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Time-resolved observations of the short period CV SDSS J123813.73-033933.0

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Abstract. We present simultaneous spectral and photometric observations of SDSS J123813.73-033933.0. From Hα radial velocity measurements we determined the orbital period of the system to be 0.05592 ± 0.00002 days (80.53 min). The spectrum shows double Balmer emission lines flanked by strong, broad absorption, indicating a dominant contribution from the white dwarf. The photometric light curve shows complex variability. The system undergoes cyclic brightening up to 0.4 mag which are semi-periodical on short time scales with periods of the order of 7-12 hours. We also detect 40.25 min variability (0̃.15 mag) in the light curve, that corresponds to half the orbital period. Its amplitude increases with the cyclic brightening of the system.

1. Observations and Data Analysis

The discovery of SDSS J123813.73-033933.0 (SDSS1238) was announced in the second CV release of the SDSS (Szkody et al. 2003). The optical spectrum shows a blue continuum with broad absorption around double peaked Balmer emission lines. From its highly doubled lines, the inclination of the system was suspected to be high. Here we present simultaneous time resolved spectral and photometric observations of SDSS1238 obtained during April and May 2004 at SPM Observatory, Mexico. Spectral observations were done in four consecutive nights in April and one night in May 2004 with a total coverage of 21h. Differential photometry was done in V and R bands in long time series (3 nights in April and 4 nights in May). The spectrum of SDSS1238 shows features characteristic of short-period, low mass transfer, high inclination CVs like WZ Sge and RZ Leo. The fit by a WD model of the Balmer absorption features shows that the Balmer decrement is probably produced by a WD rather than an accretion disc.

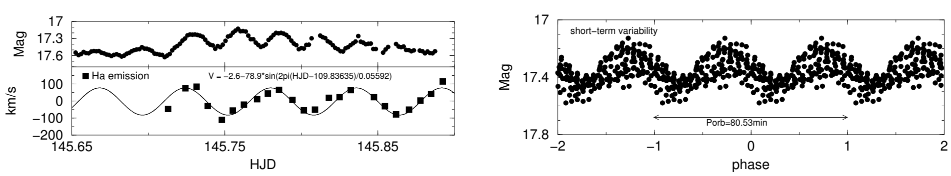

Figure 1. Left: light curve and Hα RV curve of SDSS1238 on May 19, 2004. Right: The short term variability folded with half the orbital period.

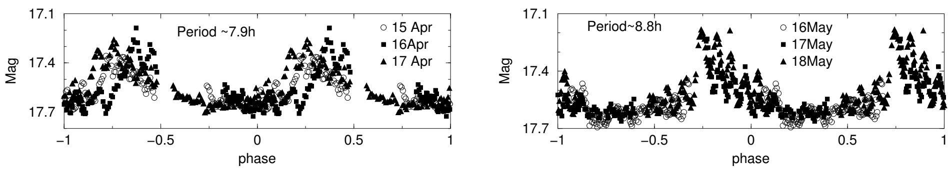

Figure 2. The long-term variability of SDSS1238 in April (left) and May (right) observational runs.

Best fit model solutions correspond to high gravity, indicating a high WD mass ($0.8-1\mathrm{M}_{\odot}$). The power spectrum of RV variations of the Hα emission line peaks at a 17.88218 day^{-1}, corresponding to an orbital period $P_{\mathrm{orb}} = 0.05592 \pm 0.00002$ days, about 4 min longer than that recently reported by Szkody et al. (2003). The period analysis shows that the period and phase of the absorption feature coincide with the emission component. Photometrically, SDSS1238 shows two types of variability: a long-term one (7-12h) with an amplitude ∼0.45 mag and a short-term one (∼0.35 mag) at half the orbital period, more visible in the bright part of the long-term variability. The maxima of the short-time photometric variability are at orbital phases 0.375 and 0.875. Long-term variability (LTV) detected during April showed a distinct periodic (7.9h) pattern. A month later, we confirmed the existence of a LTV but found that its period changed from about 9h to about 12h. The Doppler maps constructed with the bright and faint phases of the LTV cycle show different states of the accretion flows in the system. The photometric behavior of the system is complex and so far incomprehensible. The half-orbital (spectral) period photometric variations, usually attributed to the elliptically distorted secondary, do not make sense in this case when coupled with the absence of any sign of the secondary in the spectrum, the fact that they become significantly stronger at brighter phases of LTV and their phasing with the spectral data. Another rather unusual explanation includes radiation from *symmetric* hot spots in the disc or at the surface of WD. A double-hump modulation of the light curve has been observed by Rogoziecki & Schwarzenberg-Czerny (2001) in a quiescent state of the short period (0.05827d) WZ Sge -type system WX Cet in Oct. 1998 and by Kafka & Honeycutt, (2003) in the AM Her system QQ Vul at some observational runs. We interpret the LTV and the difference of the Doppler maps in bright and faint parts of the light curve of SDSS1238 as a result of changes of the accretion rate in the system with the quasi-period 7-12h. This quasi-periodic brightening is by no means outburst-like and the intervals are much shorter than the shortest known cycles (3-4 days) of ER UMa type outbursts. One can speculate that increased mass-transfer at bright phases of LTV increases the intensity of the spots causing the half-orbital period short term variability. The system certainly requires close monitoring.

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References

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