Peremennye Zvezdy (*Variable Stars*) **38**, No. 2, 2018

Received 12 April; accepted 17 April.

New Eclipsing Cataclysmic Variable Candidate in the Period Gap

D. Panov[1], D.V. Denisenko[2]

[1] Erudit Lyceum, Rubtsovsk, Russia

[2] Sternberg Astronomical Institute, Moscow State University, Universitetskij pr. 13, Moscow 119992, Russia; d.v.denisenko@gmail.com

We report the discovery of a blue eclipsing variable Dan V1 in Sagittarius with the orbital period $P = 0^{\rm d}.094277$ ($2^{\rm h}.2626$). The object is also an UV source, indicating the presence of a white dwarf in the binary system. We consider two possibilities: a cataclysmic (nova-like) variable and an eclipsing hot subdwarf of the HW Vir type. Our analysis favors the first (CV) scenario. If confirmed, Dan V1 is a very rare eclipsing cataclysmic variable in the period gap.

1 Discovery

The new variable in Sagittarius was discovered by a 10th grade student Danil Panov during the Moscow University LANAT summer camp in August, 2017. D. Panov was blinking images of the field centered at NSV 11918, obtained with the 0.51-m T31 instrument of the iTelescope network in Siding Spring, Australia. The star indicated in Fig. 1 was found to be in eclipse on the images from 11:01 to 11:08 UT, Aug. 15, and reappearing on the 11:09 UT image. The position of the variable (J2000.0) was taken from the PPMXL catalog (Roeser et al. 2010): $19^{\rm h}21^{\rm m}27^{\rm s}.38$, $-31^\circ13'49''.5$. Checking the AAVSO VSX website (Watson et al. 2007) has shown no known variable star at these coordinates as of 2017 August 15. The new object was designated Dan V1 by the discoverer.

2 Period Determination

In addition to twelve 2017 Aug. 15 images, we had 57 additional 60-second exposures from 2016 Aug. 08, covering $1^{\rm h}.2$ of observations. Another eclipsing variable, DDE 47, was discovered on those images (Denisenko 2016). We obtained additional observations of the field with T31 on 2017 Aug. 17 (11:18–11:32 UT), Aug. 19 (11:01–11:15 UT), and with the 0.43-m T32 instrument on Aug. 20 (11:13–11:30 UT). Unfortunately, no eclipses were detected in these data. However, they allowed us to exclude several possible periods we used for computing trial eclipse ephemerides.

The area of Dan V1 was observed by the NEAT survey (Teegarden et al. 2003) on 10 nights from August 1998 to August 2002, with a total of 31 images. FITS crops with $5' \times 5'$ FOV were downloaded from the SkyMorph website at https://skys.gsfc.nasa.gov/skymorph/obs.html, and the visual inspection revealed three additional eclipses in NEAT data. The magnitudes of the new variable were measured for all images using USNO-B1.0 0587-0835084 ($R = 15.58$) as the reference star.

