Astronomy and Astrophysics Supplement Series 1997 vol.122 N1, pages 31-42

An abundance analysis of the single-lined spectroscopic binaries with barium stars-like orbital elements: I. Analysis and results

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Abstract

Detailed abundance analyses have been carried out for 17 single-lined binaries (giants and dwarfs) with orbital elements and mass functions similar to those of barium stars, using high-dispersion CCD spectra and model atmospheres. All these binary systems contain an unseen low-mass component, presumably, a white dwarf. A mild enhancement (+0.1-0.25 dex) of the averaged s-process elements abundances has been found only for two stars. The heavy-element overabundances in these stars are much less marked than those of the classical barium stars having similar orbital periods. We have concluded that the existence of a white dwarf (WD) companion in binary systems with barium star like characteristics is not sufficient to produce a strong barium star. However, five of the analyzed giants show a significant enhancement (0.2-0.3 dex) of barium. The analysis indicates that a main sequence companion has not a significant influence (due to tidal mixing, as has been sometimes suggested) on the internal structure (chemical composition) of the primary star. Since barium enhanced giants occupy a place on the (eccentricity-orbital period) plane similar to Ball stars we have concluded that a mild barium enhancement in these stars is due to mass transfer from the companion during its late phases of evolution. Thus it seems likely that all giants (primaries) in barium star like binary systems with WD component have chemical peculiarities (very slight in some cases) depending, apparently, on the efficiency of mass transfer in a specific binary system. The significant enhancement of heavy elements in the atmospheres of two radial velocity non-variable barium stars shows then that these barium stars have either very long orbital periods or high inclined orbital planes.

Keywords

Binaries: spectroscopic, Stars: abundances, Stars: chemically peculiar, Stars: evolution, Stars: fundamental parameters