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Eclipse observations of V838 Her (Nova Her 1991) during nova eruption

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Abstract

I observed the very fast nova V838 Her (Nova Her 1991, optical peak at 5–5.4 mag) during the fading phase of the nova eruption in 1991. I detected eclipses, for the first time in the world in any nova during eruption, and the epochs of the eclipses were reported to IAU Circular No. 5262. Although these epochs have been referenced in the literature, the light curves of these eclipses remained unpublished. Here, I present these light curves. The phase-averaged light curve around 1991 April 21 (mean V=13.1, 27 d after the optical peak) showed an 0.14 mag primary eclipse and an 0.03 mag secondary eclipse. Combined with the subsequent literature, the eclipses likely appeared after 1991 April 14 (V=12.5). It has been suggested that the accretion disk had already been re-established before this epoch and I found no strong argument against this. The early appearance of the secondary minimum appears to be a phenomenon common to very fast novae and it looks likely to be explained, at least partly, by a strongly heated secondary. This observation reinforces the possible interpretation of the early presence of a transient luminous donor for the fastest nova V1674 Her (Nova Her 2021). As a comparison and my motivation of the observation of V838 Her, I briefly review the early history of V1500 Cyg (Nova Cyg 1975).

V838 Her (Nova Her 1991) was discovered by Matsuo Sugano on 1991 March 24.781 (JD 2448340.281) at a photovisual magnitude of 5.4 and by George Alcock on 1991 March 25.19 (JD 2448340.69) at a visual magnitude of 5 (Sugano et al. 1991). Although this was a naked-eye nova at its peak, very few people saw the nova when it was visible to the naked eyes or with small binoculars. Due to the rainy or cloudy weather in Japan following the Sugano's discovery, the first visual observation reported to the VSOLJ database[1] from Japan was 10.2 mag on 1991 April 1 by Hiroaki Narumi. Infrared photometry and spectroscopy, and optical spectroscopy confirming a very rapidly expanding nova were reported in Harrison et al. (1991). At that time, this nova showed Fe II emission lines. Wagner et al. (1991) obtained optical spectra and also detected He I, N II and other lines. Wagner et al. (1991) noted that the spectrum was strikingly similar to that of Nova V1500 Cyg (fastest classical nova known at that time and later shown as a nova eruption from a polar) obtained on 1975 September 6–7 and suggested that the nova eruption in V838 Her occurred on a strongly magnetized white dwarf.

V1500 Cyg is a famous naked-eye nova which erupted in 1975. Upon knowing this nova in a television news program, I immediately got out to find a bright nova changing the shape of the constellation. The object was even suspected to be a supernova from a large amplitude of more than 18 mag (see e.g., Lindegren and Lindgren 1975). No nova of comparable apparent brightness has been recorded since V1500 Cyg. P. Tempesti reported periodic variations with a period of 3.2 hr already when the nova declined to V=6 ($\sim$4 mag below the optical peak; report in Kozai et al. 1975) and confirmed it again at V=6.5 (report in Gieren et al. 1975). R. Koch and C. Ambruster also detected the same short-period variations (reports in de Vegt et al. 1975; Harevich et al. 1975). Semeniuk (1975) determined the period to be 0.1410 d (=3.38 hr). The period was then observed to decrease to a mean value of 0.1384 d (Tempesti 1976; Semeniuk et al. 1976; Young et al. 1977). Chia et al. (1977) remarked a resemblance to TT Ari and considered the hot spot illuminating an overlying shell or shells. Patterson (1978) reported an increase of this period in 1977. Although Patterson (1978) stated that the period

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[1] <http://vsolj.cetus-net.org/database.html>.

