COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5961

Konkoly Observatory
Budapest
5 January 2011

HU ISSN 0374 – 0676

USNO-A2.0 1425-04279615 AND USNO-A2.0 1425-04280420: TWO NEW SHORT-PERIOD ECLIPSING RS CVn VARIABLES

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During our observations of a field in Perseus, we found two new eclipsing variable stars with RS CVn variability. Their coordinates and magnitude ranges are presented in Table 1.

Table 1. New EA+RS variables

Star	α_{J2000}	δ_{J2000}	R_{max}	R_{min}
USNO-A2.0 1425-04279615	$03^h19^m59\overset{s}{.}75$	$+57°19'09\overset{''}{.}7$	$12\overset{m}{.}31$	$12\overset{m}{.}75$
USNO-A2.0 1425-04280420	$03^h20^m05\overset{s}{.}03$	$+57°07'32\overset{''}{.}1$	$13\overset{m}{.}70$	$13\overset{m}{.}97$

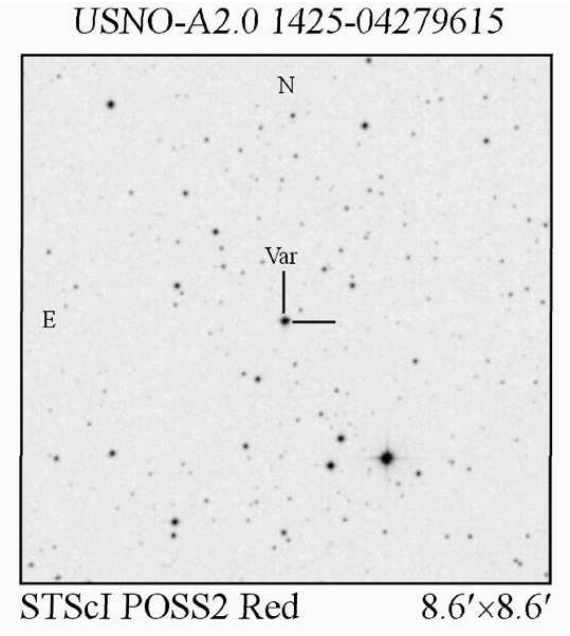

Figure 1. Finding chart of USNO-A2.0 1425-04279615

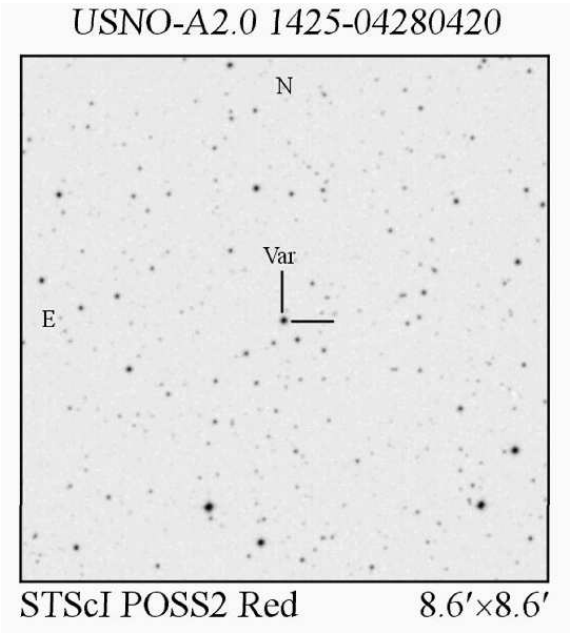

Figure 2. Finding chart of USNO-A2.0 1425-04280420

The coordinates were drawn from the 2MASS catalogue (Skrutskie et al., 2006). The finding charts for the two variables are presented in Figs. 1 and 2. Our observations were carried out at the Astrotel–Caucasus observatory using an 0.3-m Ritchey–Chretien telescope, equipped with an unfiltered Apogee Alta U9000 CCD camera. A total of 2316 images with 5-minute exposures were obtained on JD 2455080–2455519. For basic reductions for dark current, flat fields, bias and for removing cosmic-ray hits, we use IRAF routines. For search and photometry of the new variable stars, we applied VaST software

by Sokolovsky and Lebedev (2005). The comparison star was USNO-A2.0 1425-04237176 = USNO-B1.0 1473-0129296 ($\alpha = 03^h15^m37\overset{s}{.}41$, $\delta = +57°19'36\overset{''}{.}5$ (J2000, 2MASS); $R_1 = 14\overset{m}{.}33$, $R_2 = 14\overset{m}{.}60$ (USNO-B1.0)). Unfiltered magnitudes were calibrated using the comparison star, assuming $R_{\rm comp} = 14\overset{m}{.}465$. To search for period and derive epochs of extrema, we use Peranso software (`www.peranso.com`).

