OBSERVATIONAL MANIFESTATIONS OF EARLY MIXING IN B– AND O–TYPE STARS

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ABSTRACT. The helium and nitrogen enrichment of the atmospheres of early B-type stars during the main sequence (MS) evolutionary phase is re-analysed. It is confirmed that the effect depends on both the age t and the stellar mass M. For example, the helium abundance He/H increases by 0.04 (60-70% of initial value) for stars with $M = 8 - 13M_{\odot}$ and by 0.025 (about 30%) for stars with $M = 6M_{\odot}$. The nitrogen abundance rises by three times for $M = 14M_{\odot}$ and by two times for $M = 10M_{\odot}$. According to the latest theoretical computations, the observed appearance of CNO-cycled material in surface layers of the stars can be a result of the rotationally induced mixing, in particular, of the turbulent diffusion. Carbon is in deficiency in B stars, but unexpectedly does not show any correlation with the stellar age. However it is shown that the total C+N abundance derived for early B stars conflicts with the theory.

Basing on modern data the helium enrichment is first examined in O-type MS stars, as well as in components of binaries. As compared with early B stars, the He abundance for more massive O stars and for components of binaries show a different relation with the relative age t/t_{MS}. Namely during the first half of the MS stage the normal value $He/H = 0.08 - 0.10$ is conserved, whereas in the short time between $t/t_{MS} \approx 0.5$ and 0.7 a sharp jump is observed up to $He/H = 0.2$ and more. In particular, such a jump is typical for fast rotating O stars ($v \sin i \geq 200$ km s^{-1}). Therefore the effect of mixing depends on mass M, relative age t/t_{MS}, rotational velocity v and duplicity.

The mass problem (the discrepancy between M_{ev} and M_{sp}) is also analysed, because some authors consider it as a possible evidence of early mixing, too. It is shown that the accurate data for components of binaries lead to the conclusion that the discrepancy is less than 30%. Such a difference can be removed at the expense of the M_{ev} lowering, if the displacement of evolutionary tracks owing to the rotationally induced mixing is taken into consideration.

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