

THE ECLIPSING CATAclysmic VARIABLE NSV 12615 (V4041 SGR)

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RESUMEN. Se presentan observaciones fotométricas y espectroscópicas de NSV 12615 (V4041 Sgr). Se argumenta que este objeto probablemente es una variable cataclísmica magnética.

ABSTRACT. Photometric and spectroscopic observations of NSV 12615 (V4041 Sgr) are presented. It is argued that this object is probably a magnetic cataclysmic variable.

Key words: PHOTOMETRY — SPECTROSCOPY — STARS-ACCRETION — STARS-CATAclysmic VARIABLES

1. INTRODUCTION

NSV 12615 (V4041 Sgr) is an ultra-short period (88.5 min) eclipsing cataclysmic variable (Jablonski and Steiner, 1987). A spectroscopic study by Mukai, Corbet and Smale (1988) provided measurements of its orbital motion and showed a double-peaked profile in the H α line, characteristic of highly inclined emitting accretion disks. A photometric study, based on 25 eclipses covering about 4 years of observations (Baptista, Jablonski and Steiner, 1989 - BJS), indicates the existence of a high accretion rate in this system, relative to that found in ultra-short period dwarf-novae. The authors proposed two different scenarios suggesting that it could be a consequence of a high-viscosity disk or a mass transfer rate slightly above the critical value for eruptions to proceed. We performed new photometric and spectroscopic observations aiming to increase our knowledge about this object and to check the validity of the proposed scenarios.

2. ECLIPSE TIMINGS

Figure 1 shows the O-C diagram for the timings of minimum light obtained from a set of 31 eclipses covering the seasons 1985-1989, with respect to the linear ephemeris of BJS. A parabolic fit to these data gives the following ephemeris,

$$T_{\min} = \text{HJD } 2446261.671389(\pm 8) + 0.061429642(\pm 3) E + 5.8(\pm 1.0) \cdot 10^{-13} E^2$$

A F-test applied to this ephemeris shows that the quadratic term is significant at 93% probability level. In NSV 12615 the orbital period is increasing with a time-scale of

$$P/\dot{P} = 9 \cdot 10^6 \text{ years.}$$

This behavior is similar to the one seen in Z Cha (Wood *et al.*, 1986).

3. IMAGE OF THE ACCRETION DISK

We used the parameters obtained by BJS to generate an eclipse geometry matrix. We applied the Eclipse Mapping Method to obtain images of the accretion disk in NSV 12615 from its eclipse profiles (Baptista and Steiner, 1989). Figure 2 shows the reconstructed image from the average light curve. The radial temperature distribution obtained from this image is very close to the expected from the standard accretion disk model ($T \propto r^{-3/4}$), resembling those found in outburst observations of eclipsing dwarf-novae (Baptista, 1989; Horne and Cook,

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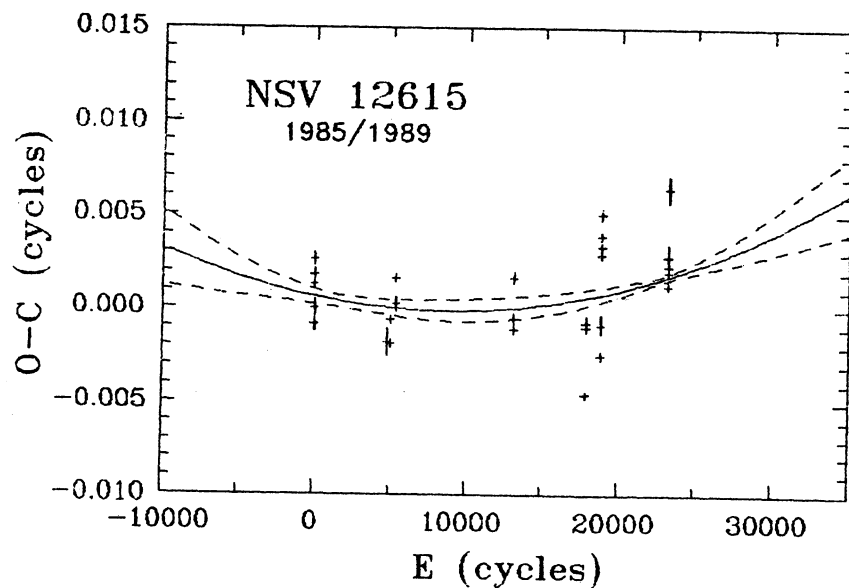


Fig. 1. The O-C diagram for NSV 12615. The full line corresponds to the best fit parabola. The dotted lines correspond to the uncertainty, at the 3σ level, associated to the fit, considering the covariances. The vertical bars are the uncertainties in the minimum time associated to each eclipse.

