Three New Eclipsing Binaries Near the Galactic Center

K. V. Sokolovsky

Max Planck Institute for Radio Astronomy, Bonn, Germany; and Astro Space Center of Lebedev Physical Institute, Moscow, Russia

#	Name	Other	Coord (J2000)	Type	Max	Min	System	Period	Epoch (JD)	type	Sp	Comment	L.Curve	Find.Chart	Data
1		USNO-B1.0 0610-0600707	17 45 49.07, -28 56 46.1	EA	17.7	18.3	U	0.82554	2453914.7337	min		Comm. 1	gc161.png	gc161_chart.png	gc161_u_w1.dat
2		USNO-B1.0 0608-0607099, 2MASS J17455451-2908127	17 45 54.49, -29 08 13.0	EB	16.15	16.60	U	3.9808	2453906.9011	min		Comm. 2	gc800.png	gc800_chart.png	gc800_u_w1_w2.dat
3		2MASS 17461044-2903184	17 46 10.443, -29 03 17.95	EA	16.5	17.1	U	1.9442	2453902.2158	min		Comm. 3	gc570.png	gc570_chart.png	gc570_u_w1_w2.dat

Comments:

1. MinII = 18.2; average color W1-U = 0.992 +/-0.017. The star is too faint to be detected in the W2 band. It is difficult to unambiguously match the star with a 2MASS catalog object. The coordinates were taken from the USNO-B1.0 catalog (Monet et al. 2003).

2. MinII = 16.37; average colors: W2-U = 2.630 +/-0.019, W1-U = 1.151 +/-0.012; 2MASS magnitudes (JD 2451825.4907): J = 9.159 +/-0.024, H = 8.649 +/-0.049, Ks = 8.345 +/-0.029. The coordinates were taken from the USNO-B1.0 catalog (Monet et al. 2003). A soft X-ray source CXOGCS J174554.4-290811 detected by *Chandra* is only 1.2" away from the USNO-B1.0 position, which is within combined position uncertainty of the catalog and *Chandra* observations. Judging from the (2.0-3.3 keV)/(0.5-2.0 keV) = -0.73 (-0.22/+0.35) hardness ratio, the X-ray source is not heavily absorbed and therefore is in the foreground with respect to the Galactic Center (Muno et al. 2006). Thus, the association with the eclipsing binary may be real.

3. MinII = 17.0; average colors: W2-U = 2.795 +/-0.037, W1-U = 1.200 +/-0.021. The object USNO-B1.0 0609-0603208 is actually a blend of two nearby stars. The variable is the brighter southern star. It was not possible to measure the stars separately using UVOT U and W1 images, so the light curves and the variability amplitudes in these two bands refer to the combination of two stars. The northern star is not visible on the W2 images, these images were used to measure the position of the variable with respect to nearby Tycho-2 stars: 17:46:10.443 -29:03:17.95 (+/-0.2", J2000). The variable star may be associated with the 2MASS object 2MASS 17461044-2903184 (J = 12.051 +/-0.037, H = 11.495 +/-0.068, Ks = 11.099 +/-0.048 measured on JD 2451825.4956) which is 0.45" away from the above position.

Remarks:

Three previously unknown eclipsing binaries were detected using archival observations of the Galactic Center region with the Ultraviolet/Optical Telescope (UVOT) onboard the *Swift* satellite. The data were obtained from the High Energy Astrophysics Science Archive Research Center (HEASARC) archive.

The UVOT (Roming et al. 2005) is a D = 300 mm, F = 3810 mm modified Ritchey-Chretien telescope equipped with a micro-channel plate intensified CCD detector operated in photon counting mode. Detectors of this type have no specific saturation limit, but it comes at cost of the nonlinear response to the number of incoming photons because of the dead time after each registered photon event (coincidence loss effect). Six photometric filters are available for the UVOT: W2 (central wavelength = 1928 A, FWHM = 657 A), M2 (2246 A, 498 A), W1 (2600 A, 693 A), U (3465 A, 785 A), B (4392 A, 975 A), and V (5468 A, 769 A). The UVOT responses with the U, B, and V filters represent the Johnson UBV system reasonably well, see Poole et al. (2008) for more details. During its 96 minute orbit, *Swift* switches between different targets. Each target is often observed during a few consecutive revolutions, so a typical *Swift*/UVOT observation consists of a series of sub-exposures (typically from 10 to 1500 seconds long) which are usually averaged during the post-processing to get one one-day average measurement with the best possible SNR and magnitude limit. In this work however, individual sub-exposures were used to preserve time resolution necessary for detection of short-period variability.

The search for variable stars has been conducted with the VaST software (Sokolovsky and Lebedev 2005) using 291 U-band images obtained between 25.10.2005 and 29.10.2008. For the three detected eclipsing binaries, the W1 light curves, and for two of them, W2 light curves were also obtained. Unfortunately, the field was not observed in the B and V bands often enough to obtain reasonable light curves, and all three variable stars are too faint to be measured on the M2 images. No significant color change during eclipses has been detected; however, the photometric precision rapidly degrades from the U band to W2, which can hide a small color change. The instrumental magnitudes determined by the VaST software were converted to the UVOT magnitude scale by comparing the instrumental magnitudes of nearby stars to the magnitudes determined with the *uvotdetect* routine from the *Swift* FTOOLS (heasoft-6.6) using the 20070522 release of the *Swift*/UVOTA CALDB described by Poole et al. (2008).

The finding charts in this paper are made from 5'x5' POSS-I blue images.

References:

Monet, D.G., Levine, S.E., Canzian, B., et al., 2003, Astron. J., 125, 984
Muno, M.P., Bauer, F.E., Bandyopadhyay, R.M., Wang, Q.D., 2006, Astrophys. J. Suppl. Ser., 165, 173
Poole, T.S., Breeveld, A.A., Page, M.J., et al. 2008, MNRAS, 383, 627
Roming, P.W.A., Kennedy, T.E., Mason, K.O., et al., 2005, Space Science Reviews, 120, 95
Sokolovsky K. and Lebedev A. 2005, in 12th Young Scientists' Conference on Astronomy and Space Physics, Kyiv, Ukraine, April 19-23, 2005, eds.: Simon, A.; Golovin, A., p.79 (http://scan.sai.msu.ru/vast/)