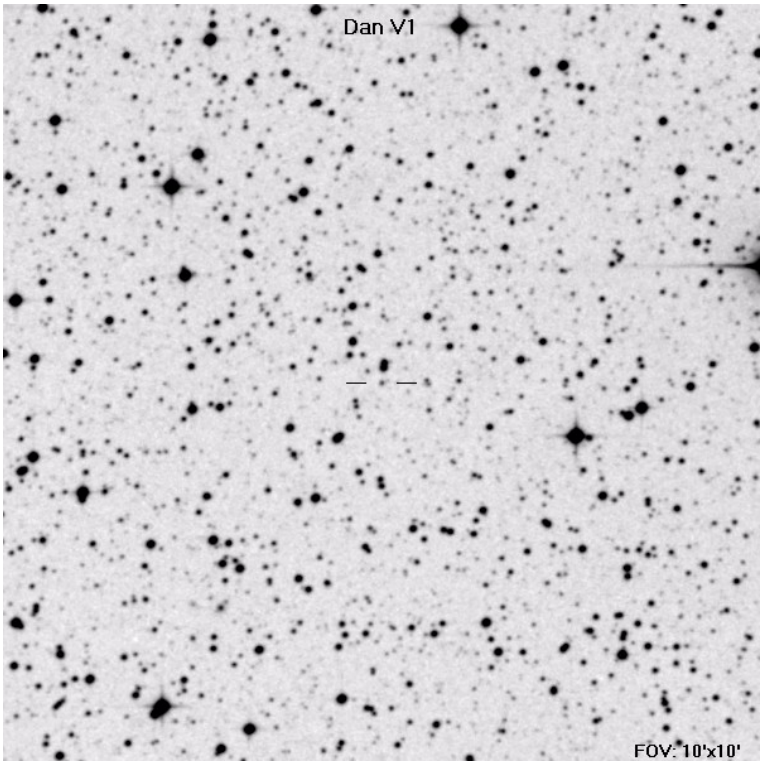

Figure 1.
The finding chart of Dan V1 from the DSS Red plate. The FOV is $10' \times 10''$, North is up and East, to the left.

The observing times were converted from JD to Barycentric Julian Dates using the online period search service http://scan.sai.msu.ru/lk/ by Kirill Sokolovsky. The best period, $0^{\rm d}.094277(2)$, was obtained using the Lafler–Kinman method. With this period and the Aug. 15 eclipse as the initial epoch, we predicted the next eclipse to occur around 11:18 UT on 2017 Aug. 28. The observations with T31 on 11:08-11:33 UT confirmed the prediction. The eclipse with epoch number 138 was successfully observed. The phased light curve using all data is presented in Fig. 2.

The light elements of Dan V1 from combined iTelescope and NEAT observations are:

$$\mathrm{Min} = \mathrm{HJD}2457980.967 + 0^{\rm d}.094277 \times E.$$

3 Discussion

The new variable Dan V1 has the following identifications and magnitudes in astronomical catalogues:

GALEX J192127.3–311349 ($FUV = 19.63$, $NUV = 19.82$);

GALEX J192127.4–311350 ($FUV = 19.35$, $NUV = 19.27$);

USNO-A2.0 0525–40560552 ($b = 17.7$, $r = 17.5$);

USNO-B1.0 0587–0835138 ($B1 = 18.18$, $R1 = 17.95$, $B2 = 18.29$, $R2 = 18.75$, $I = 18.23$).

The star was not detected in the 2MASS and WISE infrared all-sky surveys. Its color indices clearly indicate the presence of a hot white dwarf in the binary system. There

