Abundance analysis of prime B-type targets for asteroseismology I. Nitrogen excess in slowly-rotating beta Cephei stars

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Seismic modelling of the beta Cephei stars promises major advances in our understanding of the physics of early B-type stars on (or close to) the main sequence. However, a precise knowledge of their physical parameters and metallicity is a prerequisite for correct mode identification and inferences regarding their internal structure.
Here we present the results of a detailed NLTE abundance study of nine prime targets for theoretical modelling: gamma Peg, delta Cet, nu Eri, beta CMa, xi1 CMa, V836 Cen, V2052 Oph, beta Cep and DD (12) Lac. The following chemical elements are considered: He, C, N, O, Mg, Al, Si, S and Fe. Our abundance analysis is based on a large number of time-resolved, high-resolution optical spectra covering in most cases the entire oscillation cycle of the stars.
Nitrogen is found to be enhanced by up to 0.6 dex in four stars, three of which have severe constraints on their equatorial rotational velocity, \Omega R, from seismic or line-profile variation studies: beta Cep (\Omega R~26 km/s), V2052 Oph (\Omega R~56 km/s), delta Cet (\Omega R < 28 km/s) and xi1 CMa (\Omega R sin i < 10 km/s). The existence of core-processed material at the surface of such largely unevolved, slowly-rotating objects is not predicted by current evolutionary models including rotation. We draw attention to the fact that three stars in this subsample have a detected magnetic field and briefly discuss recent theoretical work pointing to the occurrence of diffusion effects in beta Cephei stars possibly capable of altering the nitrogen surface abundance. On the other hand, the abundances of all the other chemical elements considered are, within the errors, indistinguishable from the values found for OB dwarfs in the solar neighbourhood. Despite the mild nitrogen excess observed in some objects, we thus find no evidence for a significantly higher photospheric metal content in the studied beta Cephei stars compared to non-pulsating B-type stars of similar characteristics.

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