# The Curious HD 50138

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Intermediate mass and massive stars contribute only a small fraction of the luminous matter in galaxies, but throughout their lifetimes donate a disproportionate amount of energy, momentum, and chemicals to their surroundings, thus establishing their important role in the dynamical and chemical evolution of the interstellar medium and their host galaxies. Moreover, when these stars die, much of their energy and mass is ejected into their host galaxy, creating the seeds for new star formation, as well as strongly influencing the structure, composition, and evolution of the galaxy.

One particular group, B[e] stars, show observational signatures of a circumstellar envelope, probably a circumstellar disk, including narrow forbidden emission lines, molecular emission, and dust emission. This diverse group of stars are further classified by Lamers et al. (1998, A&A, 340, 117), including a group of B[e] stars defined as "unclassified", which remain quite elusive to traditional classification methods. The ambiguity of such objects stems from vast uncertainties in the stellar parameters and distances, as well as strong spectral variability.

Recently a group of researchers from Observatório Nacional (Brazil), Ondřejov Observatory (Czech Republic), Observatoire de la Côte d'Azur (France) and Koninklijke Sterrenwacht van België (Belgium) have studied the galactic star HD 50138 that belongs to this enigmatic group of objects, and has been described as a possible transition object between the classical Be stars and the B[e] supergiants. HD 50138 has been classified by Borges Fernandes et al. (2009, A&A, 508, 309) as a B6-7 III-V star based on high resolution optical spectra from the FEROS/ESO spectrograph. Based on determined stellar parameters (Borges Fernandes et al. 2009), HD 50138 appears to be located in the HR diagram at the end of the main sequence. Historically the star has exhibited several outbursts and shell episodes, evidenced by both spectral variations and photometric observations which showed a drop in UBV magnitudes by $\sim 0.2$ mag.

The circumstellar environment of HD 50138 has been studied extensively through optical spectroscopic, polarimetric and spectropolarimetric observations (see e.g. Bjorkman et al. 1998, ApJ, 509, 904; Oudmaijer & Drew 1999, MNRAS, 305, 166; Harrington & Kuhn 2007, ApJ, 667, 89). Recently, interferometric data indicate the presence of circumstellar disk composed by gas and dust and viewed under an inclination angle of $56^o \pm 4^o$ (Borges Fernandes et al. 2011, A&A, 528, A20).

Recently, Borges Fernandes et al. (2012, A&A, 548, A13), based on new high-resolution optical spectra of HD 50138 obtained with the HERMES spectrograph (Roque de los Muchachos, Spain) during some consecutive nights, confirmed the presence of short-term radial velocity variability for the photospheric lines and line profile variability for the lines formed very close

to the stellar surface (see Fig. 1). On the other hand, purely circumstellar lines do not show such a rapid variability (see Fig. 2).

However, due to the insufficient time coverage of our HERMES observations (only two spectra per night), we could just estimate a period for the short-term line profile variability of $\sim 1.7$ days, but the real period could also be (much) shorter. This period is not connected with the rotation period of $\sim 3.6$ days, derived from He I lines. Instead, it resembles those seen in pulsating stars. Thus, more high resolution ($R \geq 40000$) and high S/N ($\geq 200$) data are definitely necessary for a better comprehension of the nature of this variability.

On the other hand, even considering lower resolution data, an observational campaign to map the line profiles variations, also seen in other lines not only in the photospheric ones, will be very useful and the collaboration pro-am is a very important step. For this, optical-IR spectroscopic and photometric data covering a long time series (at least six complete consecutive nights, with exposure times of 10-15 minutes in a regular time frequency) will allow us to build the light curve of this object and a complete atlas of the line profile variations. These results may help us to properly determine the nature of this curious star and consequently to better understand the formation of the B[e] phenomenon and other phases of the stellar evolution, which are still unclear.

