Spectral Synthesis / atmospheric models

Lyudmila Mashonkina[1] , Denis Shulyak[2] , Tatiana Ryabchikova[1]

1 - Institute of Astronomy, Russian Academy of Sciences
2 - Institute of Astronomy, Vienna University

Several observational anomalies seem to confirm the presence of inhomogeneous distribution of chemical elements in the atmospheres of different types of chemically peculiar Ap type stars. The chemical non-uniformities may have influence on model atmosphere structure via modification of opacity and emissivity coefficients. Here we review recent results from the detailed modelling of the atmospheres and emergent radiation of Ap stars with the use of two alternative approaches. The first one is the straightforward and self-consistent calculations of atmospheric structure along with the abundance gradients caused by radiative diffusion. The self-consistent diffusion models predict the vertical istributions of 39 elements lighter than La, and Fe-peak distributions qualitatively reproduce the corresponding element stratifications found empirically for some Ap stars. However, no theoretical predictions are available for the rare-earth elements (REE) whichplay a key role in understanding the phenomenon of Ap stars. An iterative procedure is, therefore, applied to determine empirically the vertical distribution of chemical elements with the subsequent re-calculation of model atmosphere structure. The studies of rapidly oscillating chemically peculiar (roAp) stars reveal remarkable REE clouds, located in the uppermost atmospheric layers. We present results from the modelling of non-local thermodynamic equilibrium (NLTE) line formation for Pr II/III and Nd II/III in the atmospheres of roAp stars, and they show a dramatic inward shift of the Pr and Nd enriched layer relative to its position derived at the LTE assumption. The effect of the stratified distribution of Pr and Nd on atmosphere modelling is briefly discussed.