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DD CMa: A NEW GALACTIC DPV OF EXTREME SHORT PERIOD

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We have performed a new search for interacting binaries of the type Double Periodic Variables (DPVs) in ASAS[1] (Pojmanski, 1997). We have considered Eclipsing Algols Semi-detached and Detached (EA/SD and EA/ED respectively) within the minimum orbital period of a clasical DPV. The DPVs are intermediate binary stars that show closely linked photometric variations being the long period roughly 33 times longer than the orbital period (Mennickent et al. 2003, 2016a, Poleski et al. 2010). The nature of the second period is unknown but suspected to reflect the strength variations of a wind generated in the stream-disc impact region (Mennickent et al. 2012, 2016b, van Rensbergen et al. 2008). DPVs are considered as one specific evolutionary step for more massive Algols, one posssibly involving mild mass transfer and systemic mass loss (Mennickent et al. 2008). But an interesting property of these objects is the surprising constancy of their orbital periods, which is not expected in Algols undergoing RLOF mass transfer (Garrido et al. 2013). Also the DPVs seem to be hotter and more massive than classical Algols and seem to have always a B-type component; their orbital periods typically run between 3 and 100 days. DPVs have been found in the Galaxy (MW), the Large Magellanic Cloud (LMC) and the Small Magellanic Cloud (SMC).

We carried out a visual inspection in ASAS for orbital period less than 3 but longer than 2 days. At this opportunity we have found only one new candidate to DPVs from 821 objects and determined the orbital and long period by using the PDM IRAF [2] software (Stellingwerf 1978). Also we have estimated the errors for the orbital period and long cycle by visual inspection of the light curves phased with trial periods near the minimum of the periodogram given by PDM. We disentangled the two main photometric frequencies using a code specially designed for this purpose by Zbigniew Kołaczkowski. The code adjusts the orbital signal with a Fourier series, this code is able to disentangle both frequencies if we give us the fundamental frequency plus their harmonics. Then it removes this signal from the original time series letting the long periodicity present in a residual light curve. As result we obtain both isolated light curves without additional frequencies. The results of the search is presented in Table 1, and the disentangled light curves are shown in Figures 1 and 2. DD CMa was confirmed as the DPV that shows the shortest long-period found until moment, which makes it very peculiar. It is possible that under certain circumstances this short orbital period might let small room for the existence of an accretion disc and this fact makes this system particularly important to test models for the long-cycle based on disc winds. We believe that DD CMa is an optimal target for

[1] `http://www.astrouw.edu.pl/asas/`

[2] IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

photometric monitoring and spectroscopic studies to help understand the mass loss process and evolutionary stage of the Algols and specifically the DPVs. Also we have searched for the presence of close nebulosity around this system with the WISE image service[3] (Wright et al. 2010) especially in the band in W4 (22 mm), and we have confirmed the absence of nebulosity, which is relevant when discussing systemic mass loss and evolutionary stage in close binary stars with mass loss process.

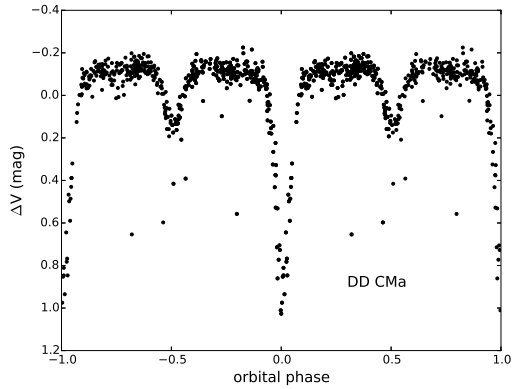

Figure 1. Disentangled ASAS V-band light curve of the new confirmed Double Periodic Variable.

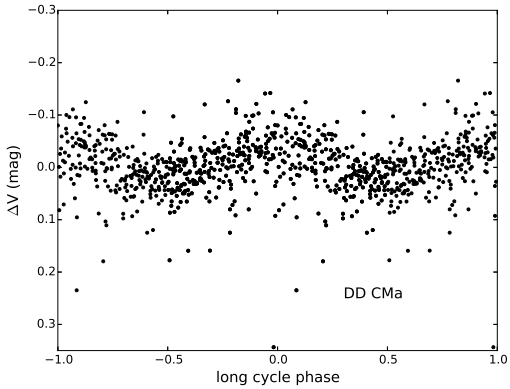

Figure 2. Disentangled ASAS V-band light curve of the new confirmed Double Periodic Variable.

Table 1: New confirmed Double Periodic Variable and their orbital (P_o) and long period (P_l). Both epoch for the minimum brightness of the orbital light curve and the maximum brightness of the long-cycle light curve are given.

ASAS-ID	Other ID	RA (2000)	DEC (2000)	P_o (days)	P_l (days)	$T_0(\min_o)$ 2450000+	$T_0(\max_l)$ 2450000+	V (ASAS) (mag)
072409-1910.8	DD CMa	07:24:09	−19:10:48	2.0084(1)	89.18(16)	2763.46515	4207.411	11.41

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[3] `http://irsa.ipac.caltech.edu/applications/wise/`