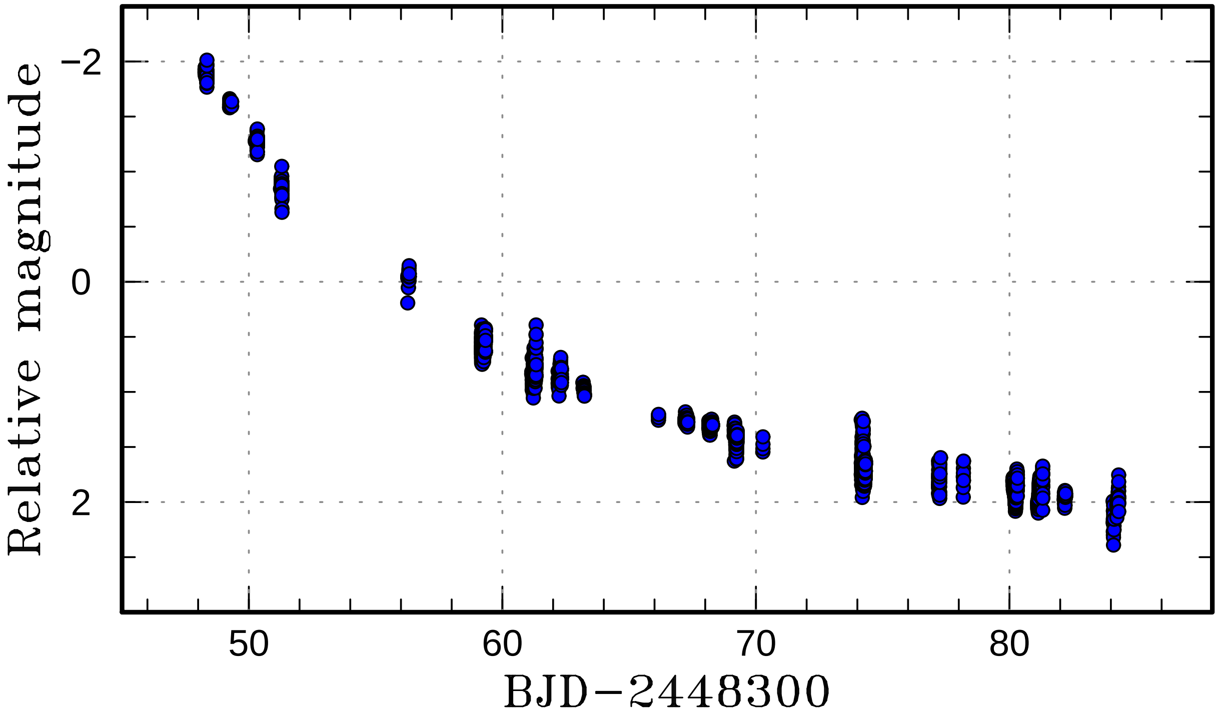

Figure 1: Light curve of V838 Her in 1991 April–May. Magnitudes are given relative to the comparison star.

and phase variations have a common origin in the central object, which powers the expanding nebula, the origin of the variations remained unknown [see also Kleine and Kohoutek (1979)]. Although Patterson (1979) [and later by Kaluzny and Semeniuk (1987)] reported the refined period, the mechanism of the variations was not yet clarified. In the meantime, Campbell (1976) recorded profile variations on a time scale of hours of the Hα emission during the early decline phase and suggested a model considering the light-travel-time effects. Hutchings and McCall (1977) proposed a searchlight illumination-type model and was refined further in Hutchings et al. (1978). Hutchings (1979) pointed out the similarity of the light amplitude, phasing, velocity amplitude and phasing and the phasing of emission-line strengths to the polar AM Her, although intrinsic linear polarization had not yet been detected (Kemp and Rudy 1976; McLean 1976; Kemp et al. 1977; these observations were apparently aimed to detect a signature of non-spherical expansion and were apparently not related to the possibility of a polar). Stockman et al. (1988) finally detected circular polarization and optical cyclotron emission, confirming the strongly magnetized nature of the white dwarf. Stockman et al. (1988) suspected that coupling between the white dwarf and the expanded envelope and the interaction of the orbiting secondary star were responsible for the asynchronism and photometric variations.

This story of V1500 Cyg from 1975 to 1988 was still fresh in my mind in 1991, and the suggestion of a nova on a strongly magnetized white dwarf by Wagner et al. (1991) strongly attracted my attention. I was a master course student of astronomy then, and immediately wrote a proposal to use the 60-cm telescope at Ouda Station, Kyoto University (Ohtani et al. 1992).[2] The time-allocating committee of Ouda Station was, however, skeptical whether I could obtain any scientifically meaningful result by time-resolved photometry of a nova in eruption. This was understandable — the V1500 Cyg case required more than 10 years to understand even by top experts of thie field, and this showed how unpredictable to detect periodic variations from a nova in eruption. I was, however, allocated some telescope time sharing with another student. As people who have visited or lived in Japan in this season (April–May) would know well, the weather is dominated by frequently passing fronts, and rain. It is usually very difficult to encounter "photometric" nights in this season, particularly for a visiting astronomer staying for observation only for a short time. These fronts and rain, however, bring migratory birds from the south, and the epoch of my observations incidentally matched the best season for meeting arriving summer migrants. Even if the night was ruined by clouds, the chorus of birds at dawn was not what I had heard

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[2] This "historical" telescope was translocated to the Museum of Astronomical Telescopes was established in Sanuki, Kagawa, Japan (<https://www.telescope-museum.com/telescope/>).

in urban life, and this experience was sufficient to bring me fascination to the world of birds (e.g., Kato 2022). Even without detailed knowledge about birdsong, I could immediately recognize the very characteristic song of Japanese Paradise Flycatcher (*Terpsiphone atrocaudata*)[3] — what a surprise!

