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#### Asynchronous polar BY Cam: periods, quasiperiods, accretion modes and magnetic field structure

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## Asynchronous polar BY Cam: periods, quasiperiods, accretion modes and magnetic field structure

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The asynchronous polar BY Cam in the low-brightness state displays observational evidence of the quadrupole component magnetic field of a magnetic white dwarf.

*Keywords:* Asynchronous polar; Low-accretion state; Quadrupole component; Quasiperiodic oscillations

BY Cam belongs to the subgroup of asynchronous polars. Comprehensive charge-coupled device photometric investigations of this magnetic binary have been carried out in 2004–2005 with a Cassegrain 38 cm telescope (Crimean Astrophysical Observatory) and 60 cm telescope (Terskol). All this time BY Cam was in a low-accretion state.

We detected the simultaneous existences of an orbital period (0.1398 day), a spin period (0.1384 day), a side-band period (0.1371 day) and a 14.56 day synodic period [1]. The shape of the spin light curve could have two peaks (mostly) or three peaks (rarer), one peak indicating the accretion that unequally occurs on to two or three magnetic poles. These peaks are located at approximately 0.25 spin phase from each other. The synodic light curve has four peaks and its shape survives over at least 43 synodic cycles [2]. The  $O - C$  values of the maxima for the major and secondary accretion spots display a behaviour which strongly depends on the synodic phase: Twice the synodic cycle at phases 0.3 and 0.8, the  $O - C$  value for the main peak show jumps for half the spin period. Between these events the  $O - C$  value slightly increases and again jumps for a quarter of the spin period at synodic phase 0.55. All these results are observational evidence for the following:

- (i) a strong variation in the accretion rate which depends on the synodic phase;
- (ii) a complex structure of the magnetic field of the magnetic white dwarf in the BY Cam binary, thus confirming our earlier suggestion of a dipole+quadrupole-type magnetic field [3];

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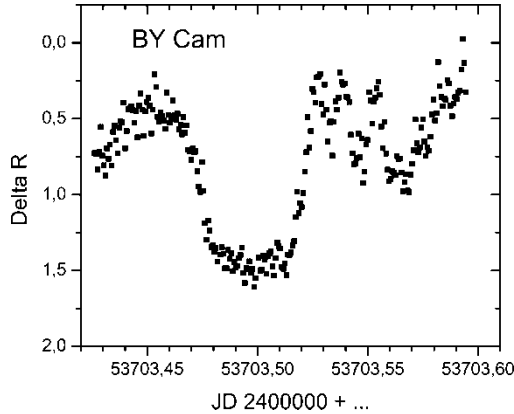


Figure 1. The light curve of BY Cam showing the large QPOs.

- (iii) several accretion modes, which depend on the magnetic field orientation (synodic phase), and also accretion switches between three magnetic poles.

There are also small-amplitude quasiperiodic light oscillations (QPOs) during the BY Cam low-brightness state that are a sufficiently good fit to the shot-noise model. However, sometimes ‘giant’ quasiperiodic brightness oscillations could be detected. For example, in figure 1, part of the night-time light curve is presented. During one of the peaks on the light curve that is associated with the accretion region, QPOs with a typical time of 18 min and an amplitude magnitude of about 0.6 were observed. Such long-term and high-amplitude QPOs are not typical for polars. However, earlier, during the high-brightness state of BY Cam, QPOs with a similar typical time (but smaller amplitude) have been observed in the optical and X-ray band by Pavlenko *et al.* [4] and Silber *et al.* [5].

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