During our observing campaign, we detected the primary minima of USNO-A2.0 1425-04279615 and USNO-A2.0 1425-04280420 listed in Table 2.

Table 2. CCD minima of USNO-A2.0 1425-04279615 and USNO-A2.0 1425-04280420

USNO-A2.0 1425-04279615		**USNO-A2.0 1425-04280420**	
HJD(TT)	±	**HJD(TT)**	±
2455116.2503	0.0002	2455116.5291	0.0002
2455117.2513	0.0002	2455122.5191	0.0003
2455122.2556	0.0005	2455123.4414	0.0009
2455123.2571	0.0007	2455142.339	0.001
2455142.2751	0.0003	2455145.5642	0.0006
2455144.2778	0.0009	2455163.5409	0.0001
2455145.2806	0.0005	2455168.606	0.001
2455163.2930	0.0004	2455169.5295	0.0006
2455202.3290	0.0002	2455230.3701	0.0007
2455230.3549	0.0002	2455260.330	0.001
		2455466.3555	0.0008
		2455495.400	0.001
		2455517.5178	0.0008
		2455518.4398	0.0005
		2455519.3633	0.0009

The light curves plotted with the detected periods (Figs. 3 and 4) reveal variations of the light curve shape characteristic of chromospherically active stars. As an example of such variations, Fig. 5 exhibits three light curves of USNO-A2.0 1425-04280420, plotted with the orbital period for three time intervals. For the analysis of additional variations to the eclipses we use observations between orbital phases 0.07–0.42 and 0.58–0.93 for USNO-A2.0 1425-04279615 and 0.2–0.8 for USNO-A2.0 1425-04280420.

For both stars, we remove the signals with P=3DPorb and find sine-wave periods presented in the corresponding columns of Table 3. The long series of observations and the high precision photometry of the stars reveal small but real differences between orbital and sine-wave periods. Light curves with the sine-wave periods are plotted in Fig. 6 and 7.

All times in Table 2 and further on are expressed in the Terrestrial Time in accordance with IAU recommendations (resolution B1 XXIII IAU GA). The light elements for eclipses of the two stars are given in corresponding columns of Table 3.

Table 3. Light elements

	Eclipsing variability		**Sine wave variability**	
Star	Min_0 HJD(TT)	P, d	Max_0 HJD(TT)	P, d
USNO-A2.0 1425-04279615	2455116.2503	0.500458	2455081.7051	0.499464
		±0.000006		±0.000080
USNO-A2.0 1425-04280420	2455116.5291	0.460909	2455080.5479	0.461208
		±0.000026		±0.000124

These stars are the shortest-period RS CVn stars when compared to chromospherically active binary stars in the third version of the catalog of chromospherically active binaries (Eker et al., 2008)

