PROPERTIES OF CLASSICAL Be STARS FROM ANALYSIS OF HIGH-RESOLUTION Hα PROFILES

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ABSTRACT. We summarize results of the 25 year period of observations of Be-stars. We suggest that Be stars with moderate and strong Hα emission are good candidates to search for binary systems.

Key words: stars: Be-stars - stars: binary.

Long-term high-resolution spectroscopic observations of classical Be stars in the Hα region are important for understanding the nature of the Be-phenomenon, which is still controversial. We carried out an analysis of published data and more than 1000 spectra obtained at the Ritter Observatory of the University of Toledo (USA) and Main Astronomical Observatory of the Ukranian Academy of Sciences over a total period of about 25 years. Our study revealed that 50% of Be stars brighter than 4 mag. show evidence (mostly from spectroscopy or interferometry) of being binary systems. This fraction is smaller for fainter objects (22% for $V \leq 7$ mag.) probably due to selection effects. The secondary components are usually a few magnitudes fainter than the primaries. We also found that Hα line profiles in high-resolution spectra (resolving power $R \geq 20000$) of many Be stars have a complex structure (3 or more emission peaks rather than the 2 peaks, typically seen at a lower resolution). A noticeable fraction of Be stars with such complex profiles turned out to be recognized binaries. Taking into account that expected separations of the companions in Be binaries are of the order of a few milliarcseconds (which is still beyond the limits of speckle interferometry), we suggest that high-resolution spectroscopy remains the best method to search for Be binaries. It is difficult to detect spectral lines of the secondary components, and hence periodic radial velocity variations of the primaries' spectral lines is the main evidence of the orbital motion in most cases. Amplitudes of such variations are of the order of a few to a few tens km s^{-1}, and therefore spectroscopy with $R \geq$15000 is needed to detect them. The Hα line is usually the strongest feature in the spectra of Be stars which often reflects the orbital motion. Observations in this spectral region are very useful to search for signs of binarity and to monitor the behaviour of the circumstellar envelopes. However, the profiles' fine structure can be resolved only with a much higher resolution ($R \geq$50000).

We suggest that Be stars with moderate and strong Hα emission are good candidates to search for binary systems. Our analysis shows that Be binaries with stronger Hα lines have larger orbital periods, as was previously found for Be/X-ray binaries by Reig, Fabregat and Coe (1997). For example, stars with primaries of early B-types (B0–B3) with a maximum Hα equivalent width of 20–30 Å have orbital periods of 100–200 days (e.g., ϕ Per, ζ Tau, and γ Cas). However, binaries with later–type primaries and similar periods usually have weaker Hα lines (e.g., o And, β CMi, and 4 Her). Thus, regular spectroscopic observations over a period of a few years are capable of determining how frequent binary systems among Be stars are.

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References

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