The outflow-accretion activity in the post UX Ori star RZ Psc

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RZ Psc belongs to the family of irregular variables with aperiodic Algol-like minima (UXORs) attributable to strong circumstellar (CS) extinction fluctuations. It is one of the coolest (Sp = K0 IV) and eldest star in this family: its age estimated from the proper motion is ~ 25 ± 5 Myr (Grinin et al. 2010; Potravnov and Grinin 2013). RZ Psc has no infrared excess in *JHK* bands but has an excess at $\lambda > 5\ \mu$m attributable to the thermal radiation of CS dust at T = 500 K (de Wit et al. 2013).This means that there is an inner cavity which is barely filled in with CS matter and this is the most probable reason of the very low photometric activity of RZ Psc (Fig. 1). In this poster we summarize the results of our spectroscopic observations of this star made with the 2 m telescope of Terskol Observatory, 2.56 m. Nordic Optical Telescope (NOT), and 2.4 m telescope of National Astronomical Research Institute of Thailand. They show how can look like the CS activity of T Tauri star at the end of P-M-S evolution.

RZ Psc: the most enigmatic UX Ori star: the deep minima are extremely short (1-2 days) and very rare.

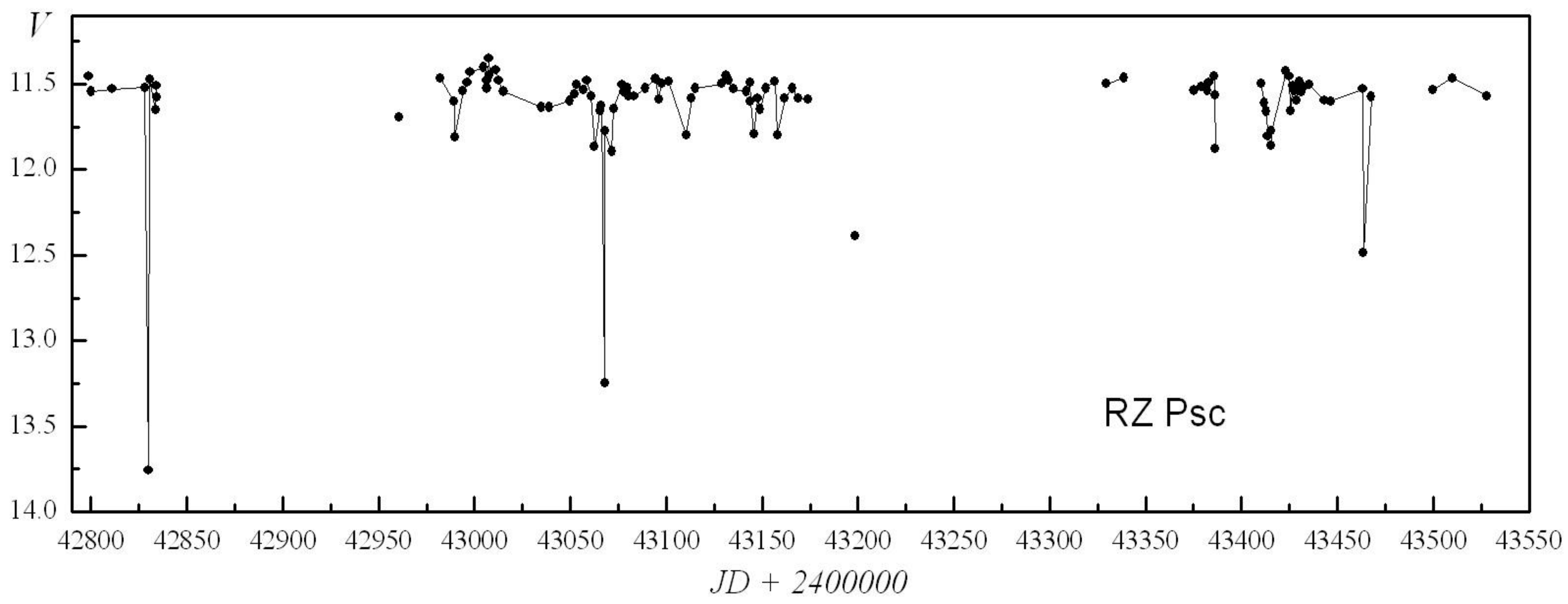

Fig. 1. The light curve of RZ Psc from Zaitseva (1985).

