Stars and their variability observed from space
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EM CEP – AN INTERESTING BE STAR

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Abstract. On the basis of $UBVR$ photometric data, obtained at Abastumani Astrophysical Observatory during 1991–1999, a very interesting and unusual flare in the Be star EM Cep was detected. An increase in brightness in the R band was observed, together with a simultaneous decrease in brightness in the U-band. The duration of the flare was over two hours. We estimated the percentage of brightness increase during the flare and the brightness decrease of the corresponding anti-flare, and the minimum amount of mass lost during this event. Different explanations for the nature of the star were investigated, from a binary companion to a pulsating star to a magnetic reconnection event. The present data point to the star probably being a single magnetic Be star; however, new observations are required to settle the question of the nature of EM Cep finally.

Keywords: $UBVR$ photometry, stellar flare, Be star

1 Introduction

We observed the B-type giant EM Cep at Abastumani Observatory from 1991 to 1999 (Kochiashvili 1999). At that time it was believed to be a bright ($V = 7.03$) short-period variable of spectral type BI IV+?. The amplitude of its variability is 0.15 mag; the period is P = 0.806187 days. Some investigators have considered the star to be a close binary system; some have regarded it as a non-radial pulsator (See Kochiashvili (1999) and literature cited therein). According to her observations, Rachkovskaya (Rachkovskaya 1977)concluded that EM Cep is either a β Cep-type variable or an oblique rotator. As Hα emission lines have been observed in its spectrum (Plaskett & Pearce (1931); Merril et al. (1925); Rachkovskaya (1977)), EM Cep must be a Be-type star. The character of the changes in its light-curves leads us to suggest that it maybe a λ Eri-type short-period Cepheid (Kochiashvili et al. (2007); Bakış et al. (2007); Kochiashvili & Kochiashvili (2008)). We also examined the case of binarity for the star (Kochiashvili & Kochiashvili 2008).

2 The Flare

It is known that O and B stars display flare activity. Two to three decades ago flares were rarely mentioned in the context of early spectral type stars, but according to more recent data such types do in fact belong to the most active class of variables in the Universe. A very interesting "unusual" flare was revealed in EM Cep in 1991. During photometric $UBVR$ observations eith the 48-cm Abastumani reflector a flare was detected in the R band, with a simultaneous anti-flare in the U band (Kochiashvili 1999). The increase in luminosity during the flare in the R band was approximately 24% of the total luminosity of the star; the simultaneous decrease in luminosity in the U-band was about 10%.

3 New findings by Bulgarian astronomers

New spectral observations were carried out during 2004–2015 with the 2-m RCC Rozhen telescope in Bulgaria, with a resolving power of 16 400; most spectra have a S/N ratio of 150–250. EM Cep was initially observed in a spectral region centred on Hα, but after 2005 July the region was changed to include the He I line at λ 6678 Å (Kjurkchieva et al. 2016). According to the new spectral data, EM Cep switches between B-star and Be-star states, as revealed by the level of Hα emission, but spends most of its time in the B-star state.

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4 Conclusions

Be stars and their massive extension, the Oe stars, may prove to be progenitors of late stages of massive-star evolution connected to rapid rotation, such as S Dor variables, or even the long GRBs. A full extension of Be star research to extragalactic environments will only be reached with future facilities, such as extremely large telescopes (Rivinius et al. 2013). There are some unsolved problems concerning S Dor and Be stars that could be related to each other. We believe observations of bright stars of both types with small telescopes is an advantage, so we are continuing to observe EM Cep using the same 48-cm Cassegrain telescope (now furnished with a new CCD), with standard $UBVRI$ filters (see a V light-curve in Fig. 1). We hope to find observational evidence for stellar pulsations, if they occur. One of the aims for these observations is to monitor flare activity of EM Cep.

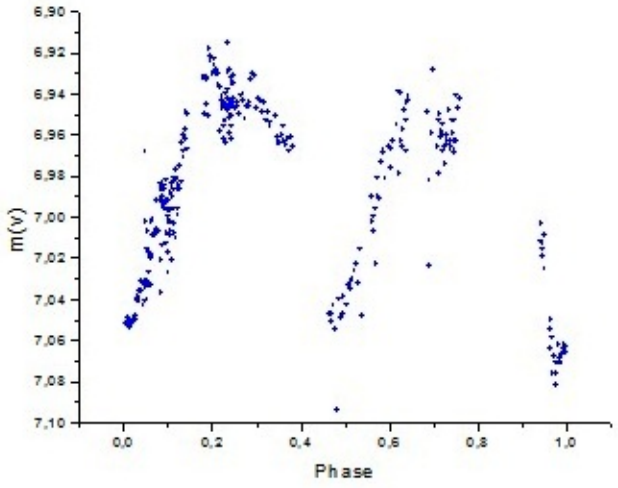

Fig. 1. Observations of EM Cep, V band, made in 2018

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