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THE INTERMEDIATE POLAR PQ GEM – STATUS OF WET OBSERVATIONS OF 1996

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Abstract. A summary of the results on PQ Gem based on WET observations conducted in February 1996 is presented. The 13.9 min spin period of the white dwarf in the system and the orbital side-band at 14.5 min have been detected unambiguously. Searches for other periods in the system gave negative results.

Key words: stars: close binaries, cataclysmic variables, individual: PQ Gem

1. INTRODUCTION

RE 0751+14 (PQ Gem) is an intermediate polar discovered from the ROSAT widefield camera all sky survey (Mason et al. 1992). Although classified as an intermediate polar, it exhibits some exceptional properties which are more akin to polars. The object has been studied in X-ray (Duck et al. 1994, Mason 1997) and optical *UBVRI* wavelengths (Mason et al. 1992, Rosen et al. 1993, Hellier et al. 1994, Hilditch & Bell 1994, Ashoka et al. 1994, Potter et al. 1997). Most of the observations have revealed the 13.9 min rotation period of the white dwarf in the system. An orbital side band at 14.5 min has also been seen in many, but not all, observations. The implied orbital period of about 5.2 h has not been detected directly.

A Whole Earth Telescope campaign on PQ Gem was conducted from February 11 to February 26, 1996 to search for all the frequencies exhibited by this system. A summary of the results is presented here.

2. OBSERVATIONS AND RESULTS

Optical photometric data from seven observatories were collected with two/three channel photometers in the Johnson B filter with 10 s integration time. The effective duration of the observation, comprised of 38 runs, was about 151 hours.

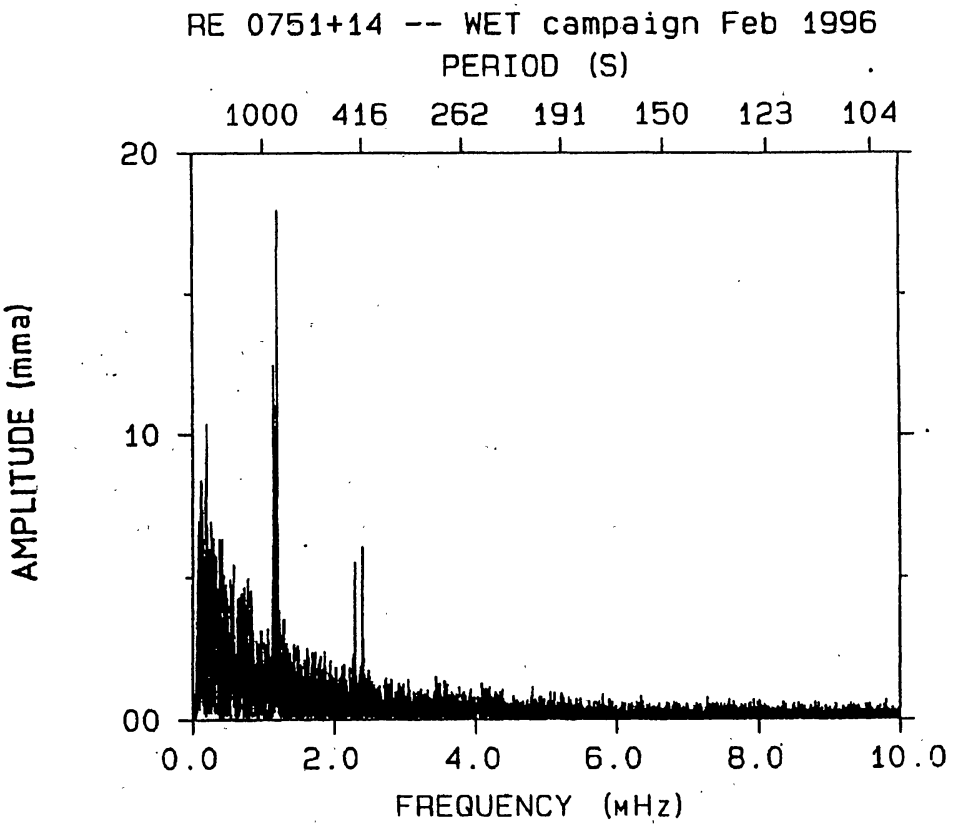

Fig. 1. Fourier amplitude spectrum of the total WET data set. Notice the spin frequency, the orbital side-band and their first harmonics very clearly.

The light curves, reduced and normalized to a mean of zero for each run, were put together and subjected to a discrete Fourier Transform analysis in order to search for the frequencies present in the system. Fig. 1 shows the Fourier amplitude spectrum of the total WET data in the frequency range 0–10 mHz, sampled at 0.15 mHz. The y axis is in the units of millimodulation amplitude (Winget et al. 1994).

