Variability of [OI] 6300 Å and [OI] 6363 Å Emission in HD 200775

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Variability of the emission in [OI] 6300 Å and [OI] 6363 Å lines from Herbig Be binary star HD 200775 is reported for the first time. The system has the common disk observed in IR-emission and an accretion disk around the primary component which is probably formed due to accretion of the common disk material. The orbital period of the binary system is about 3.7 years. The [OI] line profiles from the newly-obtained spectral data and the archival ones, derived during the last 20 years or so, were examined. The major part of the data was obtained with the 1.2 m telescope at Kourovka Astron. Obs., Ural Federal Univ. Similarity of the line profiles obtained at the same orbital phases in different epochs and with different instruments was found. So, the variability of [OI] line emission is related to the binarity of the system.

1 Context

HD 200775 (V380 Cep, MWC 361) is a Herbig Be binary star with the orbital period of about 3.7 years. Mid-infrared interferometric observations of the binary orbit [1] and a number of spectroscopic works [1]–[7] were performed to estimate the orbital parameters. Periodic maximum activity phases related to the binarity were recognized in the spectra of the star [2]. This activity is characterized by an increase in the equivalent width of the Hα line formed in the material associated with the primary component.

The authors of [8, 9] observed diffuse IR-emission from the system and suggested that it was originated from the common circumbinary disk. In [8, 6] the presence of an accretion disk close to the primary (more massive) component of the system was pointed out. This disk is probably formed by the material accretion from the common disk onto the primary component. There is no evidence of any disk material near the secondary component.

Forbidden OI line emission in Herbig Ae/Be and T Tauri stars is often observed as a blue-shifted high-velocity component originated from an outflow and a low-velocity component (e.g., [10, 11]). The origin of the latter is unclear, it might be formed on the disk surface or in the slow disk wind. A review of [OI] line emission in 49 Herbig Ae/Be stars, including HD 200775, has been performed

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in [12]. However, variability of [OI] lines in spectra of this binary star is for the first time reported in this paper.

2 Observational data

Our data were obtained from May 2, 2012 to April 2, 2015 using a high-resolution spectrograph mounted at the 1.2 m telescope of the Kourovka Astronomical Observatory of the Ural Federal University. The operating wavelength range was 4000–7800 Å, an effective exposure was 1 hour (each image is a median average of three 20-min CCD images). One spectrum was obtained in 2013 with NES spectrograph of the Special Astrophysical Observatory of Russian Academy of Science (SAO RAS). We also used archival spectral data obtained from 1994 till 2011 with ELODIE and SOPHIE spectrometers of Observatoire de Haute-Provence, the ESPaDOnS spectrometer from Canadian-France Hawaii Telescope, as well as NES data from the SAO RAS archive.

3 Results

In the spectra of HD 200775 we see a broad low-velocity component of the [OI] line (Fig. 1). There is no evidence of the high-velocity one. Unfortunately, the wavelength region around the [OI] 6300 Å line includes a number of telluric lines and narrow atmospheric oxygen emission. But these lines only arise at well-defined wavelengths, while at the other wavelengths variations in stellar emission still can be seen. The most significant changes (except for atmospheric components) occur near the values of −65, 30 and 55 km/s.

We have also considered emission in the [OI] 6363 Å line (Fig. 1, right panel). This line is about twice less intensive than the [OI] 6300 Å one. So, the signal-to-noise ratio of many of our spectra did not allow us to examine the line. On the other hand, the spectral region near this line is free from telluric lines. Thus,

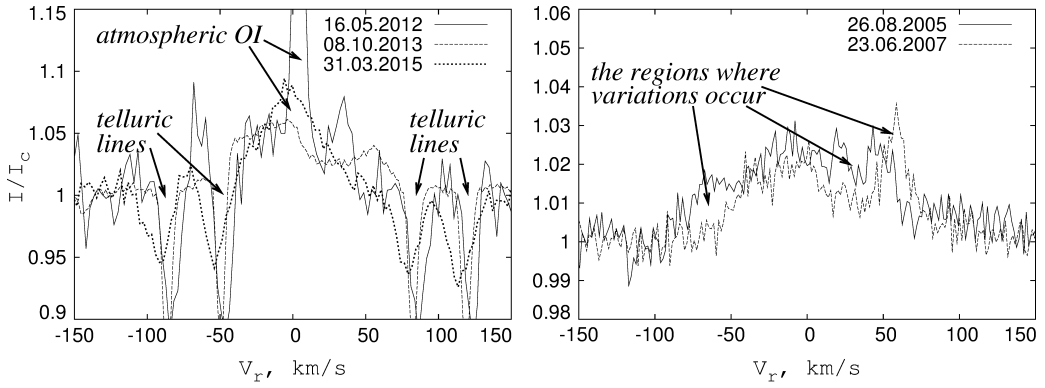

Figure 1: [OI] 6300 Å (left panel) and [OI] 6363 Å (right panel) lines profiles in HD 200775 at different epochs.

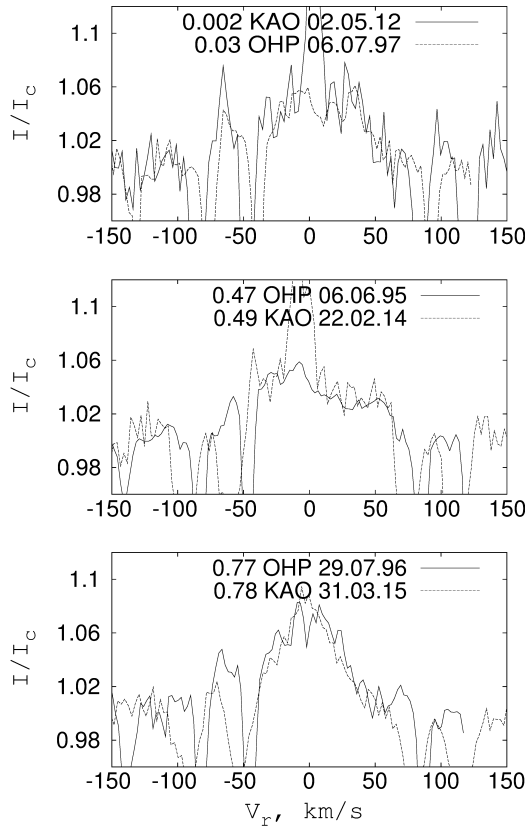

Figure 2: Comparison of [OI] 6300 Å line profiles. The line profiles are different on different panels but similar inside the panels for close orbital phases.

we can verify our results obtained for the [OI] 6300 Å line. We found that the variations in this line profile occur nearly at the same velocity values as for the [OI] 6300 Å line.

Estimating the orbital period, made on the basis of the data covering 20 years in our previous work [7], allowed us to use very accurate values of orbital phases. As a result, we noticed that the [OI] 6300 Å line profiles in the spectra, obtained with different instruments and at different observational epochs but at the same orbital phases, are similar (Fig. 2). This means that the variability of [OI] emission is related to the binarity of the system.

4 Summary

Variability of the [OI] emission in the spectra of HD 200775 is reported for the first time. Significant changes of the lines profiles appear in three components – near −65, 30 and 55 km/s for both [OI] 6300 Å and [OI] 6363 Å lines. They were examined on the basis of 20 years data including new and archival high-resolution

spectra. We found that the line profiles in spectra obtained in different epochs but at the same orbital phases are similar. Thus, we showed that the variations are related to the binarity of the system. The mechanism of the [OI] line variability in HD 200775 is still an open question.

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