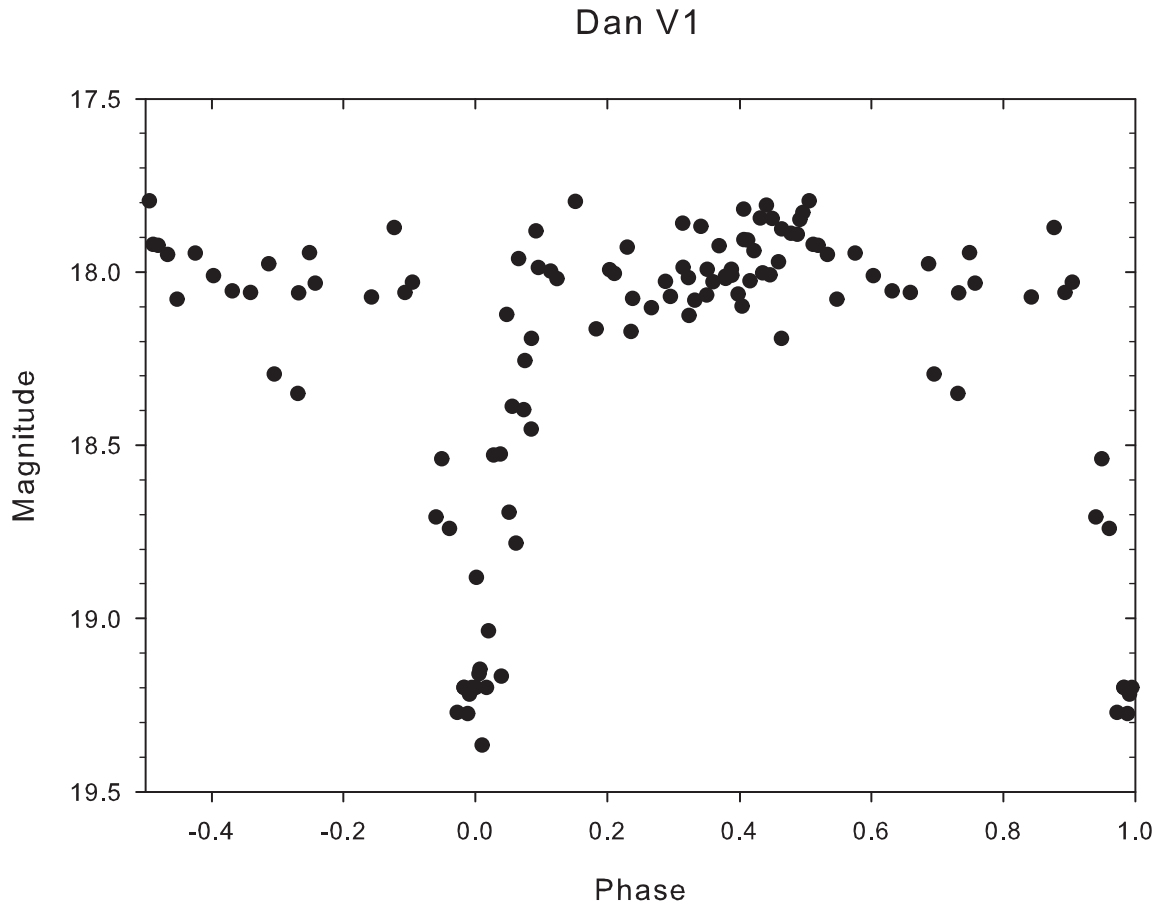

Figure 2.
The light curve of Dan V1 from the T31 and NEAT data folded with the best orbital period, $P = 0^{\rm d}.094277$, and the initial epoch T_0 =HJD2457980.967.

are two possibilities for short-period eclipsing binaries: a cataclysmic variable (CV) or a hot subdwarf system of the HW Vir type. In our case, the light curve shape is in favor of a cataclysmic variable. Namely, there is no brightness rise towards the 0.5 phase that should be expected in an HW Vir system due to reflection effect on the secondary from the subdwarf. Also, the light curve of Dan V1 folded with the orbital period does not reproduce itself exactly from one epoch to another, which is an indication of interaction between the two components. Thus, we conclude that Dan V1 is an eclipsing CV in the period gap. According to the AAVSO Variable Star Register, VSX (Watson et al. 2007), there are about 5000 CVs among 500 thousand variable stars known as of February 2018. 54 CVs fall in the period gap from 2.2 to 2.8 hours, and only 15 of them are eclipsing. Figure 3 shows the position of Dan V1 in the period distribution of cataclysmic variables.

4 Conclusion

A new candidate cataclysmic variable in Sagittarius, in the period gap, has been discovered. We would like to encourage multi-color photometry and time-resolved spectroscopy of Dan V1, needed to confirm the nature of this object. Note that the new variable is located in $15\farcm5$ from another eclipsing cataclysmic variable, DDE 47 (Denisenko 2016), which is a dwarf nova with unknown period.

