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THE SEARCH FOR SW SEXTANTIS STARS

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RESUMEN

De las 48 tipo novas que pueblan el intervalo de periodos orbitales comprendido entre 2.8 y 4 h, 13 son sistemas SW Sex eclipsantes. De hecho, éstas son todas las variables cataclísmicas (VCs) eclipsantes conocidas en dicho intervalo. Esto pone claramente de manifiesto que los sistemas SW Sex son numerosos y que, muy probablemente, representan una fase importante de la evolución de las VCs, ya que se encuentran apiñados justo por encima de la brecha de período y muestran unos ritmos de transferencia de masa extremadamente grandes. Como las propiedades físicas de los sistemas no dependen de su inclinación orbital, se puede formular la hipótesis de que todas las VCs no magnéticas o débilmente magnéticas sean físicamente similares a los sistemas SW Sex ya conocidos. Presentamos aquí nuestro proyecto de búsqueda de sistemas SW Sex no eclipsantes, que se basa en observaciones espectroscópicas con resolución temporal de todas las novas clásicas y tipo novas suficientemente brillantes en el rango de 2.8 a 4 h, con el fin de detectar el comportamiento típico de los sistemas SW Sex. El objetivo final es cuantificar el impacto del fenómeno SW Sex en la frontera superior de la brecha de período.

ABSTRACT

13 out of 48 nova-likes in the 2.8–4 h orbital period range are eclipsing SW Sex stars - these are all the eclipsing cataclysmic variables (CVs) in this range. Apparently, SW Sex stars are very frequent and probably represent an important stage in CV evolution, as they densely gather just above the period gap and exhibit extremely high mass transfer rates. As the physical properties of SW Sex stars have nothing to do with their inclination, this suggests that all non- or weakly-magnetic CVs in the 2.8–4 h period range are physically similar to the SW Sex stars. Here, we present our project on the search for non-eclipsing SW Sex type stars. We perform time-resolved optical spectroscopy of all sufficiently bright old novae and nova-like CVs in the orbital period range between 2.8 and 4 h and search for characteristic SW Sex behaviour. Eventually we want to quantify the impact of the SW Sex phenomenon at the upper boundary of the orbital period gap.

Key Words: stars: variables: other

1. INTRODUCTION

Cataclysmic Variables (CVs) are close interacting binary systems, comprising a white dwarf which receives mass from a Roche-lobe-filling, late-type star. It is widely accepted that these systems evolve towards shorter orbital periods due to continuous loss of angular momentum by magnetic braking and gravitational radiation. One of the renowned characteristics of the observed CV population is the so-called period gap, a deficiency of non-magnetic CVs in the orbital period range between 2 h and 3 h.

In recent surveys which were mainly conducted to find CVs below the period gap, a surprisingly large number of the newly identified systems is found just above the gap, with orbital periods between 2.8 and 4 h of which several are deeply eclipsing SW Sextantis stars. See Gänsicke (2005) for an overview. In detail, 13 out of 48 nova-like systems in this bin —these are all the eclipsing ones— belong to the sub-class of SW Sex stars.

SW Sex stars were initially defined as eclipsing nova-like stars with high velocity, emission line wings extending up to 4000 km s^{-1}, completely inconsistent with an origin in a standard optically thick, geometrically thin accretion disc. They show narrow absorption features in the Balmer and He I lines near the inferior conjunction of the white dwarf, and large orbital phase offsets (~ 0.2 cycle) of the radial velocity curves with respect to the photometric ephemeris. They also have large absolute magnitudes, implying extremely high accretion rates exceeding the expected rates based on standard magnetic braking as angular momentum loss mechanism.

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Since being an eclipsing system is not an intrinsic physical property of the star, it appears entirely plausible that all non- or weakly-magnetic CVs just above the period gap (excluding a tiny number of dwarf novae) share the SW Sex syndrome. This would be of major significance for the evolutionary theory of CVs, as these stars are about to enter the period gap. If our hypothesis gets confirmed, substantial revision of the ideas about CV evolution in particular, and quite likely about angular momentum loss in close binaries in general, would be required, since the evolution of CVs in the 2.8–4 h regime would dramatically deviate from the standard scenario. It might also give new input to the question of why the period gap exists in the first place, i.e. what makes a CV lose its contact at an orbital period of around 3 h.

2. THE PROJECT

Our initial hypothesis is the statement that all nova-like stars in the 2.8–4 h period regime physically are SW Sex type stars, even when they are not eclipsing. To test this hypothesis, we plan to carry out time-resolved spectroscopy of those nova-likes and old novae with known orbital period between 2.8 and 4 h.

The emission lines of these stars will be scrutinised for the presence of SW Sex characteristics such as the presence of broad line wings with large-amplitude radial velocity variations, single-peaked line profiles with phase-dependent central absorption, and phase lags between the radial velocity modulation in the line cores and wings.

Naturally, the strength of these features, i.e., the amplitude of the projected velocities depends on the inclination of the system. However, the number of known grazingly-eclipsing and non-eclipsing SW Sex stars in the 2.8–4 h orbital period regime is rapidly increasing, e.g V 795 Her (Casares et al. 1996), LS Peg (Martínez-Pais et al. 1999), RR Pic (Schmidtobreick et al. 2003), V533 Her (Rodríguez-Gil & Martínez-Pais 2002), and KUV 03580+0614 (Szkody et al. 2001).

3. RESULTS SO FAR

We have observed and analysed 10 CV systems with orbital periods between 2.8 and 4 h. For two of them, the S/N was not sufficient to detect any signal apart from the strong line centre; for one system the spectrum was still dominated from the shell of a recent nova outburst. Table 1 gives a summary of the findings on the remaining seven systems.

Six of these seven systems have been characterised as SW Sex stars. The emission lines of LQ Peg are barely resolved and higher resolution spectroscopy is needed for this system. For more details on the observations, results and discussion of all systems, see Rodríguez-Gil et al. (2007).

TABLE 1

SUMMARY TABLE OF THE SW SEX CLASSIFICATION SO FAR

System	HV	0.5-abs	PS	SW Sex
HL Aqr	y	n	y	y
BO Cet	y	y	y	y
AH Men	y	y	y	y
V380 Oph	y	y	y	y
LQ Peg	n	n	n	n
AH Pic	y	n	y	y
LN UMa	y	y	y	y

The table lists for each system the presence of high velocity S-wave (HV), of the absorption feature at $\phi = 0.5$ (0.5-abs), of the phase shift (PS) between line cores and wings, and the resulting classification.

4. OUTREACH

So far, we have confirmed that non-eclipsing SW Sex stars do exist and that possibly all nova-like systems in the 2.8–4 h period regime belong to this group. However, the influence of the inclination on the observability of the defining characteristics is not yet clear. It is also possible that e.g. very low inclination systems (like LQ Peg) rather show the characteristics of UX UMa stars, because we look directly onto the inner optical thick disc region.

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