

SIMULTANEOUS PHOTOMETRIC AND SPECTROSCOPIC ANALYSIS OF A NEW OUTBURST OF V1686 CYG

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Abstract.

This poster presented an analysis of optical observations of the Herbig Ae/Be star V1686 Cyg. This object usually demonstrates slow brightness variations with irregular Algol-type minima. Our observations were obtained with the Byurakan 2.6-m telescope between 2015–2017. During that period we obtained direct images and 14 medium- and low-resolution spectra of V1686 Cyg. In the course of the observations we noticed that it underwent an atypical brightness outburst. After reducing the data we found that the full rise and decline of the star's brightness had an amplitude of almost 3 mags, and lasted about 3 months. We were also able to trace changes in the stellar spectrum during the outburst; they were correlated with the photometric variations.

Keywords: stars: pre-main-sequence, variables: T Tauri, Herbig Ae/Be

1 Introduction

In our project we were studying a group of HAeBe stars in the vicinity of the bright star BD+40°4124, also a Herbig Be star and with a very strong H α emission line. One of group was LkH α 224, another HAeBe star. Those two stars, and the nearby star LkH α 225, were mentioned for the first time by Herbig (1960) in his much-acclaimed study of Ae/Be stars connected to bright nebulosities. Photometric variability of LkH α 224 was detected by Wenzel (1980) and being a variable it received the designation V1686 Cyg. The most complete information about its photometric behaviour so far has been collected in the papers by Shevchenko et al. (1991, 1993) and Herbst & Shevchenko (1999). Estimates of its spectral type have varied from B2 to F9 (see Hernandez et al. 2004, and references therein). In 2015 we started observing the field around BD+40°4124, since a new outburst of V1318 Cyg S had been detected (Magakian et al. 2019). In parallel to those investigations, V1686 Cyg was also observed photometrically and spectroscopically. Its unusual and unsuspected brightening by nearly 3 mag was discovered, and tracked.

2 Results

2.1 The new outburst of V1686 Cyg

During the period from 2015 September to 2016 August no significant photometric variability was detected in V1686 Cyg. But in 2016 August we noticed that the star's brightness rose significantly. During a period of (probably) several months its brightness increased unexpectedly by more than 2 mag in *V*, which is an unusually high amplitude, and then gradually returned to its previous level. The light-curve is shown in Fig. 1.

2.2 The spectrum of V1686 Cyg

2.2.1 Quiescent stage

Spectra taken before the outburst are quite typical for this star. In the red spectral region the most conspicuous line is a broad and strong H α emission, flanked by a weak, blue-shifted absorption feature. By 2016 November–December, after the end of the outburst, the spectrum had returned to the same appearance. In general, during the time of our observations the spectral type of V1686 Cyg could be classified as an early Ae star, judging from the broad wings of Balmer absorptions and the absence of the He I line at λ 5876 Å.

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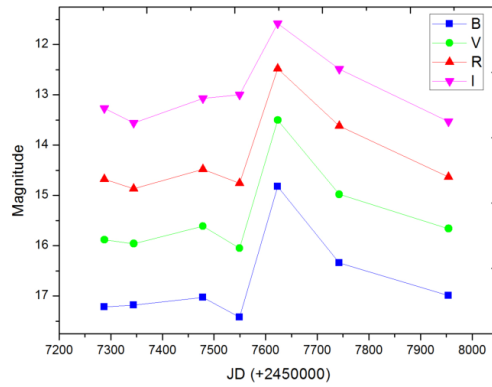


Fig. 1. *BVRI* light-curve of V1686 Cyg during the period 2015–2017.

2.2.2 During the outburst

Significant spectral changes could first be seen in the spectra of the star before any photometric variations were detected. Its maximum brightness was reached in 2016 August. To represent the changes better, we have shown parts of the normalized V1686 Cyg spectrum in Fig. 3 in the region up to $H\alpha$, in various periods; variations in the $H\alpha$ profile are presented in Fig. 2.

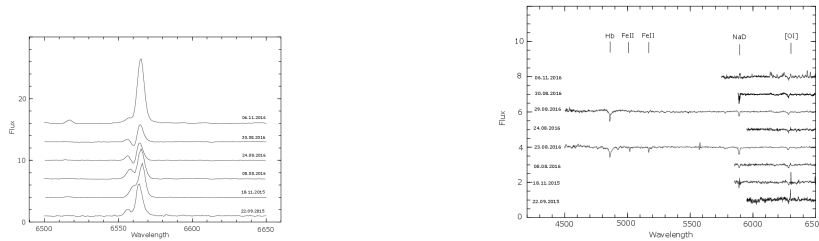


Fig. 2. Strong variations in the profile of $H\alpha$ in the spectrum of V1686 Cyg. During the outburst, the absorption component became rather shorter and is even below the continuum. **Fig. 3.** Variations of the V1686 Cyg spectrum in the region λ 4500–6500 Å. At the outburst, the absorption component became rather shorter and is even below the continuum. At shorter wavelengths $H\beta$ and Fe II absorptions are intense and prominent. There is an obvious increase in chromospheric emission on 2016 November 6.

3 Conclusion

These observations fully confirm pronounced changes in the strengths of certain absorption and emission lines, which easily explain the large range of spectral types assigned to this star. V1686 Cyg is actually one of the most variable of the HAeBe stars in both photometry and spectroscopy, and (at least in this case) we can see that its spectroscopic and photometric variations are directly related. As already stated, the rapidity of the brightening which we observed is not typical of V1686 Cyg. At least, similar events could not be found on the previous long time-span light-curve presented by Herbst & Shevchenko (1999). The brightening was not considered an outburst, because the accompanying spectroscopic changes could be interpreted as the formation of a dense expanding envelope around the star, with subsequent dissipation over several months. This envelope, emitting mainly in the continuum, hid the lower layers of the stellar chromosphere, making the metallic emissions invisible and diminishing even the very strong emission component of the $H\alpha$ line. On the other hand, the envelope was sufficiently dense to produce absorption lines with negative radial velocity. It is not known how long V1686 Cyg will remain in its present low-brightness state. Only new photometric observations will clarify the situation. This star definitely deserves continuing monitoring. Several authors make analogies between the rapid dimming of V1686 Cyg and similar events that occur in UX Ori-type variables. However, this question remains to be investigated. This star could also be an object which combines two types of PMS variability.

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