Let's move to astronomical observations. Instead of detecting V1500 Cyg-like variations, I unexpectedly discovered eclipses (report in Dopita et al. 1991). These observations were probably one of the first time-resolved CCD photometry of novae in eruption (Kato et al. 2004).[4] The data were obtained using a CCD camera (Thomson TH 7882, 576 × 384 pixels, on-chip 2 × 2 binning adopted) attached to the Cassegrain focus of the 60-cm Ritchey-Chrétien telescope at Ouda Station, Kyoto University. I mainly used V band for time-resolved photometry. I also obtained some I-band data and initially narrow and wide band interference filters (if I correctly remember, they were for Hβ and Ca lines to study the line strengths) used by another student with whom I shared some nights. The frames were analyzed using a custom C code running on NEC PC9801 personal computers. The details of the observations, however, were lost or relocated to a place difficult to find after more than 30 years. The only relatively easily accessible data were V-band measurements posted to the VSOLJ database and differential magnitudes stored in my computer. At that time, the images were stored in magneto-optical disks, which were expensive for us to keep all the images. Some images should be still present, but I'm not aware where the media are placed and are these media should be difficult to access even if they are still present. For this reason, I only use V-band measurements posted to the VSOLJ database and differential magnitudes stored in my computer. The data in the VSOLJ database were converted to real (not differential) magnitudes, and the difference from the differential magnitudes indicates that I used GSC 1034.3147 (Gaia DR3 4504548475874019840, Gaia BP=12.46 and RP=10.98: Gaia Collaboration et al. 2022) as the comparison star with a magnitude of V=11.80, as judged from the field of view of the CCD. I performed aperture photometry, and a star close to V838 Her (Gaia DR3 4504548029197366272, Gaia BP=14.74 and RP=13.81: Gaia Collaboration et al. 2022) contaminated the results. In this paper, I use differential magnitudes. As already stated, the weather in April–May was very variable and there were many observations affected by clouds. Outlier data (usually more than 0.1-mag different from the rest) have been removed (one can refer to the original data in the VSOLJ database). This manual removal was unavoidable since the data were often affected by passages of clouds (different parts of the images were differently affected), rather than photon noise-limited. The data used here are summarized in table 1. The magnitudes are given relative to the comparison.

I show the overall V-band light curve in 1991 April–May in figure 1. Although I observed this object in later seasons and detected eclipses, they are not included since the nova faded below the nearby star and the spatial resolutions of the images were rather insufficient for reliable PSF photometry.

I used the same ephemeris as in Ingram et al. (1992)

$$\mathrm{Min(BJD)} = 2448369.227(1) + 0.297635(6)E \tag{1}$$

The most important part of the observations showing the appearance of eclipses is given in figure 2. Before the initial epoch shown in this figure, there was no hint of orbital modulations. Although Leibowitz et al. (1992) suggested the presence of an eclipse already on 1991 April 13 (BJD 2448360.59, at +20 d after the optical peak at 2448340.5), our data on BJD 2448361.3 (+20.8 d) seems to exclude an eclipse with a depth reported in Leibowitz et al. (1992). Considering that Leibowitz et al. (1992) recorded only the expected ingress phase of an eclipse and not the egress part, it looks premature to conclude the presence of an eclipse before 1991 April 14 (object at V=12.5). A safe conclusion is that eclipses started to appear sometime between 1991 April 14 (BJD 2448361) and April 22 (BJD 2448369). A phase-averaged light curve of the combined three consecutive nights (BJD 2448367.1–2448369.3, +26.6–28.8 d) is shown in figure 3. On these nights, the object was around V = 13.1, 8 mag below the optical peak and 7 mag above the quiescence. As judged from this orbital profile, a secondary minimum appears to have already present in addition to the primary eclipse. Eclipses were probably present on

