PART 15.

Poster Papers

https://doi.org/10.1017/S0252921100043384 Published online by Cambridge University Press

Accretion Phenomena and Related Outflows, IAU Colloquium 163
ASP Conference Series, Vol. 121, 1997
D.T. Wickramasinghe, L. Ferrario, and G.V. Bicknell, eds.

HZ Puppis: an Old Nova and Intermediate Polar

T. M. C. Abbott
Canada-France-Hawaii Telescope and Institute for Astronomy, University of Hawaii, USA.

Allen W. Shafter
San Diego State University, USA.

Abstract. We present observations of the old nova HZ Pup (Nova Pup 1963 No. 1) showing it to be an intermediate polar with an exceptionally rich selection of photometric periodicities arising from spin and orbital variations and beating between these two.

1. Observations and discussion

We obtained time-series CCD photometry of HZ Pup on the 0.9-m Dutch and 1.54-m Danish telescopes at ESO La Silla in March 1994 and February 1995. The resulting light curves show complex variations. There is a slow variation near the run length which is presumably of orbital origin, and a number of higher frequency oscillations and some harmonics which appear to be beating in and out. Sample light curves are shown in Figure 1. An optical spectrum obtained in March 1994 is typical of an intermediate polar (IP), and we note that HZ Pup is not found in the ROSAT bright source catalog.

CLEANed Fourier transforms of the light curves yield a group of periodicities near 13 minutes with a constant frequency separation. We identify these periodicities as the spin period of a magnetic white dwarf and the result of beating with an orbital period of $18,400 \pm 100$ sec (5.11 ± 0.03 hr). We are unable to unambiguously identify the spin period among the signals observed, but Table 1 lists these signals and the two most probable identifications in the last two columns.

The relative amplitudes of the spin and beat signals do not agree well with Warner's (1986) predictions of periods likely to be observed in intermediate polars (IPs) with accretion disks. For example, the absence of a signal at $\omega + \Omega$ implies that the amplitude of the signal at $\omega - 2\Omega$ should be no more than one-half that at $\omega - \Omega$. However, recent work on X-ray models suggests that such complex light curves may be produced by an IP in which accretion proceeds not simply through a disk, but also, or perhaps solely, through a magnetically confined accretion stream. We propose HZ Pup to be a strong contender for a diskless IP (see also RX J1712.6-2412, Buckley, et al. 1995).

References

Buckley, et al., 1995, MNRAS, 275, 1028.
Warner, B., 1986, MNRAS, 219, 347.

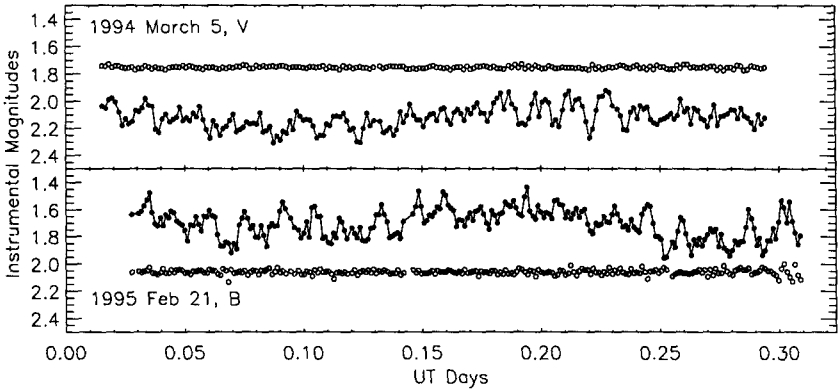

Figure 1. Sample CCD photometry of HZ Pup. A nearby comparison star light curve is also plotted to illustrate the noise properties of the data. HZ Pup was ~ 0.4 mag brighter in V in 1995 than in 1994.

	Signal	Period (s $\pm$3s)	Amplitude (mag)	Phase (rad)	Frequencies	Alternative Frequencies
1994	A	1211.8	0.051	2.25	ω	$\omega + \Omega$
	B	1297.4	0.031	-3.04	$\omega - \Omega$	ω
	C	1395.9	0.038	-0.28	$\omega - 2\Omega$	$\omega - \Omega$
	D	1126.1	0.009	2.44	$(\omega + \Omega)$	$(\omega + 2\Omega)$
1995	A	1212.4	0.044	0.28	ω	$\omega + \Omega$
	B	1297.4	0.015	2.63	$\omega - \Omega$	ω
	C	1395.9	0.014	1.95	$\omega - 2\Omega$	$\omega - \Omega$
	D	1115.6	0.011	1.19	$(\omega + \Omega)$	$(\omega + 2\Omega)$
	E	1497.0	0.011	1.33	$\omega - 3\Omega$	$\omega - 2\Omega$

Table 1. Signals present in time series photometry of HZ Pup. Phases are measured at HJD=2449415.5894461 and 2449772.0816005 in 1994 and 1995 respectively. Ω is the orbital period of the system, and ω the spin period of the white dwarf. Signal D may not be an orbital sideband and signal E may be spurious.

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