Spectroscopic evolution of massive stars on the main sequence

F. Martins^1, A. Palacios^1

1- LUPM, CNRS & Montpellier University

We provide an observational view of evolutionary models in the Hertzsprung--Russell diagram, on the main sequence. For that we computed evolutionary models with the code STAREVOL for 15 < M/Msun < 100. We subsequently calculated atmosphere models at specific points along the evolutionary tracks, using the code CMFGEN. Synthetic spectra obtained in this way were classified as if they were observational data. We tested our spectral classification by comparison to observed spectra of various stars. We also compared our results with empirical data of a large number of OB stars. We obtain spectroscopic sequences along evolutionary tracks. In our computations, the earliest O stars (O2-3.5) appear only above ~50 Msun. For later spectral types, a similar mass limit exists, but is lower. A luminosity class V does not correspond to the entire main sequence. This only holds for the 15 Msun track. As mass increases, a larger portion of the main sequence is spent in luminosity class III. Above 50 Msun, supergiants appear before the end of core-hydrogen burning. Dwarf stars do not occur on the zero-age main sequence above 80 Msun. Consequently, the distribution of luminosity class V in the HR diagram cannot be used to constrain the size of the convective core. The distribution of dwarfs and giants in the HR diagram agrees well with the location of stars analyzed by means of quantitative spectroscopy. For supergiants, there is a slight discrepancy in the sense that luminosity class I is observed slightly earlier than our predictions. This is mainly due to wind densities that affect the luminosity class diagnostic lines. We predict an upper mass limit for dwarf stars (~60 Msun) that is found consistent with the rarity of O2V stars in the Galaxy. Stars with WNh spectral type are not predicted by our models. Stronger winds are required to produce the characteristic emission lines of these objects.

Reference: accepted in Astronomy & Astrophysics
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1612.03044

Comments:

Email: fabrice.martins@umontpellier.fr