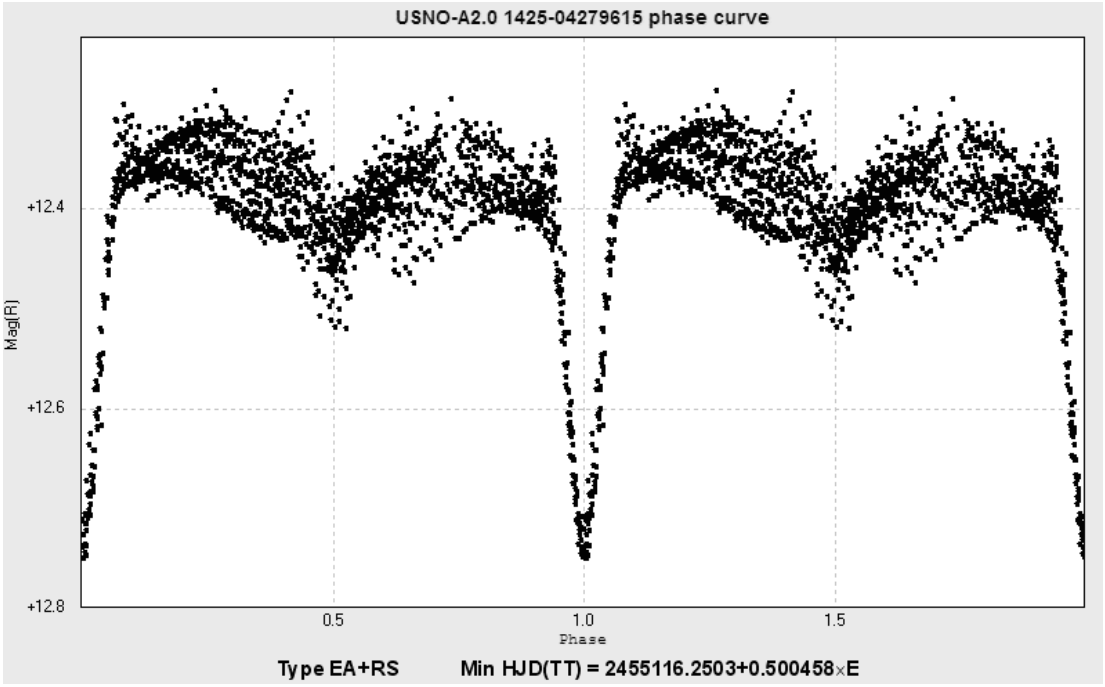

Figure 3. USNO-A2.0 1425-04279615 light curve

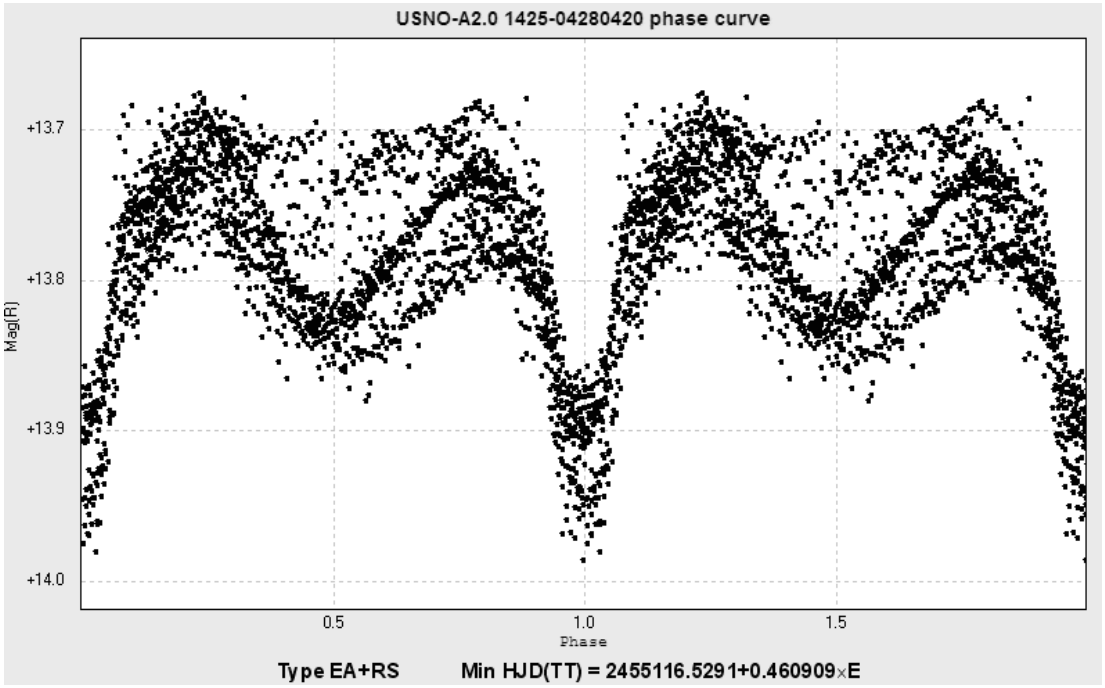

Figure 4. USNO-A2.0 1425-04280420 light curve

We conclude that USNO-A2.0 1425-04279615 and USNO-A2.0 1425-04280420 are new eclipsing RS CVn variables with periods among the shortest known and with dramatically changing light curves. Studying active stars in eclipsing binaries is very important since it makes possible to derive absolute dimensions of the components. The effect of the binarity on stellar activity is an interesting problem and such close binaries like these newly found objects can help to understand that. We hope that the present study will stimulate new observations of these interesting, very active stars.