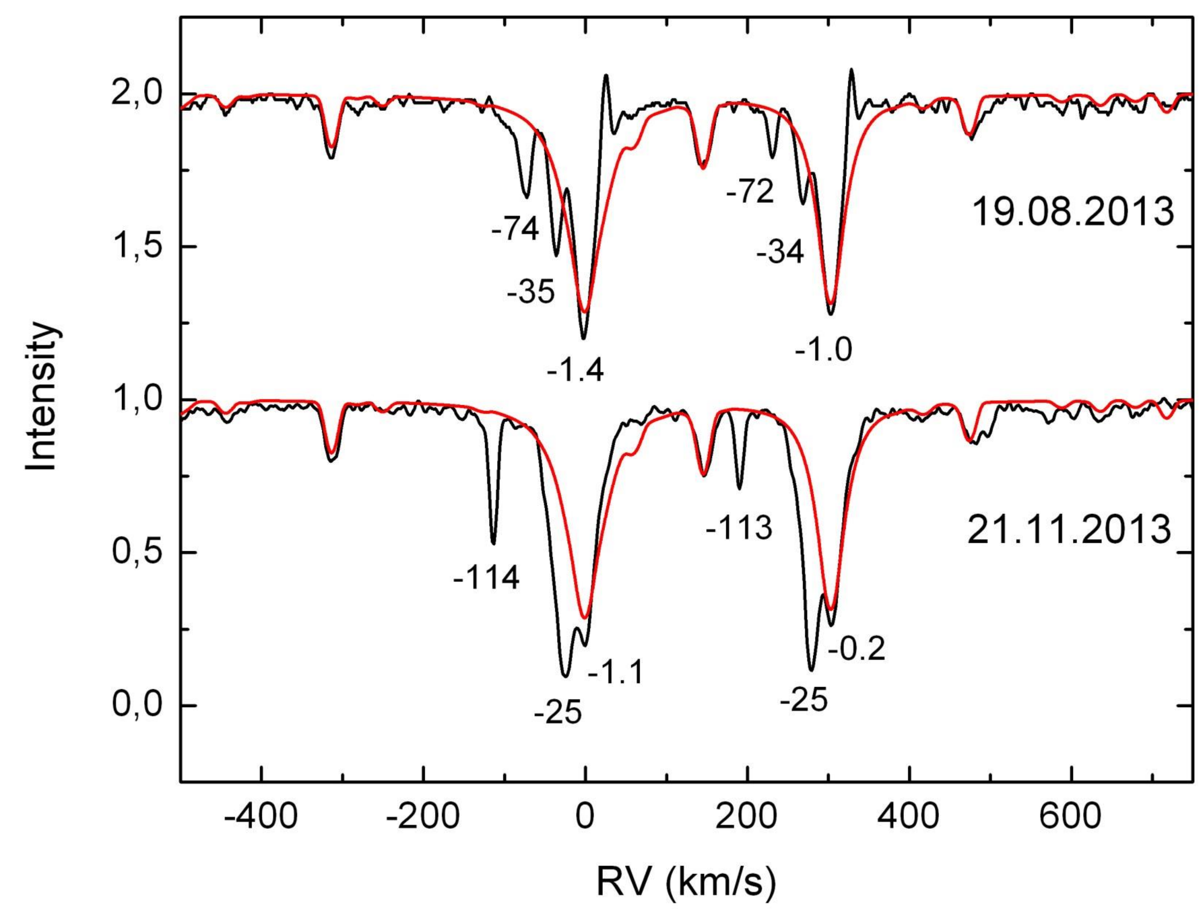

Fig. 3 The variable blue-shifted absorption components In the Na I D lines in the spectrum of RZ Psc. The red line indicates the synthetic spectrum. The radial velocities of the absorption components are specified. The narrow emission In the upper spectrum is the night sky emission.