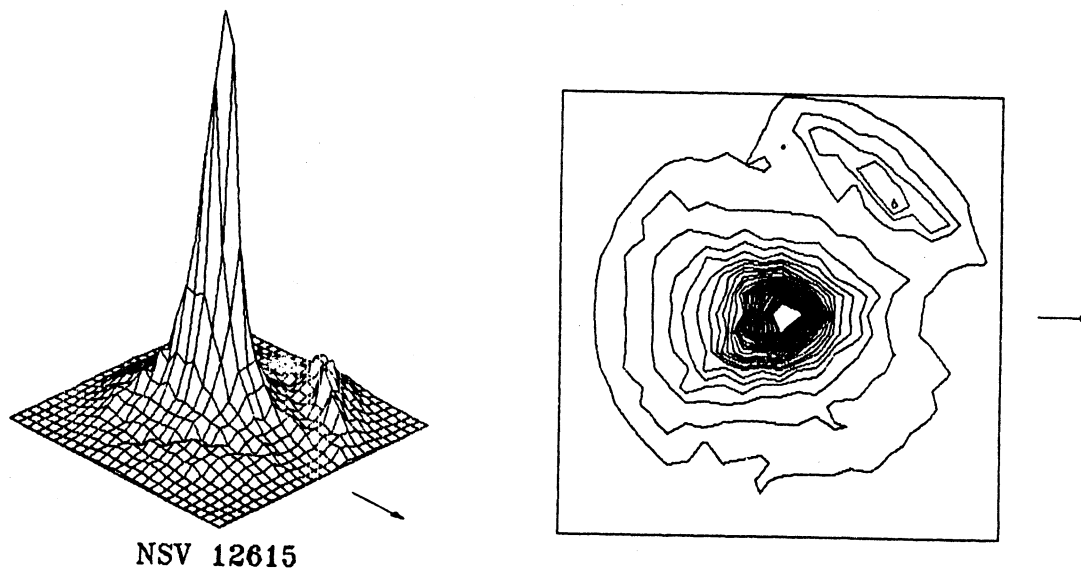


Fig. 2. Image of the accretion disk in NSV 12615. The squared matrix has sides equal to the distance from the primary star to the internal lagrangian point. The arrows indicate the direction of the secondary star.

1985). This is consistent with the presence of a high accretion rate, as suggested by BJS, and emphasizes the differences between this system and other ultra-short period cataclysmic variables like Z Cha, in which the hot spot is comparable to the disk in brightness. BJS suggested that this may indicate magnetic viscosity in the disk. In such a case, one might expect strong He II emission lines.

• SPECTROSCOPIC OBSERVATIONS

To verify the hypothesis of He II emission in NSV 12615, we took optical spectra in the blue. The spectra were taken with the 2D-Fruitti detector on the 4 meter telescope at the Cerro Tololo Interamerican Observatory. Figure 3 shows the co-added spectrum, displaying strong Balmer emission lines as well as strong He II 4686. A simple inspection of the spectrum also suggests the presence of other high excitation emission lines like C III, N II, N III and IV.

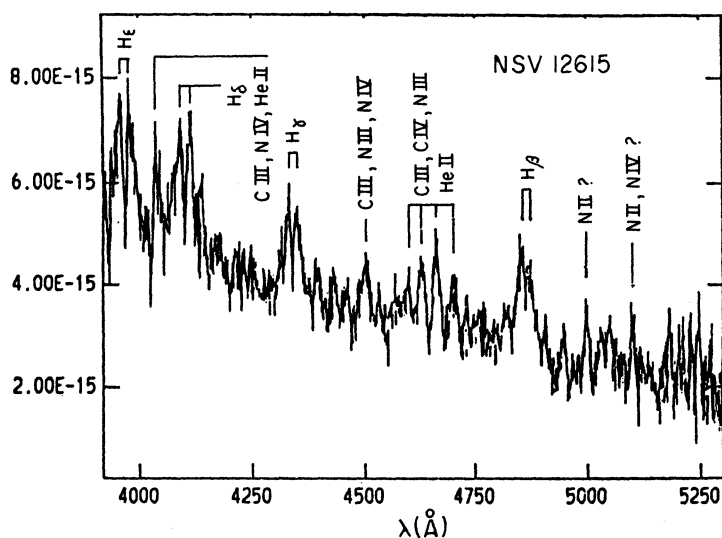


Fig. 3. The co-added blue spectrum of NSV12615. The Balmer lines are broad and double peaked. The strongest lines are identified.

5. CONCLUSION

The confirmation of the presence of high excitation emission lines in the spectrum of NSV 12615, strengthens the hypothesis that this is a magnetized cataclysmic variable. As the reconstructed image clearly displays a disk as well as a hot spot, this object is not a solar. We argue, therefore, that it may be an intermediate polar, with strong similarities to EX Hya.

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