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DEEPLY ECLIPSING DWARF NOVA RX J0909.8+1849

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RX J0909.8+1849 (= 1RXS J090950.6+184956) is a cataclysmic variable identified in the course of the Hamburg/RASS identifications of ROSAT sources (Bade et al. 1998). Bade et al. (1998) reported the magnitude of the object as 16.4. The J2000.0 coordinates are $09^{h}09^{m}50\overset{s}{.}56$, $+18^{\circ}49'47\overset{''}{.}2$. After the discovery of an apparent outburst of $V = 12.5$ on GSC (Kato 1998), we started systematic visual and CCD monitoring in order to verify the nature of variability. A total of 40 negative visual observations were obtained between 1998 April 3 and 2000 February 1 (by Kinnunen, Watanabe and Maehara; typical upper limits: 14.0–14.5), until the eventual detection of an outburst by Maehara at visual magnitude 13.0 on 2000 February 10 (Maehara and Kato 2000). The beginning of the outburst dates back to 2000 February 7 (mag 12.9) on CCD images by Schmeer using the 50-cm reflector at the Iowa Robotic Observatory (Schmeer 2000). This outburst was independenly discovered by Gänsicke et al. (2000; the object is referred to as HS 0907+1902). Schmeer (2000) noted an unexpected fading of 1.9 mag on 2000 February 10.303 UT. Upon the notification of the outburst and knowing the unusual temporal fading, we started time-resolved CCD photometry.

The Kyoto observations (Kato and Uemura) were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\rm TM}$-based aperture photometry package developed by on of the authors (Kato). The differential magnitudes of the variable were measured against GSC 1404.1852 (Tycho-2 V-magnitude 11.08), whose constancy was confirmed by comparison with GSC 1404.778 (Tycho-2 V-magnitude 11.12). Soon after the beginning of the observation, we detected a deep eclipse with an amplitude of 1.6 mag (Figure 1), with a total duration of 24 min and a flat-bottomed eclipse profile. The eclipsing nature of the object was independently detected by Vanmunster (2000a) and Gänsicke et al. (2000). The immediately identified orbital

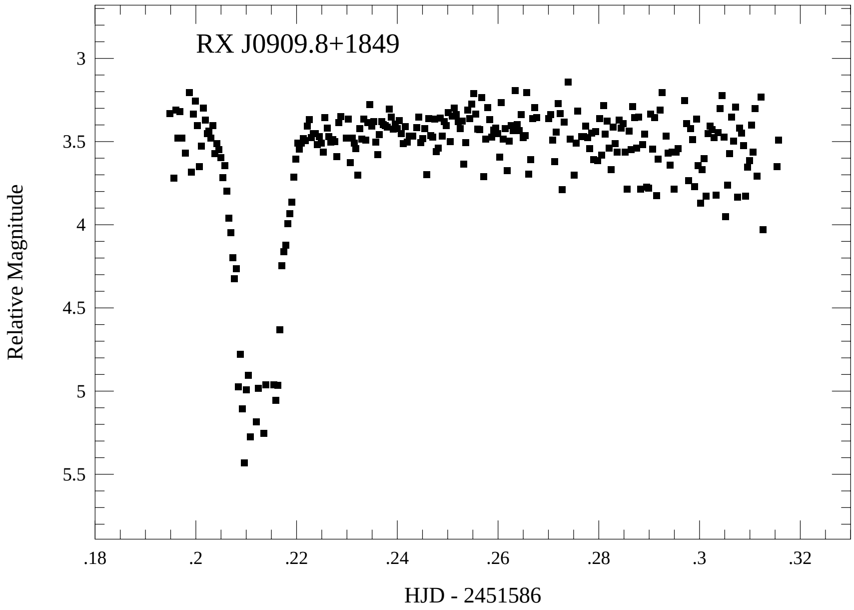

Figure 1. Eclipse of RX J0909.8+1849 (2000 February 11)

period of 0.175 d or 4.2 hours (Vanmunster 2000b; Gänsicke et al. 2000) places RX J0909.8+1849 as a cataclysmic variable above the period gap.

Our subsequent observations revealed clear fading from outburst. Figure 2 represents the outburst light curve constructed from Kyoto observations. Magnitudes are relative to GSC 1404.1852. A total of seven eclipses were caught by us. Together with two eclipse timings reported by Vanmunster (2000c) and seven eclipses reported by Gänsicke et al. (2000), we obtained the following ephemeris.

$$\mathrm{Min(HJD)} = 2451586.21266(10) + 0\overset{\mathrm{d}}{.}1754457(38) \times E, \tag{1}$$

where E refers to the cycle number since our first eclipse observation. Errors in the last digit are given in brackets. Table 1 lists the eclipse timings. This ephemeris clearly explains the temporal fading reported by Schmeer (2000) being caused by a deep eclipse.