The dominant frequencies corresponding to the 13.9 min and 14.5 min periods and their first harmonics are clearly evident in this

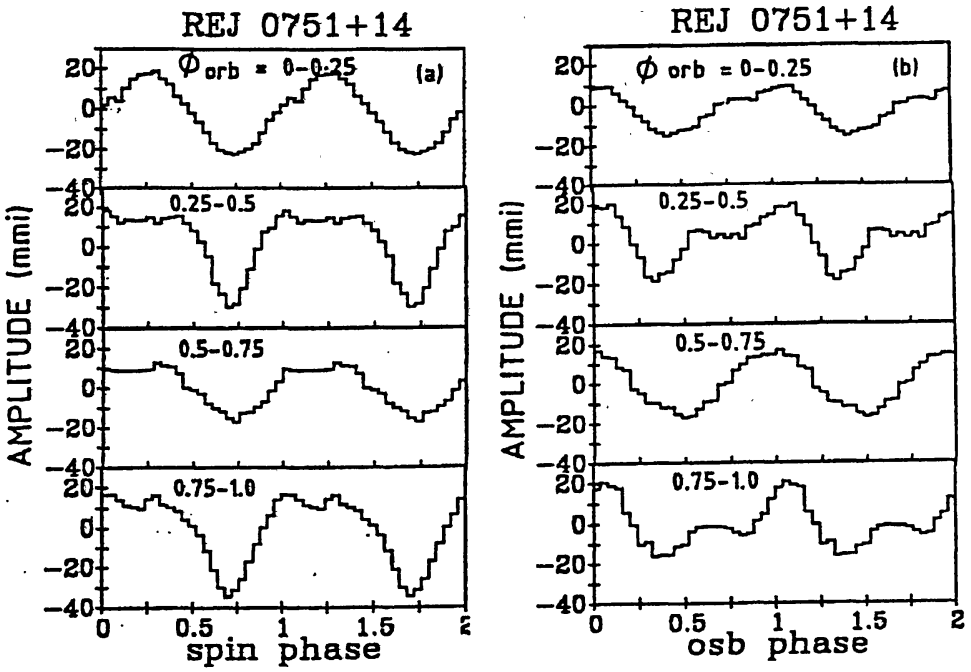

Fig. 2. Spin and orbital side-band pulse profiles as a function of orbital phase. In the case of orbital side-band, the second and fourth panels from the top indicate the emergence of a double peaked pulse profile.

plot. A detailed look at the Fourier amplitude spectrum also revealed the second and the third harmonics of the spin period and the second harmonic of the orbital side band. These are perhaps some of the best amplitude spectra of time series data so far obtained for any IP and they owe their quality to the nature of the WET data collection scheme. Search for excess power at the orbital frequency or any of its harmonics gave negative results. Hilditch & Bell (1994) have reported the possible detection of a period at 1.14 h in their CCD data on PQ Gem. We have searched for this period and find no evidence for it in our Fourier amplitude spectrum of the total data set.

Using our long WET data set, we derive an ephemeris for the spin pulse maximum in the B filter as

$$T_{\max}(\mathrm{BJED}) = 2450124.587715(26) + 0.00964574(10) \cdot E,$$

where E is the cycle number, and for the maximum of the orbital side-band pulse in the B filter as

$$T_{\max}(\mathrm{BJED}) = 2450124.585304(38) + 0.01009553(18) \cdot E.$$

In order to investigate the possible variation of pulse profiles as a function of orbital phase due to changes in viewing geometry, we prewhitened the data with the spin and orbital side band periods, one at a time, divided the total data set into four quadrants and folded the lightcurves at the orbital side band and spin periods respectively. Fig. 2 shows the results.

A clear indication of the variation of the pulse shape is evident in this figure which also shows the emergence of a double peak structure of the orbital side-band in panels (2) and (4) from the top. We propose that this may be the result of reprocessing of X-rays which also shows a double peaked pulse profile in the energy range of 2–6 keV (Duck et al. 1994). Further details of the analysis will be published elsewhere.

3. CONCLUSION

We have detected the 13.9 min spin period and three its harmonics in the WET data of the intermediate polar RE 0751+14 (PQ Gem). We also have detected the orbital side-band at 14.5 min period and two its harmonics. The implied orbital period is 5.196(2) h. Evidence for the variation of the spin as well as the side-band pulse profiles as a function of orbital phase has also been obtained.

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