Active OB stars: structure, evolution, mass loss, and critical limits
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Near-infrared excess and emission characteristics of classical Be stars

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Abstract. Classical Be (CBe) stars are fast-rotating emission-line stars associated with infrared excess often attributed to plasma free-free emission. A few with exceptionally large near-infrared excess, namely with (J−H) and (H−K_s) both greater than 0.6 mag, however, must be accounted for by thermal emission from circumstellar dust. From 2007 to 2009, spectra of more than 100 CBe stars have been collected. We present some of these spectra and discuss how temporal correlation (or lack of) among spectral features would provide possible diagnosis of the origin of the CBe phenomena.

Keywords. stars: early-type, stars: evolution, stars: emission-line, Be, stars: pre–main-sequence, infrared: stars

1. Be stars with large near-infrared excess

Near-infrared excess of most CBe stars is due to free-free emission. A few show significantly large excess in the 2MASS colors (Zhang, Chen & Yang 2005) which cannot be explained by gas only, but requires thermal emission from circumstellar dust. Lee & Chen (2009) suggested that CBe stars are turning-off the main sequence. Dust properties in such evolved main-sequence stars should be markedly different from those in pre-main sequence or in post-main sequence stars. To diagnose the possible relation between gas activity and dust formation in the circumstellar environments, we obtained optical spectra of more than 100 Be stars with the Lulin One-meter Telescope in Taiwan, the SMARTS 1.5 m in Chile, and the 2.16 m telescope in Xinglong, China. Additional infrared photometry has been acquired — in a few cases simultaneously with optical spectra — with the SMARTS 1.5 m, and the 1.88 m telescope of the Okayama Observatory in Japan.

2. Emission lines and near-infrared excess

Fig. 1 shows the near-infrared excess and Balmer activity of CBe stars in a 2MASS/JHK$_S$ color-color diagram. Stars with both Hα and Hβ in absorption — signifying low gas activity — show little near-infrared excess due to lack of free-free emission. Those with Hα in emission, but Hβ and higher Balmer lines in absorption, have moderate near-infrared excess. CBe stars with Hα and Hβ both in emission are highly active, and exhibit large near-infrared excess as well. Some CBe stars have excess emission extending to far-infrared or longer, so must be accounted for by dust emission (Lee & Chen, these proceedings). CBe star are known to vary with timescales from days to years, photometrically and spectroscopically. The 2MASS data shown in Fig. 1 were taken at the same epoch, but the spectra were not. Simultaneous observations of active CBe stars

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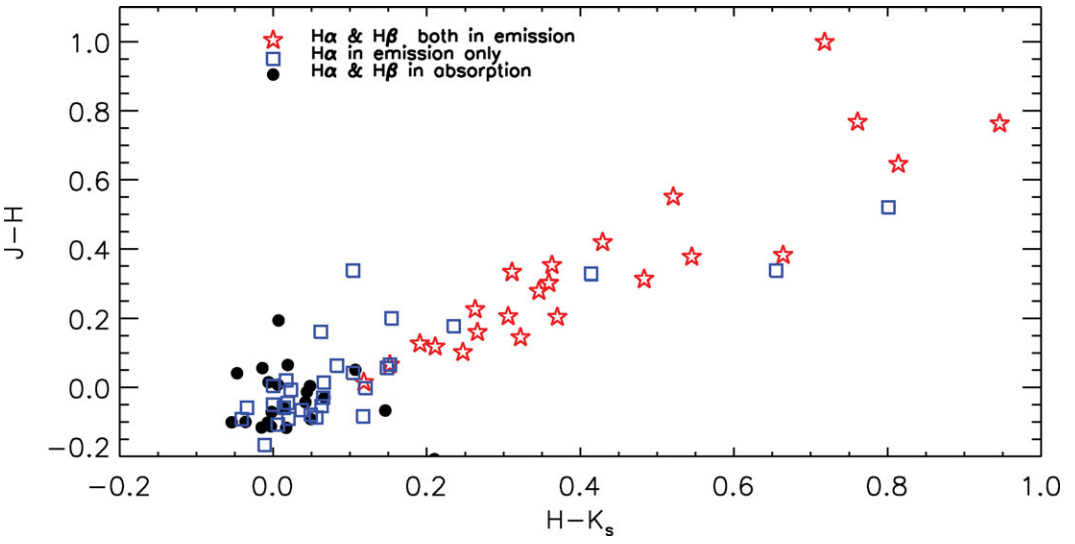

Figure 1. The emission lines and near-infrared excess of CBe stars.

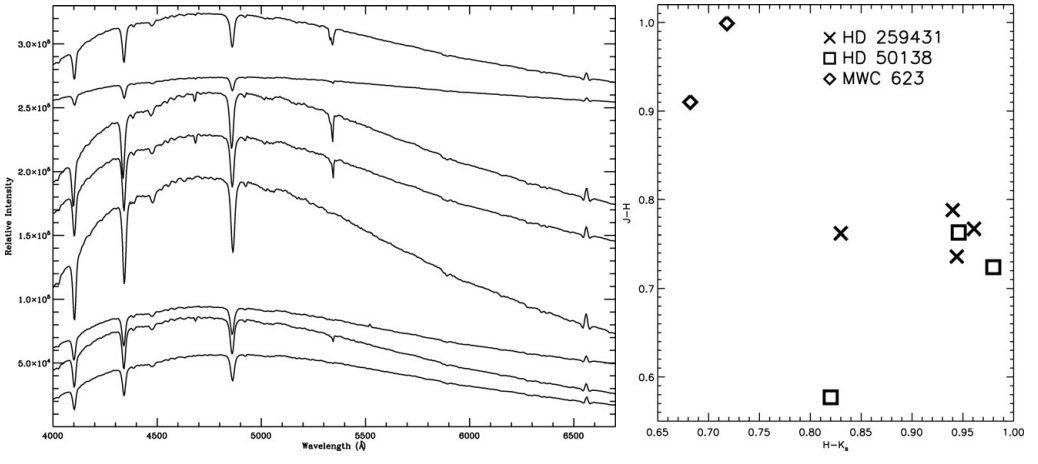

Figure 2. *Left*: HD 142926 shows rapid variations of its He II 5412 Å line within half an hour. *Right*: HD 259431 (crosses), HD 50138(squares) and MWC 623 (diamonds) show variable infrared colors on time scales of hours.

hence are desirable in order to probe the gas activity and dust formation mechanism. So far, variability of near-infrared excess (in hours) and emission lines (within half an hour) have been detected (Fig. 2). We are currently processing data taken simultaneously of the same CBe stars.

References

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