The most intriguing spectroscopic properties of RZ Psc are:

1. **the clear signature of the matter outflow from the star vicinity in D Na I lines (see [4,5] and Figs. 3, 4), and**
2. **an absence of any signatures of accretion: the emission in the H alpha line is much weaker than in WTTS's (Figs. 2).**

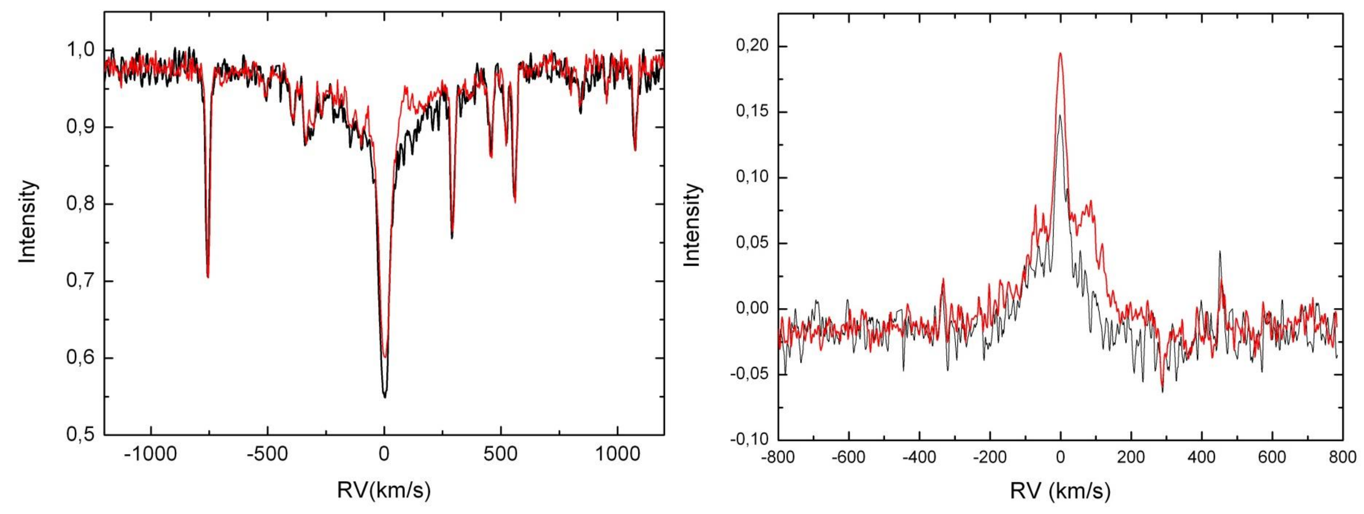

Fig. 2. The spectrum of RZ Psc around the Hα line. The dates of observations are the same as in Fig. 1. *Right*: The emission component of the Hα line obtained by subtracting the synthetic spectrum from the observed one.