The presence of the long-lasting faint state and a short outburst is a clear signature of RX J0909.8+1849 being a dwarf nova. The lack of detectable outbursts in 1998 and 1999 may constrain the outburst frequency. Including the 2000 February outburst, visual observations recording magnitudes brighter than 14.0 comprise 7% of all observations. Taking this value as the rough estimate of the outburst duty cycle, the system may be classified as one of SS Cyg-type dwarf novae with relatively rare outbursts. Since such bright, deeply eclipsing dwarf novae above the period gap are extremely rare (only IP Peg and EX Dra reach magnitudes brighter than 13), the system will provide an excellent opportunity in spatially resolving the accretion disk. Another noteworthy feature of RX J0909.8+1849 is the relatively strong X-ray emission. IP Peg is not recorded in the ROSAT 1RXS catalog; EX Dra is four times fainter than RX J0909.8+1849. This may reflect some sort of magnetic nature of the white dwarf in RX J0909.8+1849, although no coherent photometric modulations suggesting the white dwarf spin were found in our

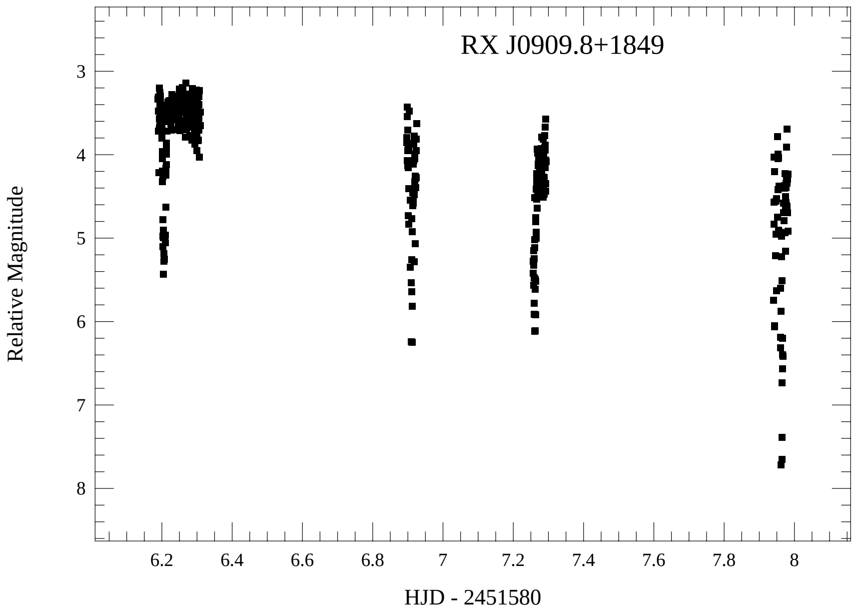

Figure 2. Outburst of RX J0909.8+1849 from Kyoto data. Eclipses getting increasingly deeper are superimposed on the general decline trend.

Table 1: Eclipses of RX J0909.8+1849

Time[a]	E	$O-C$[b]	Observer/source[c]
51581.8263	−25	−0.0002	Gänsicke et al. (2000)
51582.0017	−24	−0.0003	Gänsicke et al. (2000)
51585.6861	−3	−0.0002	Gänsicke et al. (2000)
51586.21253	0	−0.00012	Kato and Uemura
51586.38832	1	0.00023	Vanmunster (2000c)
51586.56370	2	0.00018	Vanmunster (2000c)
51586.91463	4	0.00018	Kato and Uemura
51587.96811	10	0.00099	Kato and Uemura
51588.31800	12	0.00000	Buczynski
51589.8969	21	−0.0001	Gänsicke et al. (2000)
51590.07237	22	−0.00009	Garradd
51590.7742	26	−0.0001	Gänsicke et al. (2000)
51590.9496	27	−0.0001	Gänsicke et al. (2000)
51590.94995	27	0.00026	Garradd
51591.12455	28	−0.00059	Garradd
51599.7219	77	−0.0001	Gänsicke et al. (2000)

[a] HJD − 2400000
[b] against Eq. (1), (d)
[c] Buczynski (33-cm reflector + SXL8 CCD);
Garradd (45-cm reflector + AP-7 CCD)

data. A more detailed analysis of the eclipses during this outburst and the following quiescence will be presented in a separate paper.

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