A Study of the Cataclysmic Variable 1RXS J174320.1–042953

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We report on our photometric analysis of the poorly studied cataclysmic variable in Ophiuchus, 1RXS J174320.1–042953 (DDE 11). The results of the monitoring with the Bradford Robotic Telescope (BRT) are presented, as well as the time-resolved photometry obtained at the Montecatini Astronomical Centre. The long-term behavior of J1743–0429 shows that it is a probable magnetic cataclysmic variable (polar), with a large difference between its low and high states. The orbital period obtained from our observations is $0^{\rm d}0866$, or $2^{\rm h}08$, close to the lower boundary of the period gap of cataclysmic variables.

The cataclysmic variable DDE 11=1RXS J174320.1–042953 ($\alpha = 17^{\rm h}43^{\rm m}20\overset{\rm s}{.}29$, $\delta = -04°29'57\overset{''}{.}1$, J2000; UCAC3) was identified by Denisenko and Sokolovsky (2011) from its magnitudes in the USNO-B1.0 catalogue ($B_1 = 16\overset{\rm m}{.}12$, $R_1 = 15\overset{\rm m}{.}15$, $B_2 = 18\overset{\rm m}{.}95$, $R_2 = 18\overset{\rm m}{.}13$). They suggested the star to be a dwarf nova that had been in outburst on July 1, 1954, when the first-epoch Palomar Observatory Sky Survey blue and red plates had been obtained.

After the discovery of variability on the digitized photographic plates and in the USNO-B1.0 catalog, one of us (D.D.) started monitoring the variable with the Bradford Robotic Telescope located on Tenerife (Canary Islands, Spain). The images from the 0.35-m $f/5.3$ telescope with an FLI Microline CCD (1k×1k pixels) were requested via the website http://www.telescope.org. Due to the large number of observers using this publicly available facility, the requests are fulfilled at irregular time intervals. Typically one has to wait for an image from 2 weeks to 2 months after submitting the request. However, even this arrangement of observations allows one to obtain valuable data on the long-term behavior of cataclysmic variables.

In the case of 1RXS J174320.1–042953 (hereafter referred to as J1743–0429 for brevity), the BRT observations have shown that the initial hypothesis of this star being a dwarf nova was incorrect. Instead of spending most time at quiescence with occasional outbursts, J1743–0429 was found to be always near the high state. The results of the BRT observations are presented in Table 1.