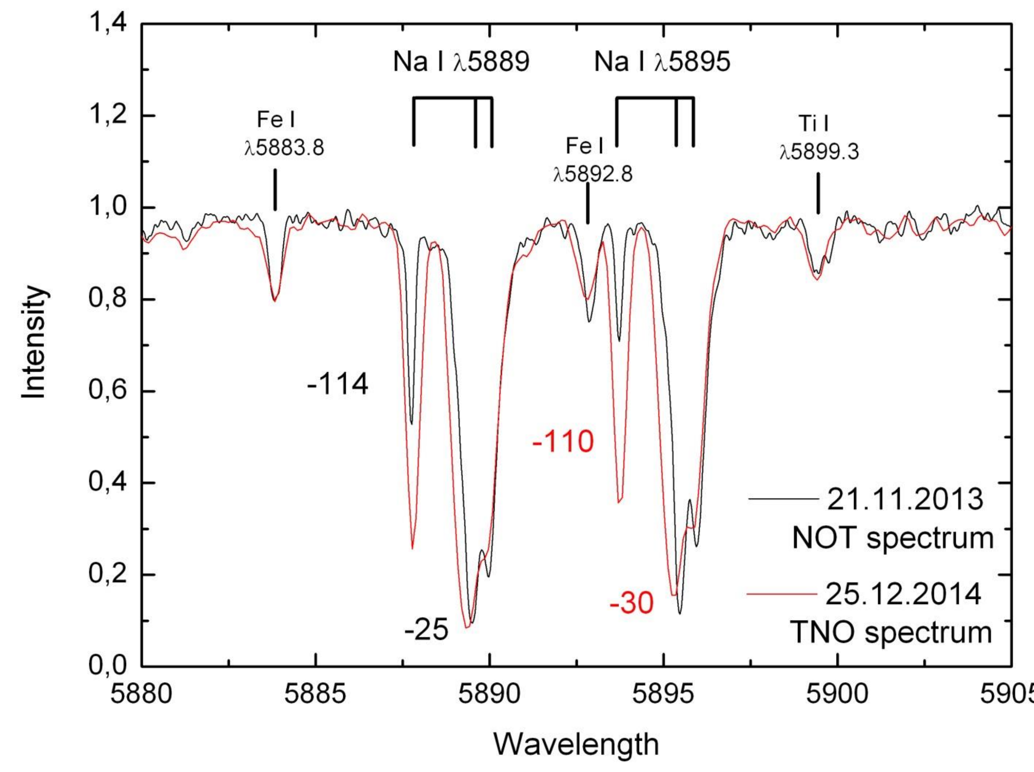

Fig. 4 Indication for periodicity: the repeating absorption events with almost the same radial velocities.

