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Activity of symbiotic star CI Cyg between 2008 and 2012

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Abstract. The activity of the classical symbiotic star CI Cyg from 2006 to 2012 was studied based on the photometric and spectrophotometric data. The flux of the strongest spectral lines were calculated. It has been shown that the fluxes of Hα, He I λ5876 lines with a low ionization potential were increased in the outburst. At the same time, the flux of lines with a high ionization potential of [Ne V] λ3426, [Fe VII] λ6087 lines were decreased or disappeared completely. In addition, during outbursts the molecular bands belonging to the cold component weakened and the ultraviolet excess behind the Balmer jump decreased or disappeared. At the maximum and close to it, only the emission lines H I, He I and Fe II were observed in the spectra. A comparison was made with the previous period of activity in 1971–1975. It is noted that both periods of activity have similar properties. In particular, a series of outbursts were observed, with each of the subsequent outburst being weaker than the previous one. In addition, the curve of eclipsing in the first outburst of the series was wider than the subsequent ones in both periods of activity. Besides, the brightness of the star weakened before the first flashes of the series.

Keywords: stars: symbiotic; individual: CI Cyg

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1 Introduction

CI Cyg is a symbiotic eclipsing star consisting of a cold giant of the spectral class M5.5 II and a hot component, most likely a white dwarf. This star belongs to a small number of symbiotic stars in which the cold component fills its Roche lobe or is close to filling it. Between 1970 and 1978, the star was in an active phase consisting of a series of outburst with amplitudes up to almost 3 magnitudes (Belyakina 1983; Kenyon et al. 1991). After quiescent state, it shows a new series of the outbursts in 2008, 2010 and 2012 years. The activity of CI Cyg in 2008 were studied by Siviero et al. (2009). The second outburst of 2010 was described by Teyssier (2011). Our observations cover the period of activity from 2008 to 2012. Therefore, the aim of this work was to study the activity of CI Cyg from 2008 to 2012 year and compare it with the activity from 1971 to 1975 years.

2 Observation

The low-resolution spectra ($R = 1000$ and $R = 1300$) were obtained using a spectrograph mounted at the Nesmyth focus of the 2.6-m ZTSh telescope. The detector was a SPEC-10 CCD camera (1340×100) pixels. The spectrophotometric standart HR 7534 was used to calibrate the measured flux in the star spectrum.

3 A light curves analysis

Photometric observations were taken from the Siviero et al. (2009); Sekeráš et al. (2019) and from the AAVSO database. Fig. 1 shows the phase light curve for all three outbursts. Phase was calculated according to the ephemeris $V_{\min} = 2442690 + 853.8E$, where the epoch is the photocentre of the 1975 eclipse. The orbital period was taken from Fekel et al. (2000). It can be seen that the 2008 outburst occurred during the eclipse of the active region by the cold component. The beginning of the outburst in 2010 and 2012 occurs when the active region around the white dwarf and the cold component are visible. In fact, the shape of the eclipse curves of the 2008 outburst differ from curves of the eclipse in 2010 and 2012.

4 The spectral evolution

In the spectra, obtained during the period of the star, the molecular bands of the cold component are enhanced and the lines of high ionization potential are present, such as [Ne V], [Fe VII], He II. In the spectra of the star during the outburst the molecular bands belonging to the cold component weakened, the ultraviolet excess behind the

Balmer jump disappeared, as well as the lines of high ionization potentials [Ne V], [Fe VII], He II. In the next outbursts in 2010 years, in the spectrum obtained before the maximum brightness there are weak lines [Fe VII] and [Ne V]. In addition, some excess radiation is observed behind the Balmer jump, although less than when the star was in a quiet state. In 2012, a similar behavior of the flux in the continuum and spectral lines was observed. The variability of the flux of the lines Hα, He I λ5876, He II λ4686, [Ne V] λ3426 and [Fe VII] λ6086 are shown on Fig. 2.

