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# PERIODIC VARIABILITY OF RY Tau

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## ABSTRACT

The results of spectral studies of the CTTS type young star RY Tau with spectrograms of the ultraviolet and the visual ranges are presented. We show the first detection of periodic variability of the emission line intensities in UV and visual ranges with a period of 23 days.

*Key words:* Pre-Main Sequence stars: circumstellar matter: variability: RY Tau

## 1. ON THE PERIODIC VARIATIONS OF RY Tau

RY Tau (HD 283571, V $\sim 10^m.3$) is a classical T Tauri star (CTTS) that was first cited in the original list of Joy (1945) as one of 11 stars with emission lines similar to those of the solar chromosphere. This is one of the most active stars, sometimes showing dramatic changes in the spectrum and brightness (Zajtseva et al. (1985); Johns & Basri (1995); Petrov et al. (1999)). Despite the large number of papers devoted to the study of the star, its actual physical nature remains uncertain.

Based on their photometric observations in 1985–1986, Chugainov et al. (1991) confirmed the existence of 5.6 and 7.25-day periods. Recently, when searching for long- and short-term periodic variations, Zajtseva & Kurochkin (1980) analyzed a 30-yr UBV light curve based on the 1965–2000 data. She confirmed the existence of a 2000-day long-term cycle that was revealed previously by photographic observations (Zajtseva & Kurochkin (1980)). Zajtseva (2010) also confirmed the existence of a 7.5-day period but did not reveal the 5.6-day period, which she explained by a change in the phase of the period. Ismailov & Adygezalzade (2012) showed that the light variations of the star in 1983–2004 were cyclic in pattern. The authors managed to identify a variability period of 377 days with a high significance.

In this report we have presented a results of researches on periodical variability in the UV and optical spectra of the star.

## 2. RESULTS AND DISCUSSION

For RY Tau, we processed 15 SWP spectrograms and 86 LWP and LWR spectrograms obtained by IUE in 1979–1990 (Ismailov et al. (2011)). Our search for a period using the Mg II $\lambda$ 2800 ($\lambda\lambda$ 2795 and 2802 ÅÅ) emission doublet showed that one of the most probable periods could be 23.26 days. Despite a significant brightness variability in 1983–1984 (Petrov et al., 1999), the Mg II $\lambda$ 2800 emission doublet showed no synchronous variation with the UBV photometric data. A periodicity of 23.26 days is also observed for a group of lines such as CIV $\lambda$ 1450, He II $\lambda$ 1640 and SII $\lambda$ 1756.

The optical observations in 1975, 1984, and 1985 showed that while the components of the $H_\alpha$ emission and $H_\epsilon$, H and K CaII lines were well described by the 23-day period, the absorption components of the other hydrogen lines $H_\beta$, $H_\gamma$, $H_\delta$ exhibited no variability with this period (Ismailov et al. (2011)).

Figure 1 presents the phase curve of the Mg II $\lambda$ 2800 line intensity from all measurements. As we see, the maximum deviation, an increase in line intensity approximately by a factor of 4, is observed near phases 0.4–0.5.

In the top panel of Figure 2, the radial velocities of the individual $H_\alpha$ line components are plotted against the phase of the 23.26-day period. As we see, the picture of periodic variations in the blue, VB, and central, VA, components of the $H_\alpha$ line is satisfactory. In the bottom panel of Figure 2, ratios of the equivalent widths of blue to red components WB/WR is plotted against the phase of the same period. As we see, the radial velocity minimum corresponds to phase $0.4P$, while the minima of the relative component intensities correspond to phase $0.25P$. The solid curves in Figure 2 are sinusoidal fits.

For an interpretation of the 23-day period, we hypothesize that we may observe as yet not completely formed protostellar objects which are moving in Keplerian orbits in the circumstellar environment of RY Tau. Judging by the period $\sim 23^d$ and mass 1.6 $M_\odot$, the orbital semimajor axis of the presumed object expected to be as $\sim 0.16 \pm 0.01$ AU.

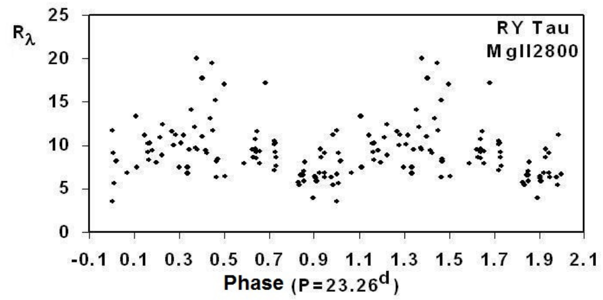


Figure 1. Phase curve of the Mg II $\lambda$ 2800 emission doublet intensity.

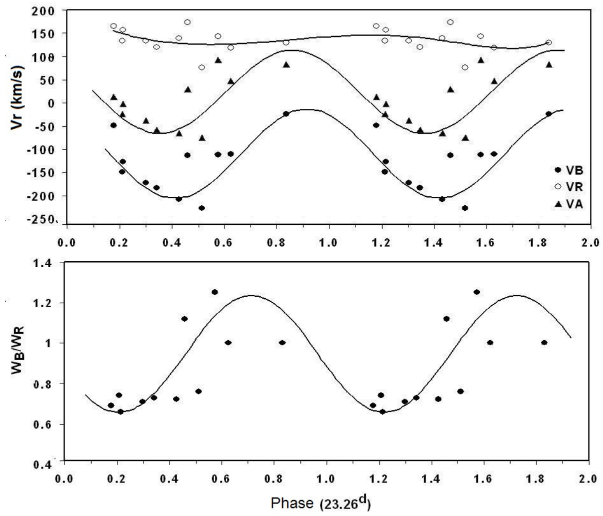


Figure 2. Phase curves of the radial velocities for the individual $H_\alpha$ line components (top panel) and the equivalent width ratios of the emission components WB/WR (bottom panel). The solid curves are sinusoidal fits.

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