ORBITAL PERIOD DISTRIBUTION OF THE SDSS CATACLYSMIC VARIABLES

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Abstract

The evolution of all binary systems containing a compact object is driven by the loss of angular momentum from the orbit. Unfortunately two of the most important mechanisms, common envelope evolution and magnetic braking, are poorly understood. A major advance in our understanding of binary evolution requires the characterisation of a large and homogeneously selected sample of close binaries, such as the population of cataclysmic variables (CVs) spectroscopically discovered by the Sloan Digital Sky Survey (Szkody et al., 2002, and later papers). We are therefore undertaking a project to measure the orbital periods of all SDSS CVs. Of the 291 known systems, 153 now have reliable orbital periods and 46 have approximate measurements (Southworth et al., 2006, 2008, 2010). The orbital period distribution is shown in Fig. 1, and compared to the distribution of those CVs known prior to the SDSS survey.

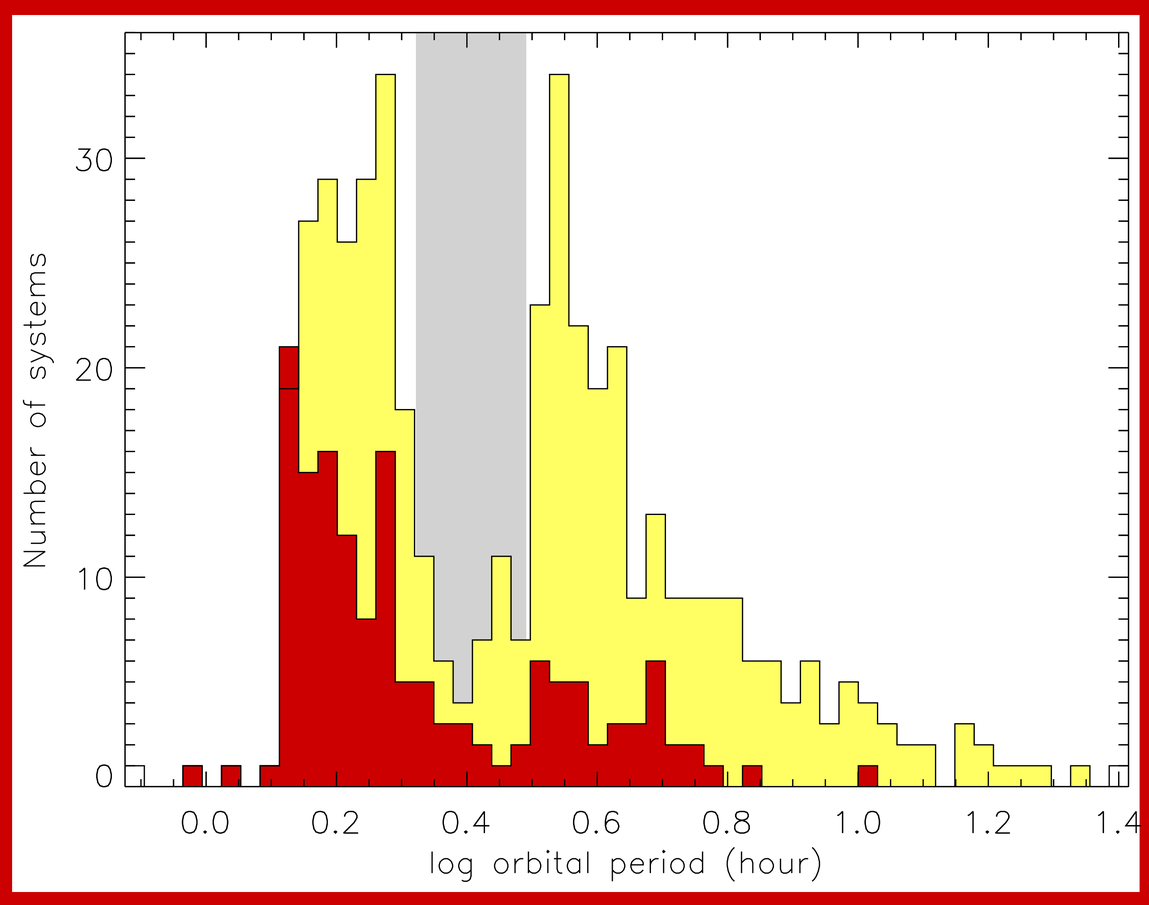

Fig. 1. The orbital period distribution of SDSS CVs (red histogram) compared to that of the known non-SDSS CVs (yellow histogram) as catalogued by Ritter & Kolb (2003). The 2–3 hr period gap, a characteristic feature of the CV population, is shown by grey shading.