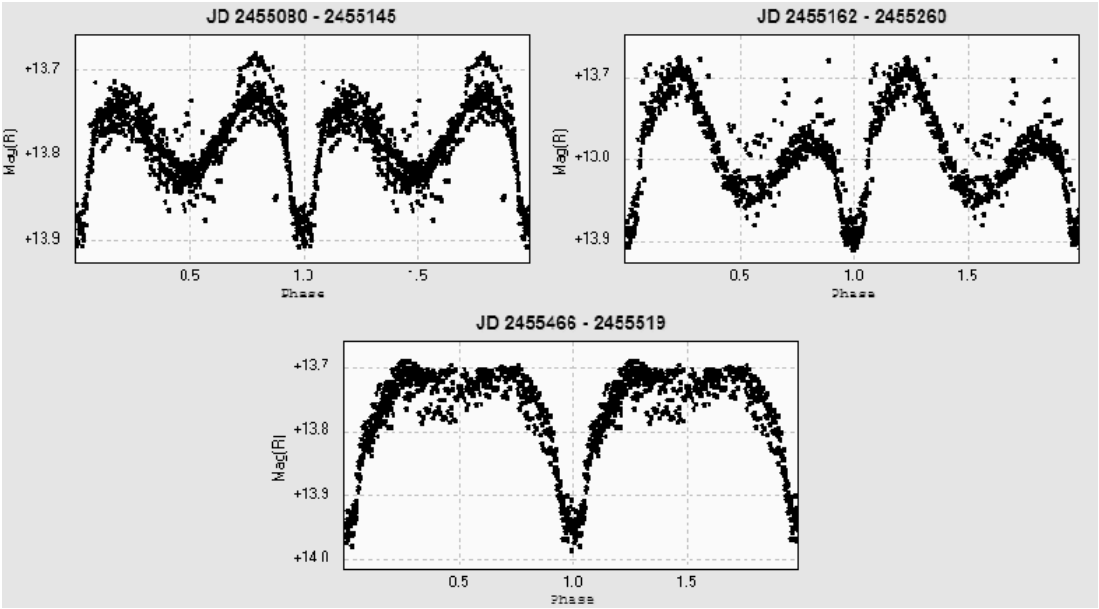

Figure 5. USNO-A2.0 1425-04280420 light curve variability

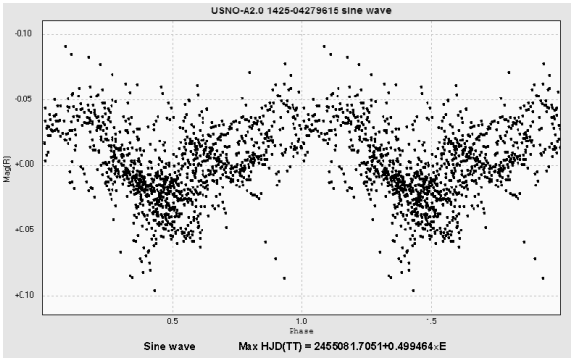

Figure 6. USNO-A2.0 1425-04279615 sine wave

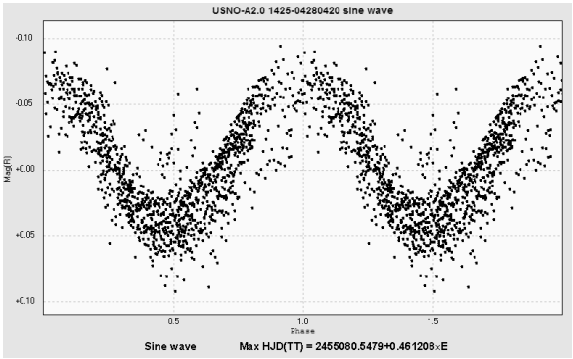

Figure 7. USNO-A2.0 1425-04280420 sine wave

Acknowledgements We would like to thank N. Samus (Institute of Astronomy, Russian Academy of Sciences) for helpful discussion.

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