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[3] The reason why I was already familiar with this bird was that it had been introduced as an "astronomy fan among birds". Its Japanese name is "sankōchō", which can be literally translated to "three-light bird". The three lights here are the Moon ("tsuki" in Japanese), the Sun ("hi" in one of expressions in Japanese) and stars ("hoshi"). The bird sings "tski-hi-hoshi hoi-hoi-hoi" (Brazil 2009). I had learned this literal expression of the birdsong in a popular astronomy magazine. This species is a summer migrant to Japan and the exceptionally long tails of male birds not only attract female birds (the long tail is therefore a target of sexual selection) but also birdwatchers. This species once became rare in the 1990s (around my observations at Ouda Station), together with other summer migrants. Deforestation in the wintering grounds and big Asian Forest Fires in 1997–1998 (<http://datazone.birdlife.org/sowb/casestudy/in-indonesia-human-initiated-fires-are-responsible-for-massive-losses-of-rainforest->) were suspected to be some of the causes. The population has apparently increased (<https://www.yamashina.or.jp/hp/yomimono/hanshokubunpu_chosa_report.html>, <https://www.bird-atlas.jp/news/j_bird_atlas_2016-21.pdf>) and we can now sometimes hear the voice in the suburbs of Kyoto.

[4] See also the statement by Schaefer (2022) in relation to the eruption of U Sco in 2010.

Table 1: Log of observations of V838 Her.

Start*	End*	Mean mag.	Error	$N^\dagger$	Filter
48348.2738	48348.3463	-1.898	0.001	335	V
48349.2406	48349.3230	-1.616	0.009	10	V
48350.2527	48350.3388	-1.277	0.005	62	V
48351.2477	48351.3061	-0.871	0.011	51	V
48356.2649	48356.3283	-0.034	0.021	17	V
48359.1710	48359.3312	0.565	0.003	364	V
48361.1548	48361.3298	0.823	0.005	245	V
48362.1956	48362.3276	0.837	0.008	75	V
48363.1765	48363.2359	0.979	0.007	30	V
48366.1520	48366.1589	1.225	0.011	5	V
48367.1983	48367.3114	1.261	0.002	135	V
48368.1389	48368.2852	1.310	0.002	174	V
48369.1359	48369.2578	1.420	0.007	147	V
48370.2725	48370.2751	1.487	0.033	4	V
48374.1498	48374.3175	1.677	0.009	188	V
48377.1975	48377.2804	1.800	0.015	40	V
48378.1737	48378.1872	1.767	0.043	8	V
48380.1298	48380.3117	1.902	0.005	212	V
48381.1031	48381.3096	1.906	0.005	257	V
48382.1542	48382.2104	1.953	0.004	64	V
48384.0819	48384.3069	2.038	0.010	108	V

*BJD−2400000.

†Number of observations.

April 20 (BJD 2448367). There was no suggestion of a secondary eclipse on April 14.

Leibowitz et al. (1992) reported the presence of an accretion disk three weeks after the nova eruption. I here examine whether the light curve can be expressed by an eclipse of an accretion disk. In modeling the eclipse light curve, I used an orbital inclination (i) of 78–90° (Szkody and Ingram 1994). The estimate of the primary (white dwarf) mass by Szkody and Ingram (1994) was too small for a very fast nova, and I used 1.35 $M_\odot$ from Kato et al. (2009) instead. The secondary mass was assumed to be 0.86 $M_\odot$ considering that the secondary is an unevolved main-sequence star and was extrapolated from the table in Knigge (2006, 2007). This value is not very different from the one (0.73–0.75 $M_\odot$) in Szkody and Ingram (1994). The duration of the observed eclipse (0.2 orbital phase) could be reproduced for i=78–90° assuming a flat, standard accretion disk (yes, this is an awfully rough approximation) with a size limited by tidal truncation. The eclipse depth was 3.6 mag for i=90° and 2.0 mag for i=78°. The observed depth (figure 3) of 0.14 mag. roughly suggests the fractional contribution from the disk to be 0.04 (i=90°) to 0.07 (i=78°). Considering that the object was V = 13.1 around these observations, the apparent brightness of the disk can be estimated to be V=16.6 (i=90°) and V=16.0 (i=78°). Using the distance modulus of 12.2(4) mag and $E(B-V)$=0.53(5) by Kato et al. (2009), converted to A_V=1.6(2), the brightness of the disk corresponds to M_V=+2.8(4) (i=90°) and +2.2(4) (i=78°). These values are ∼2 mag brighter than novalike systems observed by Gaia (Abril et al. 2020). The difference becomes even larger if the geometrical effect of the high orbital inclination of this system is taken into account. These observed values, however, would be explained by a strongly irradiated disk. I used a geometrically thin disk for modeling, which is probably not a very good approximation of the real disk, if present, and these values and discussions would better be regarded as a rough approximation.

The secondary appears on day +9 according in the model by Kato et al. (2009). The presence of eclipses 18 d after the appearance of the secondary appears to be consistent. Leibowitz et al. (1992) gave an upper limit of ∼0.05 mag for the secondary eclipse. The present data, however, suggest a detectable secondary eclipse with a duration comparable to the primary eclipse (figure 3). The depth was ∼0.03 mag.