The period spike unveiled

CVs evolve towards shorter orbital periods, reach a minimum value, and then bounce back to longer periods due to structural changes in the low-mass secondary star. A long-standing prediction of CV evolution theory is an accumulation of systems at a minimum period somewhere between 60 and 70 min (Rappaport, Joss & Webbink 1982) where the evolutionary timescale becomes long and the period derivative passes through zero. Unfortunately, the observed population has persistently shown both a longer minimum period of around 80 min and no significant increase in the number of CVs at this period. The population of SDSS CVs, however, shows for the first time a significant excess of objects at a minimum period interval of 80–86 min (Gänsicke et al., 2009). This period spike is composed primarily of CVs which are faint and therefore have been missed by previous surveys (Fig. 2). The position of the spike remains at a longer period than expected, implying that the angular momentum loss rates predicted by CV evolution theory are too low.

Four new eclipsing CVs

On recent observing runs with the ESO New Technology Telescope, we have discovered eclipses in four faint CVs within our project. SDSS J075653.11+085831.8 shows 2 mag deep eclipses on a period of 197 min. The system SDSS J093537.46+161950.8 has 1 mag deep eclipses on a period of 92 min, SDSS J105754.25+275947.5 has short and deep eclipses and an orbital period of 90 min, and SDSS J143209.78+191403.5 shows 1.5 mag deep eclipses spaced by 169 min (Southworth et al., in prep.; Breedt et al., in prep.). The modest quality of the light curves is due to the poor seeing encountered throughout the observing runs (see Figs. 2 and 3). Eclipsing CVs are hugely valuable because they are the only examples whose physical properties can be measured to high precision (e.g. Southworth et al., 2010; Savoury et al., 2011). Follow-up observations of these objects are planned.

