The nature of TW Pictoris

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1. The history of TW Pic

Tuohy et al (1986) identified TW Pic with H0534–581 and suggested it was an intermediate polar based on its $L_{\rm x}/L_{\rm opt}$ ratio and strong HeII 4686Å emission line. Buckley & Tuohy (1990) later measured spectroscopic periods of 2.1 ± 0.1 hr and 6.5 ± 1.0 hr and interpreted them as spin and orbital periods. *EXOSAT* data revealed marginal evidence for a 2.1 hr period too, and optical photometry showed the 6.5 hr period. Patterson & Moulden (1993) then measured periods of 6.06 ± 0.03 hr and 1.996 ± 0.001 hr from optical photometry, but noted that the longer period drifted throughout their 3 weeks of observation. Different periods in the range 6.0 – 6.5 hr were apparent in different sections of their data.

2. Is TW Pic and intermediate polar?

Although TW Pic has been proposed as an intermediate polar, the power spectrum of our long *ROSAT* HRI X-ray lightcurve (Figure 1) shows no sign of either the previously proposed white dwarf spin period (1.996 hr) or the proposed binary orbital period (6.06 hr). The two largest spikes in the CLEANed power spectrum, near to 3.5×10^{-4} Hz, are at window function frequencies and so are unlikely to represent real signals. The absence of a coherent X-ray pulsation casts doubt on the proposed classification. Whilst the strengths of spin, beat or orbital signals in the X-ray power spectra of a few intermediate polars have been seen to vary, no intermediate polar has been seen to lose its X-ray spin pulse.

3. Does TW Pic display superhumps?

TW Pic is near to the critical line in the $\dot{M}/P_{\rm orb}$ plane which separates thermally stable systems (permanent superhumpers and nova-like variables) from those that are thermally unstable (SU UMa stars and U Gem stars). We therefore suggest that TW Pic might display permanent negative superhumps with a period of about 6.06 hr and that its orbital period is around 6.36 hr. Under this interpretation, TW Pic follows the same relationship between superhump period excess and orbital period as the rest of the negative superhump systems (Figure 2). The observed period of 1.996 hr may be the second harmonic of the superhump period, shifted by about 1%, as is seen in several other superhump systems. Problems with this interpretation are that theoretical models for permanent superhumps predict that the phenomenon will not occur at such long orbital periods and that the short period is seen in optical radial velocities which is not expected for a superhump harmonic.

[1] A postscript version of the full paper can be obtained from: http://physics.open.ac.uk/~ajnorton/papers/twpic.ps

4. Does TW Pic have a short orbital period?

Since the 1.996 hr period is apparently the most stable clock in the system, it is possible that this represents the orbital period of TW Pic. However, in this case there is a problem in explaining the origin of the ~ 6 hr period, as this is too short to be a disc precession period, for instance. Possibly the ~ 6 hr period is itself a harmonic of a longer disc precession period of, say, ~ 24 hr.

5. Is TW Pic a VY Scl star?

Photometry of TW Pic (Table 1) shows that on one occasion it faded by ~ 4 magnitudes, when compared with its 'normal' brightness. This measurement was simultaneous with the *ROSAT* All-Sky Survey observation of TW Pic, during which the X-ray flux was also reduced in comparison with our later X-ray observation. This suggests that TW Pic may be a VY Scl star. A problem here is that all known VY Scl stars are well constrained to the period range $\sim 3-4$ hr.

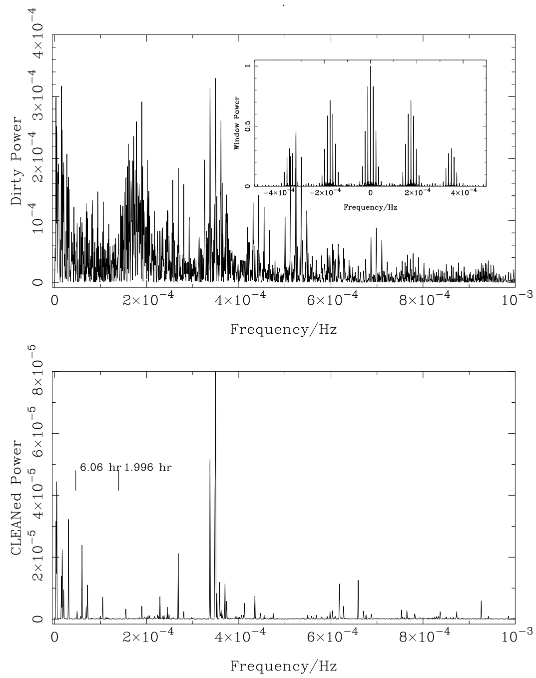

Fig. 1. The X-ray power spectrum of TW Pic. The top panel shows the 'dirty' power spectrum with the window function inset, and the bottom panel shows the CLEANed power spectrum.

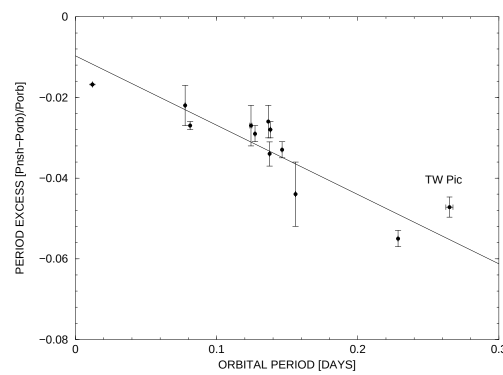

Fig. 2. A graph of superhump period excess against orbital period for all the negative superhump systems, with the position of TW Pic added.

Table 1: Photometry of TW Pic

Star	Date (1990)	B	V	R
Comparison	12/13 Aug	14.35	13.55	13.09
	19/20 Sep	14.45	13.57	13.07
	24/25 Sep	14.45	13.57	
TW Pic	12/13 Aug	17.92	18.12	17.85
	19/20 Sep	14.19	14.55	14.36
	24/25 Sep	14.25	14.27	

References

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Patterson J., Moulden M., 1993, PASP, 105, 779
Tuohy I.R., et al., 1986, ApJ, 311, 275