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Discovery of 15-second Oscillations in *HST* observations of W Sge following the 2001 Outburst

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Abstract. We report the discovery of 15 s oscillations in *HST*/STIS far-UV spectroscopic observations of WZ Sge in decline, one month after the start of its 2001 outburst. We discuss the implications of this finding for both the magnetic and pulsating white dwarf models that have been proposed to account for the 28 s oscillations.

1. Introduction

WZ Sge is one of the most extreme CVs known: it has a very short orbital period (82 min), a very low mass ratio ($q = 0.05$), is one of the faintest CVs ($M_V \simeq 11.5$) and has a 7-8 outburst amplitude recurring on a time scale of roughly 33 yr. Because of its extreme behaviour and characteristics, it is thought that WZ Sge is a highly evolved CV whose secondary is probably a brown dwarf-like object. WZ Sge went into outburst on 2001 July 23, around 10 yr earlier than anticipated. We obtained *HST*/STIS far-UV spectroscopic observations to cover the immediate aftermath of the outburst. Fig. 1 (left) illustrates the timing of the three observing epochs, each consisting of 4 *HST* orbits.

2. Analysis of the oscillations

Discrete Fourier transform immediately revealed the presence of strong, rapid oscillations in the *HST*-3 observations, though not in the data obtained in *HST*-1 and *HST*-2. Fig. 1 (right) shows the discrete Fourier transform of the individual orbits in *HST*-3. There are no significant peaks around the 28 s period seen in previous observations of the system during quiescence (e.g. Skidmore et al. 1999). The dominant frequencies near 15 s are clearly visible and in two of the orbits a signal at around 6.5 s can also be seen. The 15 s oscillations are quite strong (amplitude $\simeq$ 5%) but not particularly coherent.

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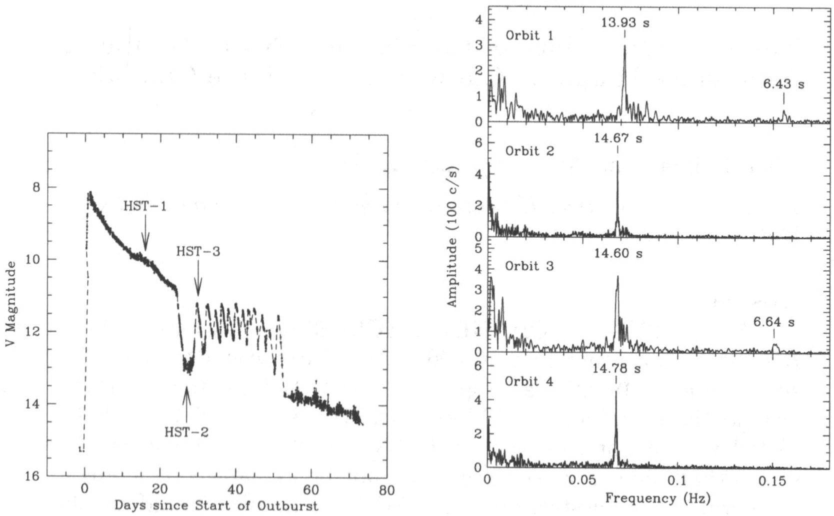

Figure 1. Right. Timing of the *HST*/STIS far-UV spectroscopic observations relative to the optical outburst light curve. Left. Discrete Fourier transform of the individual orbits in *HST*-3.

3. Discussion

It seems unlikely that the 15 s oscillations in our data can be explained by the ZZ Ceti-like white dwarf (WD) pulsations model favoured by Skidmore et al. (1999). Preliminary modelling of the FUV spectrum suggests $T_{\rm WD} \simeq 25,000$ K during the time of our observations. This is well beyond the blue edge of the ZZ Ceti instability strip.

If we use the magnetic rotator model (see Patterson et al. 1998), the magnetosphere should have been completely crushed onto the WD surface as $\dot{M}$ in *HST*-3 exceeded the quiescent rate by a factor in the range 150 - 15,000.

An alternative magnetic rotator model proposed by Warner & Woudt (2002) predicts a much weaker dependence of the magnetospheric radius on $\dot{M}$. Small $P_{\rm osc}$ discontinuities occur as a magnetic reconnection events switch the feeding from one belt region to another. Long-term $P_{\rm osc}$ changes reflect changes in $\dot{M}$. This model still needs to explain the 6.5s oscillations as well as the absence/weakness of the oscillations in *HST*-1 and *HST*-2.

References

Patterson, J., Richman, H., Kemp, J., & Mukai, K. 1998, PASP, 110, 403

Skidmore, W., Welsh, W. F., Wood, J. H., Catalán, M. S., & Horne, K. 1999, MNRAS, 310, 750

Warner, B., & Woudt, P. A. 2002, MNRAS, in press (astro-ph/0204484)