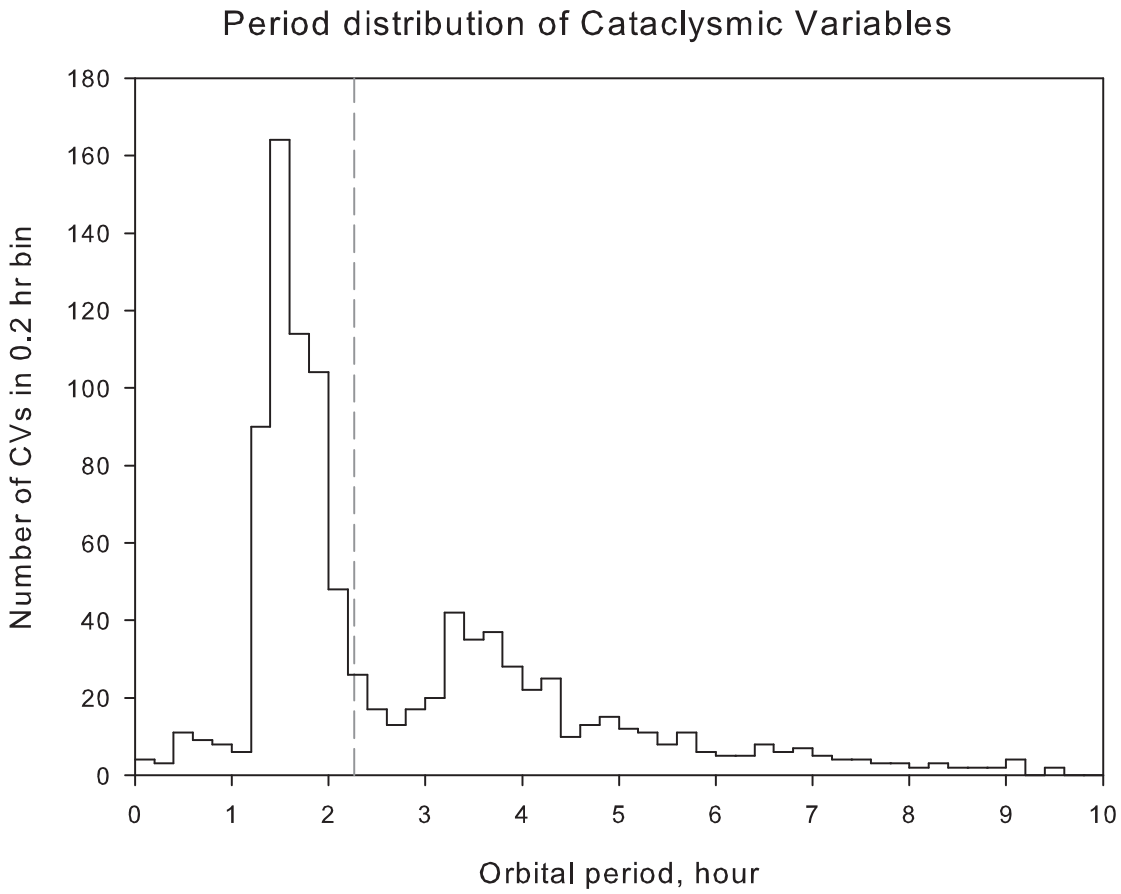

Figure 3.
Position of Dan V1 (the vertical dashed line) in the period gap of cataclysmic variables. The bin size along the period axis is $0^{\rm h}.2$. Cataclysmic variables with periods longer than 10 hours are not shown.

Acknowledgments: Danil Panov's participation in the LANAT summer camp was supported by the Andrey Melnichenko Foundation and Siberian Generating Company. The authors are grateful to Dr. S.V. Antipin for useful discussion.

References:

Denisenko, D., 2016, *Astronomer's Telegram*, No. 9342
Roeser, S., Demleitner, M., Schilbach, E., 2010, *Astron. J.*, **139**, 2440
Teegarden, B.J., Pravdo, S.H., Hicks, M., et al., 2003, *Astrophys. J.*, **589**, L51
Watson, C.L., Henden, A.A., Price A., 2007, *Journal of the AAVSO*, **35**, 414