The Missing CV Population: Results From An Objective Prism Survey

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Abstract. We present the results of a search for cataclysmic variables (CVs) in the Calán-Tololo survey. We detected a total number of 21 CVs, 12 of them are previously unknown objects. Our results suggest that the mismatch between the theoretically predicted sample and the observed one is not due to observational bias but has to be resolved by a revision of the theoretical models.

1. The survey

Theoretical models of the CV population predict that the vast majority consists of low-mass-transfer systems, which have passed a theoretical minimum period $P_{\text{min, the}} \sim 65$ min and are evolving back to longer periods. Observationally, this should cause a pile-up of systems at $P_{\text{min, the}}$ (Stehle, Kolb, & Ritter 1997). However, the observed minimum period is $P_{\text{min, obs}} \sim 78$ min, and neither the large number of evolved CVs nor the pile-up are seen (Patterson 1998). CVs of this ‘missing population’ are expected to be intrinsically very faint and to have long outburst recurrence times, making them hard to discover. The presently observed sample is likely to be biased towards bright, young CVs, and does not serve as an unambiguous testbed for theoretical models.

Spectroscopic surveys should be ideally suited to discover evolved CVs, as low mass-transfer-rate systems generally show strong emission lines. The Calán-Tololo objective prism survey (hereafter CTS; Maza et al. 1989) covers 5150 deg$^2$ of the southern sky with $|b| \geq 20^\circ$ down to $\sim 18.5$ mag. About half of the plates have been examined, and 59 candidate CVs have been selected visually on the basis of their spectral appearance on the plates. Follow-up observations included medium-resolution spectroscopy, calibrated and time-series photometry for all previously unknown objects, and time-resolved spectroscopy for selected identified CVs.
2. Results

From the initial sample of 59 objects, 21 were identified as CVs (16 dwarf novae and 5 magnetic CVs in low state), with 12 previously unknown objects. Figure 1 shows the period distribution of the CTS CVs in comparison with the known sample from the Ritter & Kolb (1998) catalogue. Both samples are limited to galactic latitudes $|b| > 20^\circ$ and to nonmagnetic CVs, as the evolution for magnetic systems might be significantly different. The restriction to high galactic latitudes does limit the bias towards distant, long-period, high-mass-transfer systems, which affects the sample at low latitudes. As expected, our survey detected predominantly short-period CVs, which are thought to be low-mass-transfer systems.

However, the number of newly discovered CVs is far too low to solve the mismatch between theory and observations. Furthermore, although the high-$|b|$ limited period distribution shows a (small) peak at $P_{\text{min,obs}}$, the periods of the newly discovered CVs actually make this feature less pronounced (Fig. 1).

Unfortunately, the visual inspection of the CTS plates introduces a different bias which is very difficult to quantify. It certainly affects to a high degree the completeness of the sample, and also leads to a significant contamination by non-CVs. We remark however that this ‘personal’ bias in principle should not be directed against evolved CVs. The fact that we did not find these systems therefore indicates that their number indeed is much lower than predicted by the theory, thus supporting the discussion and conclusions by Patterson (1998).

References

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