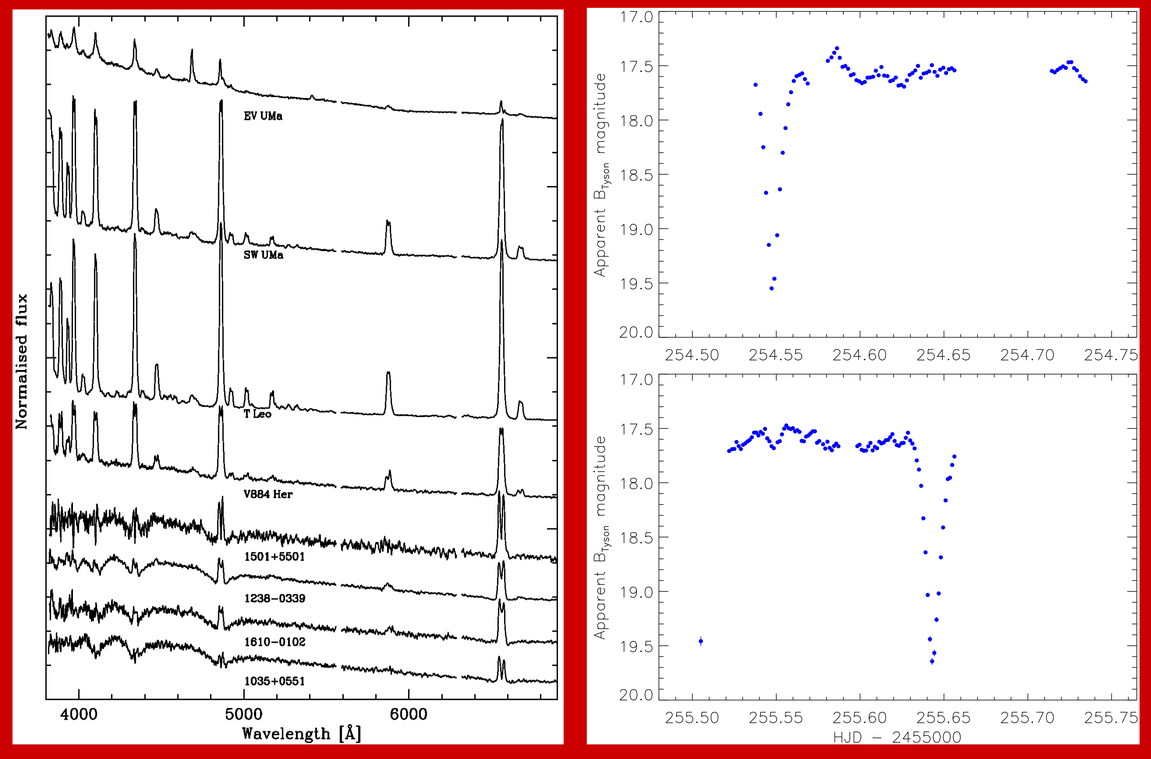

Fig. 2. *Left:* comparison between the spectra of four previously known CVs (higher) and four SDSS CVs (lower) with orbital periods below 86 min.
Right: NTT/EFOSC2 light curve of the eclipsing CV SDSS J075653.11+085831.8.

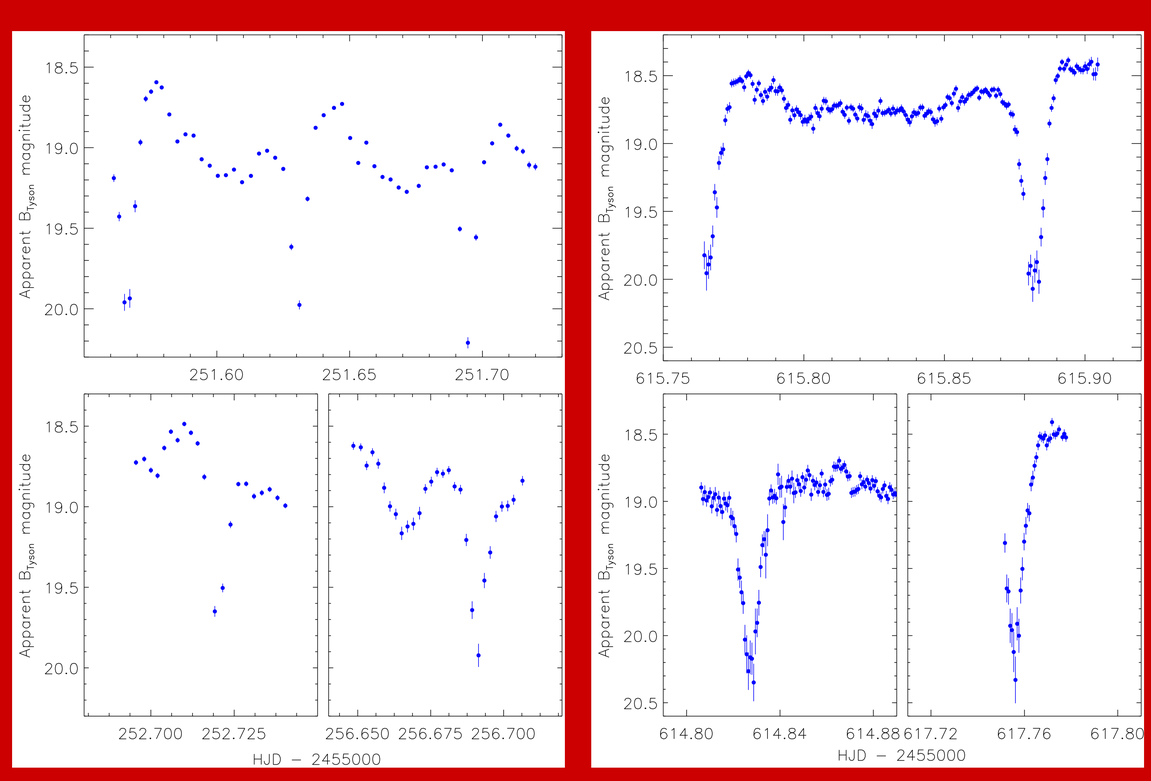

Fig. 3. NTT/EFOSC2 light curves of the eclipsing CVs SDSS J093537.46+161950.8 (left) and SDSS J143209.78+191403.5 (right).

References

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