Let's compare with modern observations of the eclipsing, fast recurrent nova U Sco. During its 2010 eruption, Worters et al. (2010) suggested that an accretion disk had already been re-established 7 d after the optical peak

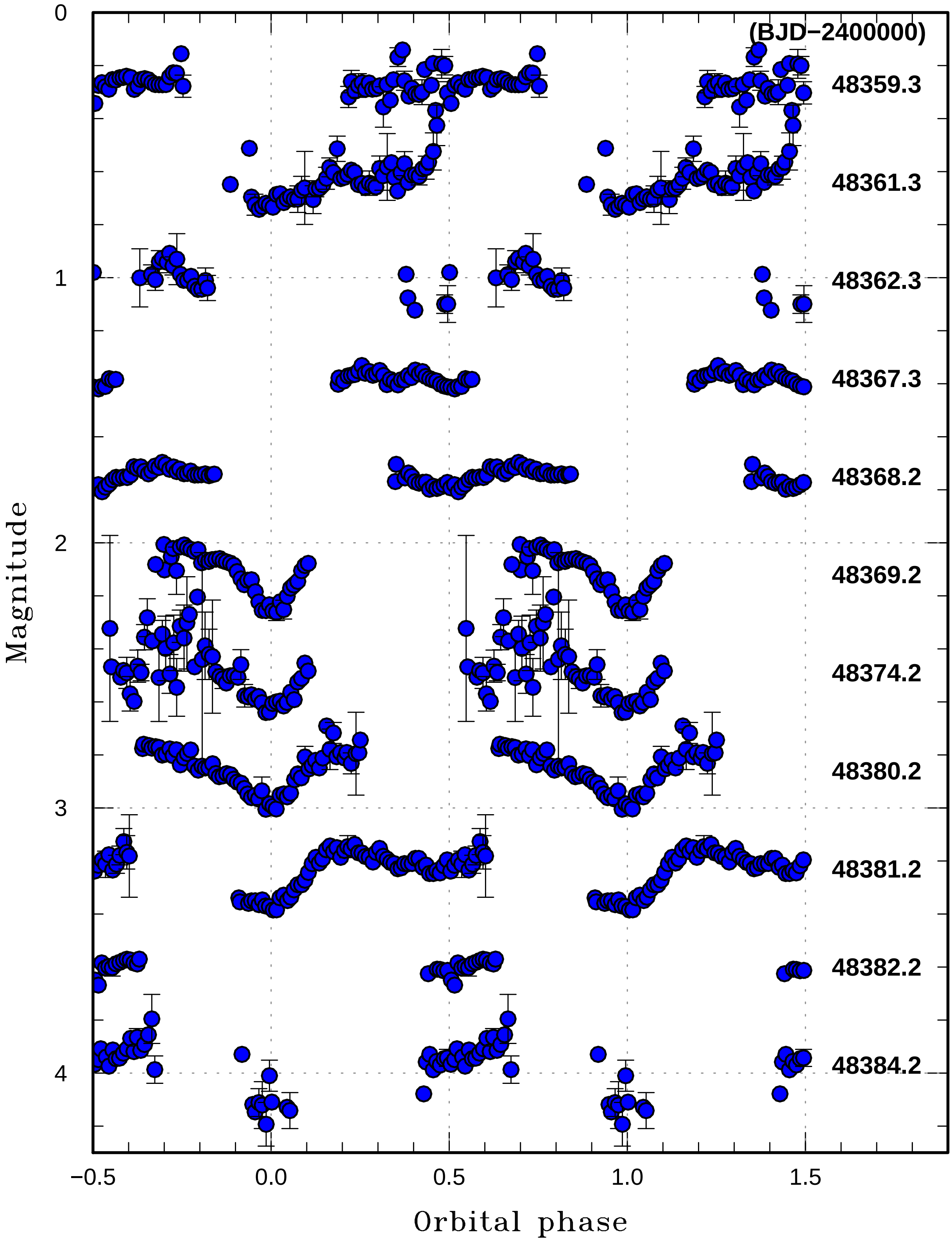

Figure 2: Variation of the orbital profiles of V838 Her. The data were binned to 0.01 phase.