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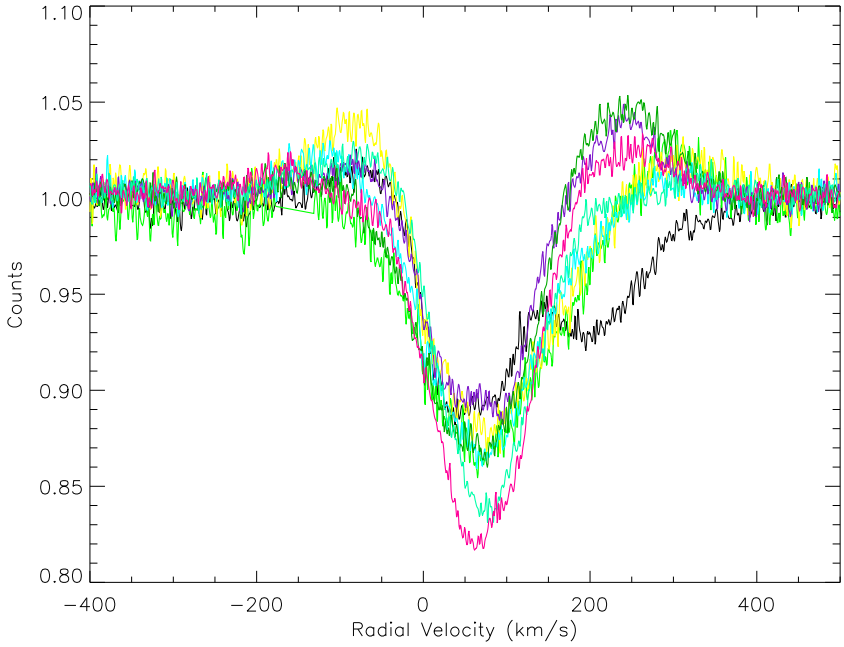


Figure 1: Si II $\lambda$6347 line and its variation night by night seen by data from HERMES spectrograph.

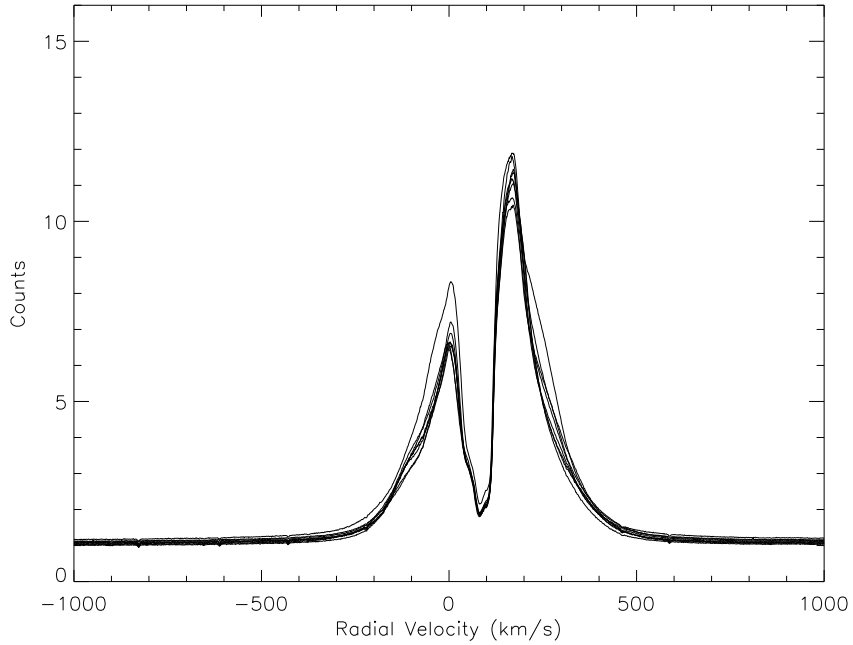


Figure 2: H$\alpha$ and its variation night by night seen by data from HERMES spectrograph.