Observations were performed in the white light with 60-second exposures. Magnitudes were measured using USNO-A2.0 0825-11051991 ($\alpha = 17^{\rm h}43^{\rm m}22\overset{\rm s}{.}71$, $\delta = -04°30'29\overset{''}{.}6$, J2000; $R = 15\overset{\rm m}{.}7$) as a reference star and USNO-A2.0 0825–11051825 ($\alpha = 17^{\rm h}43^{\rm m}22\overset{\rm s}{.}49$, $\delta = -04°30'59\overset{''}{.}8$, J2000; $R = 16\overset{\rm m}{.}3$) as a check star. The variable, reference and check stars are shown in Fig. 1 which is a sum of two best BRT exposures. It should be noted that the image scale of the Galaxy camera is $1.44''$ per pixel and that there is another star only $6''$ to the south of the variable. This is why the aperture radius, the width of the annulus where the sky background is measured, and the width of the gap between this annulus and the aperture were all set to 3 pixels.
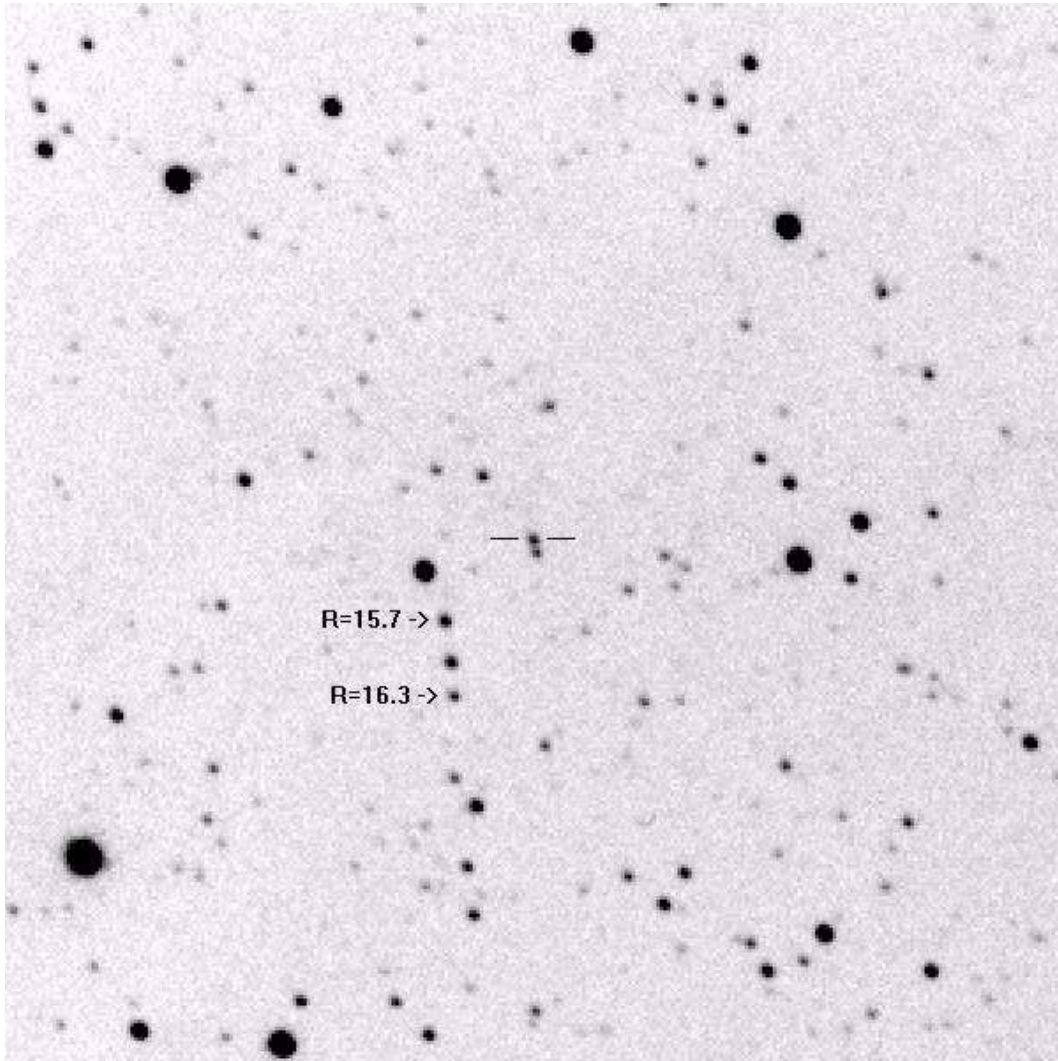
Figure 1. The finder chart of J1743–0429 from a Bradford Robotic Telescope image. North is up, east is to the left. The field of view is $14' \times 14'$. The variable is marked with dashes; the reference and check stars are shown with arrows, and their USNO-A2.0 R magnitudes are indicated.

Following the request by D.D., time-resolved photometry of J1743–0429 was performed by F.M. at the Montecatini Astronomical Centre (http://www.astronomicalcentre.org) on two nights using an 0.35-m telescope equipped with an ST8-XME CCD camera. 70-second unfiltered exposures were taken on both nights. A 4.6-hour-long time series was obtained on 2012 July 16/17 and a 3.5-hour-long one, on July 18/19. The images were calibrated using flat fields and dark frames obtained on the same night. The photometry was made using the same reference and check stars as indicated above.