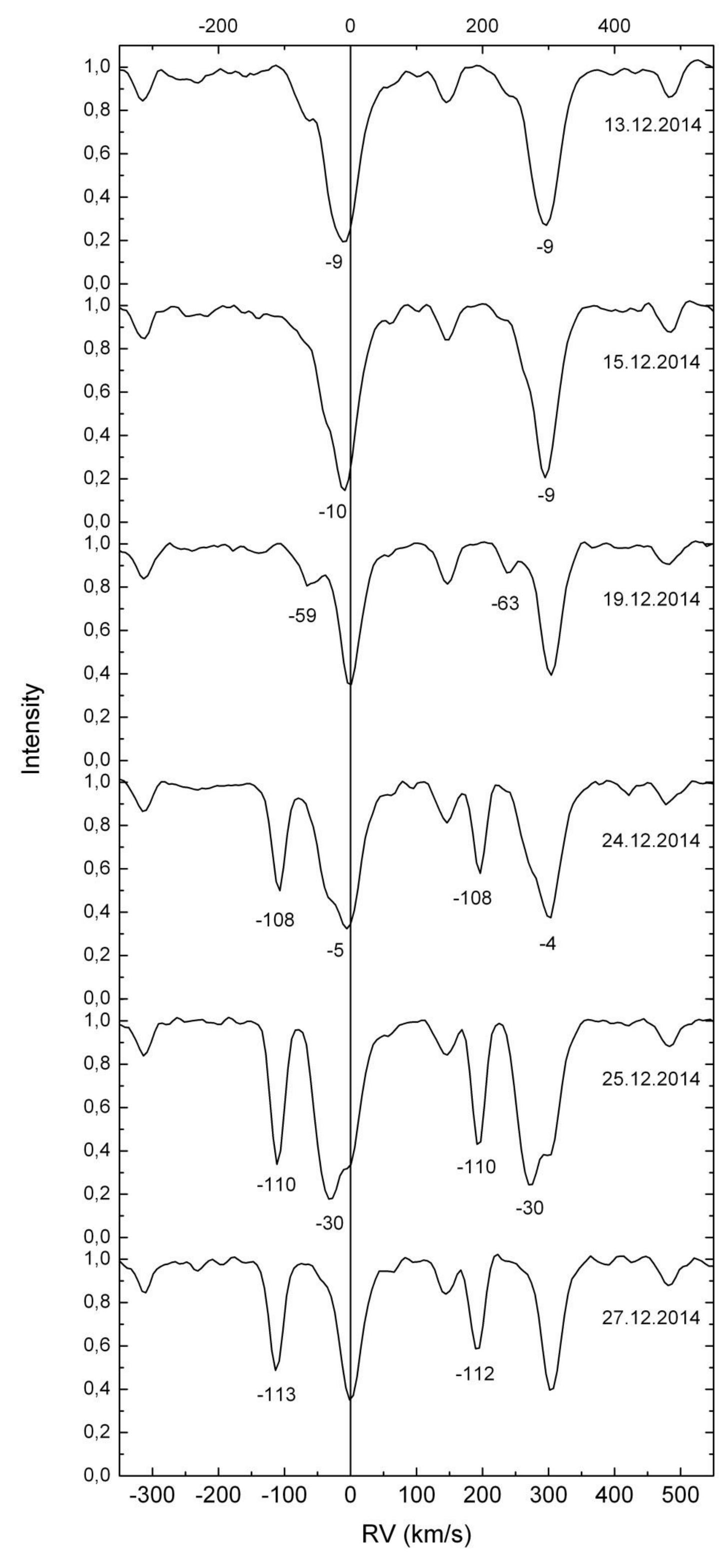

Fig. 5. The night to night spectral variability of RZ Psc In the sodium D Na I lines.

Magnetic propeller regime

At the small accretion rate the truncation radius of the magnetosphere can significantly exceed the corotation radius. In this case the magnetosphere works as the magnetic propeller which prevents the motion of the CS matter to the star. The estimations show [5], that this scenario can be realized in RZ Psc if the star has a surface magnetic field of ≈ 1 kG and the accretion rate does not exceed 10^{−10} Msun per yr.

The repeating absorption events (Fig. 3) can indicate that the magnetic dipole axis is inclined relatively to the stellar rotation axis. The MHD simulations by Romanova et al. (2009) show that in this case, the magnetospheric wind generates two spiral streams (one stream per one semi-sphere, Fig. 6). The intersection of such a stream with the line-of-sight can produce the periodic repeating absorption details in the spectrum of RZ Psc.

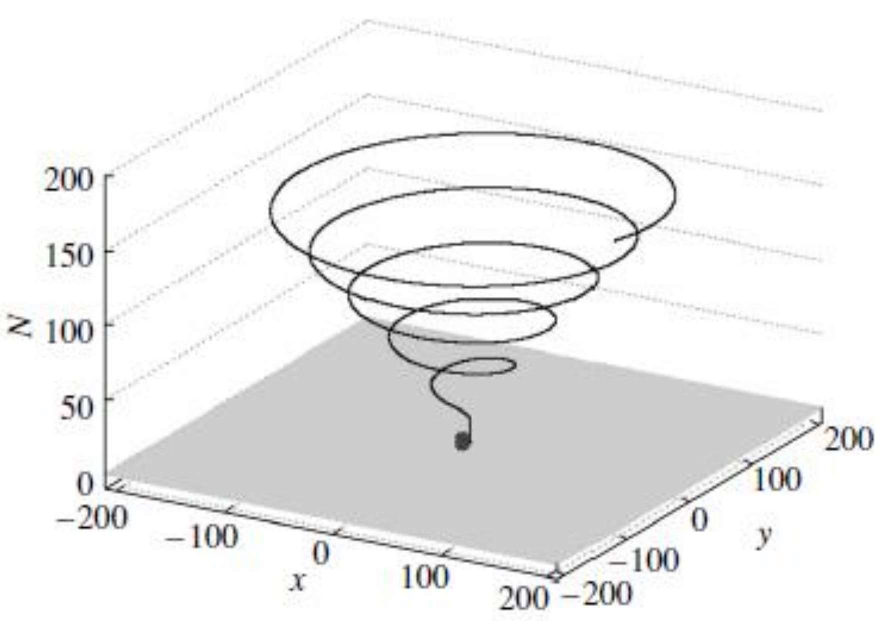

Fig. 6. Sketch of the spiral stream of matter in the propeller regime from [5].

References

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