

TREASURE CHEST OF PERIOD BOUNCERS:
DETECTION OF THE BROWN DWARF DONOR IN BW SCULPTORIS

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Photometric properties of donor stars in cataclysmic variables (CVs) change dramatically at the very late evolution stages of these interaction binaries. CVs evolve from longer to shorter orbital periods. At some point known as the period minimum, the main-sequence (MS) donor star becomes of a substellar mass and partially degenerates. The binary then begins evolving back towards longer orbital periods. Such CVs are called the “period bouncers”. It is expected that the NIR flux of the donor star drops by several times during the period turn that makes its spectral analysis extremely difficult. While indirect methods are able to distinguish period-bounce candidates with such a kind of brown dwarf-like donors, they fail to produce an accurate measurement of the donor’s parameters. Thus, due to a deficient sample size of confirmed period bouncers, their properties are known very poorly and are not suitable for detailed comparison with theoretical predictions.

Here we present an analysis of multi-epoch spectroscopic observations of BW Scl in quiescence, which is believed to be one of the best period-bouncer candidates. We report the detection of multiple irradiation-induced emission lines from the donor star allowing the radial velocity variations to be measured with high accuracy. Also, using the absorption Mg II 4481 line originated in the photosphere of the accreting white dwarf (WD), we measured the radial velocity semi-amplitude of the WD and its gravitational redshift, allowing direct measurement of the WD mass. From this analysis, we find that the WD has a mass of $M_{\text{wd}}=0.92\pm 0.04 M_{\odot}$, while the donor is a low-mass object with a mass of $M_2=0.053\pm 0.008 M_{\odot}$. Using NIR photometric and spectroscopic data, we also put a conservative upper limit on the effective temperature of the donor to be $T_{\text{eff}} \leq 1600$ K that corresponds to the luminosity of $L_{\text{donor}} \leq 2.5 \times 10^{29}$ ergs⁻¹. These findings rule out an MS star as the donor in BW Scl. Indeed, combined NIR Doppler-corrected spectra show hints of a few neutral atomic species which are expected to be seen in spectra of L and T brown dwarfs. However, their presence should be confirmed in further studies.