The light curves for both nights are shown in Fig. 2. The combined data set was analyzed using the WinEffect software by Dr. V.P. Goranskij. Period search was performed using the Deeming and Lafler–Kinman methods. Both algorithms have provided the best period value of $0\overset{d}{.}0866(3)$, or 11.55 cycles per day. The periodogram in the 8–16 cycles/day range obtained for the Lafler–Kinman method is shown in Fig. 3 and the resulting phased light curve, in Fig. 4.
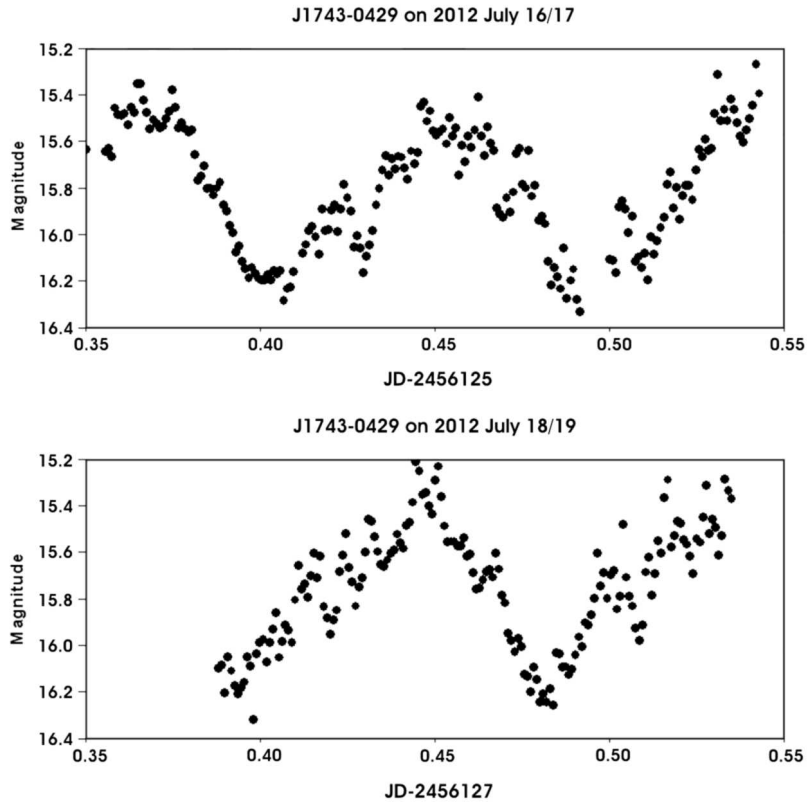
Figure 2. Light curves of J1743–0429 obtained at the Montecatini Astronomical Centre on 2012 July 16/17 (top) and 2012 July 18/19 (bottom).

The main features of the light curve are its quite large amplitude ($0\overset{m}{.}8$) and a dip by about $0\overset{m}{.}4$ shortly before the maximum. Together with the orbital period close to the bottom edge of the cataclysmic-variable period gap, these features are indicating the probable polar nature of this cataclysmic variable.

One can also suspect a hint to shorter-period brightness variations superimposed on the main orbital curve. It is possible that this cataclysmic variable is an intermediate polar with a quickly rotating white dwarf. Photometric time series with a larger-aperture telescope are required to study this variable in more detail. We also encourage spectroscopic studies, to measure relative intensities of the HeII 4686 Å and Hβ lines.

References:

Table 1: BRT observations of J1743–0429

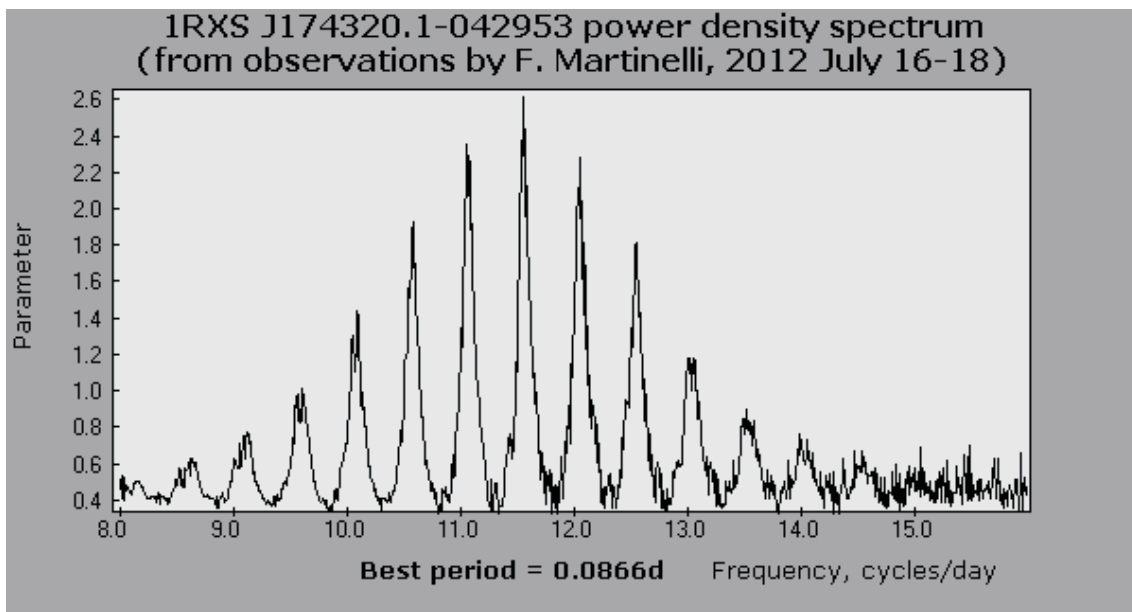| Date	JD	Mag
2011 May 22	2455703.627	16.14
2011 Aug 04	2455777.509	15.88
2012 July 16	2456124.560	15.58

Figure 3. The Lafler–Kinman periodogram of the observations of J1743–0429.

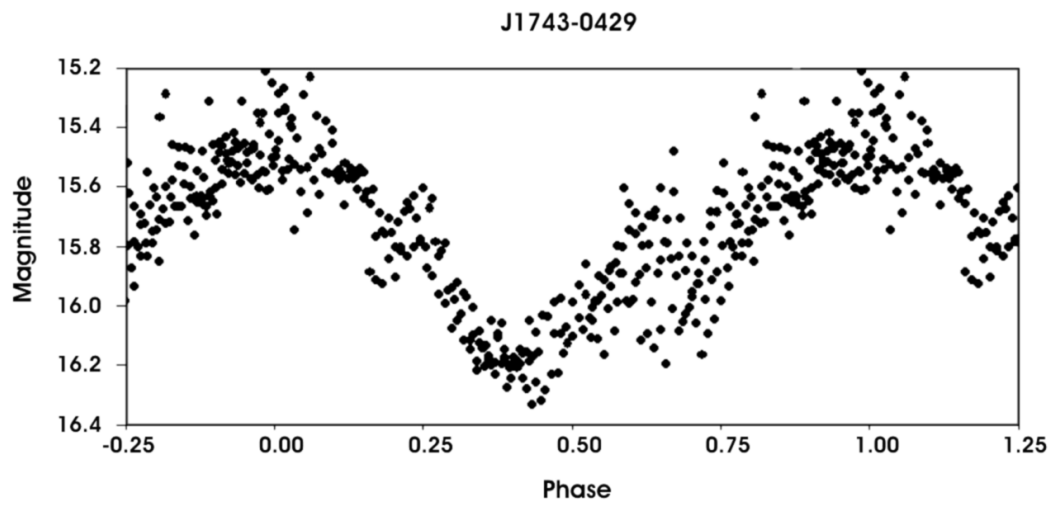Denisenko D.V., Sokolovsky K.V., 2011, *Astron. Letters*, **37**, 91

Figure 4. The light curve of J1743–0429 folded with the best period, $0\overset{\text{d}}{.}0866$.