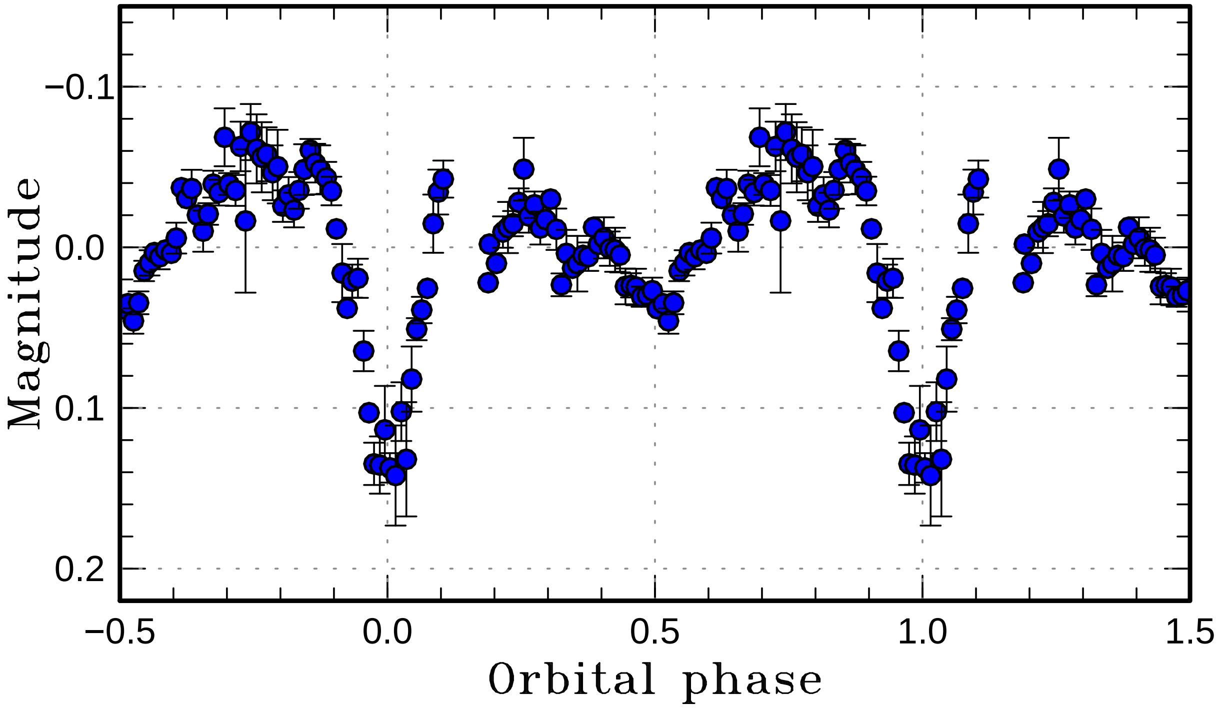

Figure 3: Phase-averaged light curve of V838 Her on the initial three nights (1991 April 20–22) when eclipses appeared. The data were binned to 0.01 phase.

based on appearance of flickering. U Sco was around V=12.5 then, which was ∼100 times brighter than the object in quiescence. The observed amplitude of 0.2 mag was too large (∼20 times of the quiescent luminosity) to be considered as genuine flickering, which is produced by the variable release of the gravitational potential at the hot spot. Munari et al. (2010) casted doubts on the interpretation by Worters et al. (2010) due the absence of such variations at 15.7 d after the optical peak. Schaefer et al. (2011) interpreted such variations in the early phase of decline as flares (of unknown nature). Schaefer et al. (2011) suggested from eclipse mapping that the light source at the primary was spherically symmetric 15–26 d after the optical peak and that it was a rim-bright disk 26–41 d after the peak. Although re-establishment of the accretion disk 7 d after the optical peak would have been too early in U Sco, I can make a comparison whether the disk could be re-established in V838 Her at +27 d. Drake and Orlando (2010) considered the case of U Sco and a mass-transfer rate of 10^{-8} to 10^{-6} $M_\odot$ yr^{-1} was sufficient to build up a disk in 7 d, if the dynamic pressure of the radiatively-driven outflow from the evolving central object could be overcome. One should also note that the pre-eruption surface densities of the disk (and, consequently, the disk mass) are not absolutely required when the disk is re-established. Before the eruption, the disk should have been in a hot, ionized state due to viscous heating, which requires high surface densities. After the nova eruption when the white dwarf is sufficiently hot, the disk can be maintained in hot, ionized state due to radiation even if the surface density is low and a lower-mass disk is expected to explain the observation. The pre-eruption mass-transfer rate of V838 Her is expected to be comparable to that of a novalike star: 10^{-8} $M_\odot$ yr^{-1} or larger (Knigge et al. 2011). Irradiation by the primary would probably increase the mass-transfer rate and the condition given by Drake and Orlando (2010) appears to have easily been achieved, if only the dynamic pressure of the radiatively-driven outflow from the evolving central object could be overcome. I therefore could not find a strong argument against the presence of an accretion disk in V838 Her at +27 d.

