SPECTRAL VARIATION OF Be HERBIG STARS

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ABSTRACT. We researched the characteristic time scales and amplitudes of the variability of Hα emission and intrinsic polarization of Be Herbig stars: VY Mon, LkHα215 and HD 259431. The change of Hα profiles as PCyg - PCygIII - single-peaked was revealed in the spectrum of VY Mon. Such transformation is widely accepted to be formed in stellar wind. The double Hα profiles of LkHα215 and HD 259431 reflect the presence of the rotating disk-like envelope with signs of outflow and infall of matter.

Key words: Stars: Be Herbig stars: individual: VY Mon, LkHα215 and HD 259431

1. Introduction

The high resolution studies of emission line profiles of young AeBe Herbig (HAeBe) stars offer the possibility to understand the structure and the physical conditions in the line-emitting regions. The strongest evidence for a disk-like structure around HAeBe comes from the near-IR and millimeter interferometry. The Hα spectropolarimetric observations show traces of dust at the distances of tens of stellar radii (Vinc et al., 2002). Emission line intensities and continuum excesses in the UV may be connected with a level of accretion activity, NIR excesses - with the hot inner disk, millimeter and sub-millimeter excesses - with cold dust in an outer disk. The long-term study of the profile variations can provide a definition of a nature of young stars and the structure of their envelopes.

The emission profiles of Hα can be classified as double, single or P Cyg. It is known that in spectra of some stars Hα profiles can change from one type to another, but a moment of such transformation is unpredictable because of irregularity of these events.

Variability is mainly revealed in change of the bluer wing and the central peak. A scale of variability is from a few hours up to an year. The presence of P Cyg profile of Hα is widely accepted to be the result of the stellar wind. The double profile is explained by the presence of a rotating disk-like envelope with signs of outflow and infall matter of envelope.

We researched the characteristic time scales and amplitudes of Hα variability and the intrinsic polarization of the following stars: VY Mon, LkHα215 and HD 259431.

2. Individual objects

VY Mon - the very young star (O9e -B8e) with a large IR excess, (A_v=8.7mag, P=10%). It's Hα profile changes from PCyg to PCygIII and to single-peaked type. When star is seen as bright, it shows a PCyg profile, when it becomes weaker, an additional blue emission appears, forming a PCygIII profile. And then it turns into a single peak. We received, that PCyg velocity can vary from -62km/s up to -340km/s during 8 months. We have derived the systematic shifts of the main emission centre as: +62km/s, +120km/s, +140km/s for the profiles PCyg, PCygIII and single-peaked, correspondingly. The last observations showed the change of Hα profile type from PCygIII (December, 2006) to PCyg (January, 2007). But variations of the central peak intensity relatively to continuum and fluctuations of the red edge of the line were weak.

All three types of the profile can be explained by the models of anisotropic stellar wind with a variable terminal velocity. Cidale and Ringuelet, (1993) showed, that the different velocity gradients at the onset of the wind can result the transformation of an emission profile from single-peaked into PCyg and into double-peaked in order of decreasing velocity gradients.

Polarimetric measurements provided the study of a nature and geometry of the circumstellar matter. Stellar radiation will be affected by an intrinsic polarization only if a distribution of the scattering matter is not spherically symmetric. The existence of circumstellar dust is supported by large values of an intrinsic polarization. We received the polarization data in the B band for 17 stars in Mon RI (Pavlova, Rspaev 1985). Following estimations of the interstellar contribution in this direction were derived: P_{is}=0.9%, Θ_{is}=162^o. The Stokes parameters U=Psin2Θ and Q=Pcos2Θ for the intrinsic polarization were determined as U_{in}= U*-U_{is}, Q_{in} =Q* - Q_{is}. The intrinsic polarization degree P_{in} and position angle Θ_{in} were evaluated:

$$P_{in} = \sqrt{U_{in}^2 + Q_{in}^2}$$

$$\Theta_{in} = \frac{1}{2} \arctan \frac{U_{in}}{Q_{in}}$$

Then for VY Mon P_{in}=10.3% and Θ_{in}=22^o. A polarization vector may be parallel or perpendicular relatively to a disk plane. Thus one may expect a correlation between a polarization angle and a direction of jets and outflows or disk orientation.

LkHα215 (B1e-B7e) and HD259431 (B6pe) have very broad double Hα profiles, which reveal a rotating star/disk configuration. The double-peaked Hα emissions in spectra of these stars have the constant separations: 173km/s for LkHα215 and 96 km/s for HD259431, while the relative intensities of red and blue peaks are variable. We discovered, that in the spectrum of HD259431 the bluer peak became smaller than the red one during 2005, although the earlier observational data have always shown a reverse picture. The relative intensities of the red and blue peaks may change according to an action of the outflow and infall mechanisms in disk/envelope matter.

The velocities of the central absorptions vary from -35km/s to +58km/s for LkHα215 and from +18km/s to +32km/s for HD259431. These variations may be connected with a variable thickness of an asymmetric disk-like envelope. The observational data of Fernandez et.al., (1995) show that VV Ser (B5) also has a constant separation of a double-peaked Hα, about 230 km/s with the variable intensities of the peaks. A deep central absorption testifies that an equatorial tours of obscuring material can be thick and close to the line of sight.

The following estimations of the intrinsic polarization were obtained for LkHα215: are P_{in}=2.33 - 1.68% Θ_{in}=80 - 78^o and for HD259431: P_{in}=2.09% Θ_{in}=93^o. An orientation of a polarization vector for an optically thick disk may by parallel to a disk plane, then orientation of a disk of such an object is perpendicular to the Galactic plane (Θ_{gal} =165^o). This situation may be consider as a main attribute of an youth of an object.

References

Cidale L.S., Ringuelet A.E.: 1993, *Ap.J.,* **411**, 874.
Fernandez M. et. al.: 1995, *A&ASS,* **114**, 439.
Pavlova L., Rspaev F.: 1985, *Astrophysika,* **23**, 521.
Vink J., Drew J.: 2002, *MNRAS,* **337**, 356.