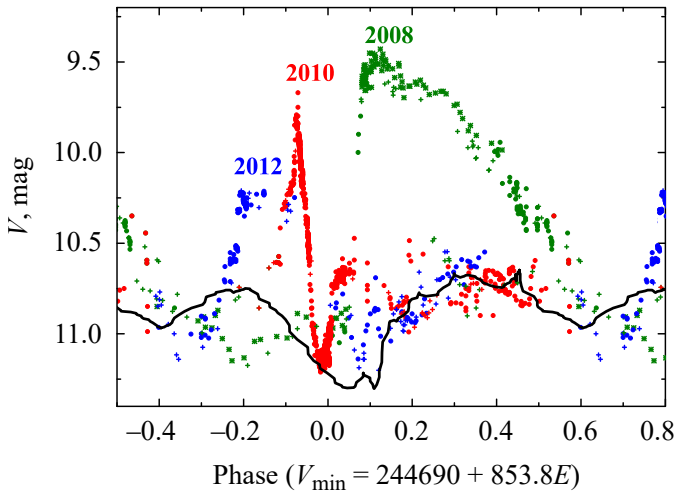

Fig. 1. Phase curves of outburst 2008, 2010, 2012. A solid black curve depicts the phase curve of a star in a quite state.

5 Conclusions

The symbiotic star CI Cyg entered a new period of activity with a series of outbursts in 2008, 2010, 2012. In the year 2008, the shape of the eclipse curve is wide, but the shape of the eclipse curves is narrow in the years 2010 and 2012. The different shape of the eclipse curves appears to be related to the variability of the eclipsed component. A similar series of outbursts was observed in the previous period of activity from 1971 to 1975. As then, the first flash had a wide minimum, and the rest had a narrow minimum. In addition, the similarity was also traced in the fact that before the outburst in 2008, as well as before the flash of 1971, the brightness of the star fell. The observed variability in the shape of the eclipse curve seems to be due to the variability of the gas envelope around the hot component. The different behavior

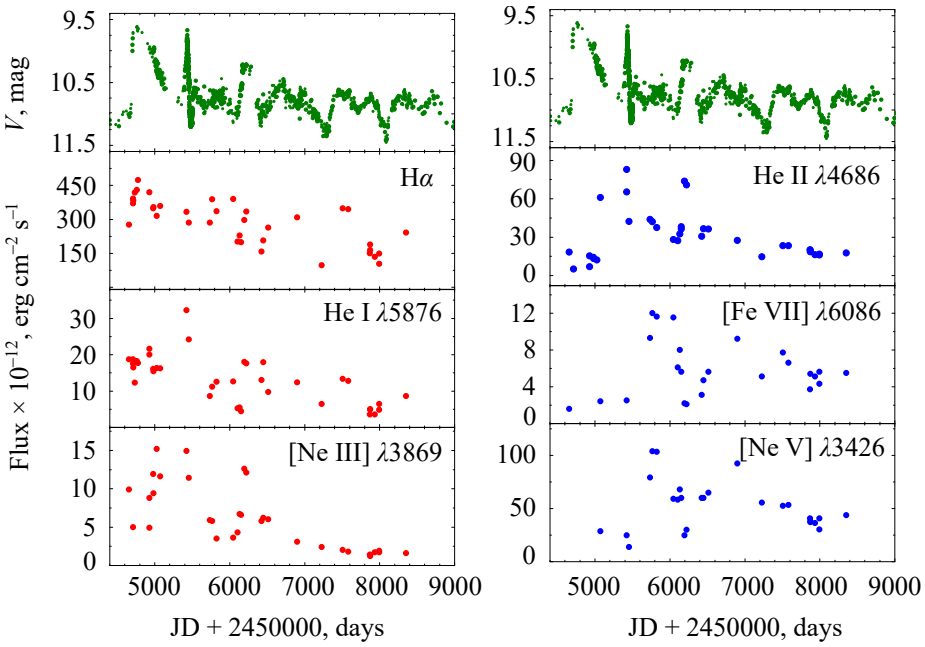

Fig. 2. Light curve in V-band and variation of line fluxes.

of the fluxes during the outbursts in 2010 and 2012 from the fluxes in 2008 is due to the fact that the hot radiation from the white dwarf during these outburst is not fully eclipsed by the envelope around the white dwarf formed during the outburst. It is possible that such a shell may be a disk-shaped object.

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