The presence of black body emission at ∼20000 K was reported in infrared observations of U Sco (Evans et al. 2023), This component was attributed to the irradiated secondary or a combination with free-free emissions from the nebula. In the case of V838 Her, the secondary filling the Roche lobe and having a temperature of 20000 K corresponds to M_V=+4.7 (compare with M_V=+7.1 for a non-irradiated secondary: Kato et al. 2009). The secondary with this temperature comprises 0.7% of the luminosity of the nova at V=13.1. Although this contribution (0.007 mag) is much lower than the depth (0.03 mag) of the secondary minimum I recorded, the contribution of the secondary may become an observable one assuming an even higher temperature (0.02 mag for a full eclipse of a 40000 K object). Considering the observational uncertainty, the secondary eclipse suggested by my observations could have been a real feature arising from the eclipse of the secondary. The fastest known classical nova, but non-eclipsing, V1674 Her showed orbital variations starting from +5 d, 4 mag below the optical peak, often accompanied by secondary minima (Patterson et al. 2022), in which a transient luminous donor (=irradiated secondary, as in I my suggestion for V838 Her) was given as a hypothesis.

Supplementary Data

The *V*-band differential data used in this analysis is given as a plain text v.bjd.

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List of objects in this paper

V1500 Cyg, AM Her, V838 Her, V1674 Her, Nova Her 1991, U Sco, Gaia DR3 4504548029197366272,
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References

Abril, J., Schmidtobreick, L., Ederoclite, A., & López-Sanjuan, C. (2020) Disentangling cataclysmic variables in Gaia's HR diagram. *MNRAS* **492**, L40

Brazil, M. (2009) Birds of East Asia (Princeton: Princeton University Press)

Campbell, B. (1976) Hα variations in Nova Cygni 1975. *ApJ* **207**, L41

Chia, T. T., Milone, E. F., & Robb, R. (1977) A few observations of and remarks on V1500 Cygni. *Ap&SS* **48**, 3

de Vegt, C. et al. (1975) Nova Cygni 1975. *IAU Circ.* **2837**, 2

Dopita, M., Ryder, S., Vassiliadis, E., Kato, T., & Hirata, R. (1991) Nova Herculis 1991. *IAU Circ.* **5262**, 1

Drake, J. J., & Orlando, S. (2010) The early blast wave of the 2010 explosion of U Scorpii. *ApJ* **720**, L195

Evans, A., Banerjee, D. P. K., Woodward, C. E., R., T., Geballe, Gehrz, R. D., Page, K. L., & Starrfield, S. (2023) Infrared spectroscopy of the 2022 eruption of the recurrent nova U Sco. *MNRAS* **in press (arXiv/2304.13508)**

Gaia Collaboration et al. (2022) Gaia Data Release 3. Summary of the contents and survey properties. *A&A* **(arXiv:2208.00211)**

Gieren, W. et al. (1975) Nova Cygni 1975. *IAU Circ.* **2842**, 1

Harevich, V. et al. (1975) Nova Cygni 1975. *IAU Circ.* **2839**, 1

Harrison, T. E. et al. (1991) Nova Herculis 1991. *IAU Circ.* **5223**, 1

Hutchings, J. B. (1979) Spectroscopic studies of V1500 (Nova) Cygni. III – the nebula and central binary system. *ApJ* **230**, 162

Hutchings, J. B., Bernard, J. E., & Margetish, L. (1978) Spectroscopic studies of Nova V1500 Cygni. II — Models for the 3 hour profile modulations. *ApJ* **224**, 899

Hutchings, J. B., & McCall, M. L. (1977) Spectroscopic studies of Nova V1500 Cygni. I — The 3 hour periodicity and the nebula. *ApJ* **217**, 775

Ingram, D., Garnavich, P., Green, P., & Szkody, P. (1992) Photometry and spectroscopy of Nova Herculis 1991. *PASP* **104**, 402

Kaluzny, J., & Semeniuk, I. (1987) Photometry of Nova V1500 Cygni eleven years after outburst. *Acta Astron.* **37**, 349

Kato, M., Hachisu, I., & Cassatella, A. (2009) A universal decline law of classical novae. IV. V838 Her (1991): A very massive white dwarf. *ApJ* **704**, 1676

