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PALOMA:A Magnetic CV between Polars and Intermediate Polars

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Abstract. Using observations made with XMM-Newton, we present temporal and spectral analysis of an intermediate polar-like object Paloma. We also interpreted Paloma as a key object for magnetic CV evolution with an orbital period right within the period gap.

Keywords : stars: novae, cataclysmic variables – stars: individual: Paloma

1. Introduction

Magnetic cataclysmic variables (MCVs) are evolved, semi detached interacting binaries containing a magnetic white dwarf (WD), which accretes material from a Roche lobe-filling red dwarf star. Based on magnetic field strength, MCVs are broadly classified into two categories: Polars and Intermediate Polars. Paloma is one of the other system which is described as nearly synchronous IP, whose orbital period falls right inside the period gap and thought to be currently in the process of attaining synchronism and evolving into polars (Norton et al. 2004; Schwarz et al. 2007).

2. Observations And Data Reduction

Paloma was observed with XMM-Newton observatory using different set-ups of the instruments (Jansen et al. 2001). We used standard XMM-Newton Science Analysis System (SAS) software package version-14.0.0 for data reduction with updated calibration files (CCF). The X-ray light curves and spectra of Paloma were extracted from circular region of radius 20 arc-sec around the source and same size source-free region was chosen on the detectors for the background extraction.

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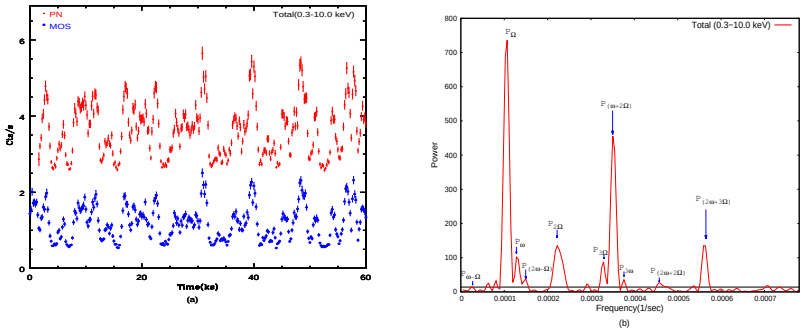

Figure 1. (a) X-ray light curves of Paloma, (b) Lomb-Scargle power spectra corresponding to the light curve obtained from EPIC-PN ccd.

3. Analysis And Results

The 0.3-10.0 keV background-subtracted X-ray light curve of Paloma is shown in Figure 1(a) and the corresponding power spectra of PN light curve is shown in Figure 1(b). The frequencies correspond to the longest periods of 156±6 and 130±4 min appear to be orbital and spin periods and compatible with periods reported by Schwarz et al. (2007) using optical photometry. The phase folded light curves at most of the derived periods also show periodic modulation. X-ray spectra of Paloma were fitted with best fit model wabs×pcfabs(apec+apec+gauss). Best fitting value of the partial absorber hydrogen column density was $6.1^{+0.4}_{-0.4} \times 10^{22}$ cm $^{-2}$ with a covering fraction of 64±1 % and apec temperatures of $0.09^{+0.011}_{-0.005}$ and $12.5^{+0.55}_{-0.55}$ keV. In orbital and spin phase-resolved spectral analysis extracted spectra were fitted with the best-fit model to the average spectra and also found the variations in spectral parameters with orbital and spin phase.

The presence of significant power at spin, beat and $2\omega - \Omega$ frequencies suggest that Paloma is disc-less accreting system (see Wynn and King 1992). Similar to the results of optical data by Schwarz et al. (2007), the asynchronocity ($1\text{-}P_\omega/P_\Omega$) of Paloma is found to be ~ 16.6 % from the X-ray data, which is slightly further away from the line of synchronisation. The values of P_ω/P_Ω obtained from X-ray data of Paloma satisfies the synchronisation condition derived by Norton et al. (2004) i.e., $P_\omega/P_\Omega > 0.6$, indicating that Paloma might be represent a transition object currently in the process of attaining synchronism and evolving into polars.

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