DECOMPOSING INTERACTING BINARY LIGHT CURVES: THE ECLIPSES OF THE MEAN LIGHT, SECULAR VARIABILITY AND FLICKERING IN RW TRI

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Abstract. We describe a new method of orbital light curve decomposition which is applicable to long-term photometry of interacting binaries. This method determines the orbital dependence (including eclipses) of the mean light, secular variability and RMS flickering. We identify the true line of centres of RW Tri and find that the accretion disc is a location of secular variability and a source of flickering.

1. Introduction

The 13th magnitude nova-like cataclysmic variable RW Tri is an eclipsing binary which displays photometric variability on differing time-scales. The secular brightness variations, which can be sinusoidal (Honeycutt et al. 1994), have an amplitude of 0.5 mag. Horne & Stiening (1985) determined the flickering to be compactly eclipsed through phases $\pm\, 0.04$.

A consistent set of light curves was obtained spanning 1993 November to 1995 March comprising differential photometry from the CCD equipped 0.9 m James Gregory telescope (St. Andrews). Thirty binary orbits were observed which yielded 19 $R-$band eclipses covering 2100 cycles. The eclipse shapes were broad, rounded and variable to the extent typical of nova-likes.

2. Decomposition method and discussion.

The eclipses of the mean light, secular variability and RMS flickering may be determined by decomposing ensembles of phase binned eclipse light curves. Real variations in the disc flux between light curves are used to quantify the amounts by which that flux is lessened through eclipse. These real variations of the disc flux are determined by calculating a mean flux value across each light curve, excluding phases where the flux is attenuated (eclipse) or

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enhanced (bright spot). These mean flux values are the reference fluxes. We then plot, for an individual phase bin, the observed flux versus the reference flux for each light curve. Fig. 1a shows plots for three such phase bins through eclipse egress, where the 19 data points from the 19 light curves are clearly linearly related.

Each linear fit to a flux-flux plot yields a mean light value, and a gradient which represents the visibility of the secular variability at that phase. Fits for all phases yield the eclipse light curves of the mean light, and the secular variability (Fig. 1b). The minimum of the secular variability occurs earlier and may represent the true line of centres if we equate the centres of light variability and mass. The eclipse shape of the secular variability is clearly dissimilar to that of the mean light, indicating differing disc distributions.

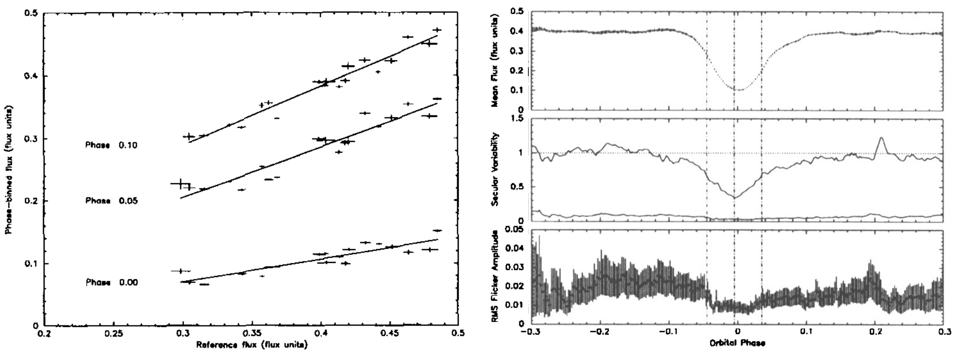

Figure 1. (a) Three flux-flux plots at phases through eclipse egress. (b) The eclipses of the mean light (top), secular variability (middle) and flickering (bottom) in RW Tri.

The residuals about the fit for each phase in Fig. 1a are larger than the plotted measurement uncertainties because they include contributions from orbital flickering and observational noise. The RMS flickering amplitude is simply isolated by manipulating these distributions in quadrature and is presented in Fig. 1b. The eclipse of the flickering source is coincident with the inner disc but the ingress appears steeper than egress and the eclipse may not be of the dominant system flickering. This result may be sensitive to our preliminary technique, but is insensitive to biasing by the secular variability. Our eclipse results may be eclipse mapped (Horne 1985).

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