spectral scans from the filter wheel. Program star observations are interleaved with comparison star observations in the ratio 3 to 1, and the comparison star data are used to deduce atmospheric extinction coefficients for all wavelength regions of the filter wheel, using the standard magnitude versus air mass linear relationship. Intermediate band spectral determinations of the variable object in units of the comparison star, corrected for extinction effects, are obtained via estimates of the comparison star at the different air masses involved.

Ideally, analysis should proceed from this point by including all the binary spectral data in one modelling procedure. However, as a first step we have isolated several spectral regions of the data and fitted the individual light curves in the standard way using a model developed by Budding (Budding and Najim, 1980). This model treats a number of the distortions from spherical symmetry of the two components by semi-analytic methods. Binary mass ratios were fixed in each case using spectroscopic data and satisfactory fits were obtained. Space limitations here prevent a detailed discussion of the fitting parameters. These results will be published elsewhere.

4. REFERENCES

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DISCUSSION

Graham: With a filter wheel rotation rate of about 2 Hz you should be able to observe through (variable) cloud. Is that practical?

Sullivan: Atmospheric transparency changes with a period long compared to 0.5 sec should have a relatively small impact on the colour information. That is the theory. However, I have found the practical results on cloudy nights to be disappointing.

Graham: How expensive are these filters?

Sullivan: For the visible wavelengths ~ $US300, in the IR ~ $US3000.

Ryan: Could you give an estimate, in magnitude units, of the photometric accuracy of your scanner.

Sullivan: Data accuracy, of course, depends on the observation time. A comparison with the Strömgren uvby system is probably the best way of gauging the potential accuracy of the system. We are approximately a factor of 2 behind in filter transmittance and time is spent gathering data from more spectral intervals. So, depending on whether this data is useful or not, we are between 2 to 10 times behind the uvby system in intensity precision.

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