Kato, T. (2022) Evolution of short-period cataclysmic variables: implications from eclipse modeling and stage a superhump method (with New Year's gift). *VSOLJ Variable Star Bull.* **89**, (arXiv:2201.02945)

Kato, T., Uemura, M., Ishioka, R., Nogami, D., Kunjaya, C., Baba, H., & Yamaoka, H. (2004) Variable Star Network: World center for transient object astronomy and variable stars. *PASJ* **56**, S1

Kemp, J. C., & Rudy, R. J. (1976) Nova Cygni 1975: narrow-band polarimetry and photometry 0.36–1.7 microns. *ApJ* **203**, L131

Kemp, J. C., Sykes, M. V., & Rudy, R. J. (1977) Nova Cyg 1975: minute time-scale flickering and a possible 6.6 hour light period. *ApJ* **211**, L71

Kleine, T., & Kohoutek, L. (1979) On the 3 hour variation of Nova Cygni 1975. *A&A* **76**, 133

Knigge, C. (2006) The donor stars of cataclysmic variables. *MNRAS* **373**, 484

Knigge, C. (2007) Erratum: The donor stars of cataclysmic variables. *MNRAS* **382**, 1982

Knigge, C., Baraffe, I., & Patterson, J. (2011) The evolution of cataclysmic variables as revealed by their donor stars. *ApJS* **194**, 28

Kozai, Y. et al. (1975) Nova Cygni 1975. *IAU Circ.* **2834**, 1

Leibowitz, E. M., Mendelson, H., Mashal, E., Prialnik, D., & Seitter, W. C. (1992) The presence of an accretion disk in the eclipsing binary system Nova Herculis 1991 three weeks after outburst. *ApJ* **385**, L49

Lindegren, L., & Lindgren, H. (1975) Nova in Cygnus of record brightness. *Nature* **258**, 501

McLean, I. S. (1976) Optical polarimetry and distance estimate for Nova Cyg 1975. *MNRAS* **176**, 73

Munari, U., Dallaporta, S., & Castellani, F. (2010) BVR_CI_C photometric evolution and flickering during the 2010 outburst of the recurrent nova U Scorpii. *IBVS* **5930**, 1

Ohtani, H. et al. (1992) The 60 cm Ritchey-Chrétien telescope and its instruments. *Mem. Faculty of Sciences, Kyoto Univ., Series A of Physics, Astrophysics, Geophysics and Chemistry* **38**, 167

Patterson, J. (1978) The strange case of the 3 hour variation of Nova Cygni 1975. *ApJ* **225**, 954

Patterson, J. (1979) The stabilization of the 3 hour period of Nova Cygni 1975. *ApJ* **231**, 789

Patterson, J. et al. (2022) The periodic signals of Nova V1674 Herculis (2021). *ApJ* **940**, L56

Schaefer, B. E. (2022) The recurrent nova U Scorpii from the 2010.1 to 2022.4 eruptions; the missed eruption of 2016.78±0.10 and the critical complex period changes. *MNRAS* **516**, 4497

Schaefer, B. E. et al. (2011) Eclipses during the 2010 eruption of the recurrent nova U Scorpii. *ApJ* **742**, 113

Semeniuk, I. (1975) Short period variability of Nova Cygni 1975. *IBVS* **1058**, 1

Semeniuk, I., Kruszewski, A., & Schwarzenberg-Czerny, A. (1976) Changes in period of short term variability of Nova V1500 Cygni. *IBVS* **1157**, 1

Stockman, H. S., Schmidt, G. D., & Lamb, D. Q. (1988) V1500 Cygni – Discovery of a magnetic nova. *ApJ* **332**, 282

Sugano, M., Kosai, H., Alcock, G. E. D., Hurst, G. M., McNaught, R. H., Harrison, T., & Buczynski, D. (1991) Nova Herculis 1991. *IAU Circ.* **5222**, 1

Szkody, P., & Ingram, D. (1994) The masses of V838 Herculis (Nova Herculis 1991) and QZ Aurigae. *ApJ* **420**, 830

Tempesti, P. (1976) On the short period light variation of Nova Cygni 1975 (V1500 Cyg). *IBVS* **1098**, 1

Wagner, R. M., Bertram, R., Ali, B., & Starrfield, S. G. (1991) Nova Herculis 1991. *IAU Circ.* **5227**, 2

Worters, H. L., Eyres, S. P. S., Rushton, M. T., & Schaefer, B. (2010) U Scorpii. *IAU Circ.* **9114**, 1

Young, P. J., Robinson, E. L., Africano, J., Ferland, G. J., & Woodman, J. (1977) Periodicities and rapid variability in Nova Cygni 1975. *PASP* **89**, 37

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