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NLTE Model Atmospheres for Extremely Hot Compact Stars

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Abstract. Present observational techniques provide stellar spectra with high resolution at a high signal-to-noise ratio over the complete wavelength range – from the far infrared to the X-ray.

NLTE effects are particularly important for hot stars, hence the use of reliable NLTE stellar model atmosphere fluxes is required for an adequate spectral analysis.

State-of-the-art NLTE model atmospheres include metal-line blanketing of millions of lines of all elements from hydrogen up to the iron-group elements and thus permit precise analyses of extremely hot compact stars, e.g. central stars of planetary nebulae, PG 1159 stars, white dwarfs, and neutron stars. Their careful spectroscopic study is of great interest in several branches of modern astrophysics, e.g. stellar and galactic evolution, and interstellar matter.

1. Introduction

During their evolution the more massive post-AGB stars can reach extremely high effective temperatures: Up to about 700 kK are predicted by Paczynski (1970) for a star with a core mass of $1.2\,M_\odot$. Due to their flux maximum in the EUV/X-ray wavelength range and depending on their photospheric composition and interstellar absorption, some post-AGB stars have been detected as supersoft X-ray sources, e.g. all PG 1159 stars with $T_{\rm eff} > 140$ kK have been detected by ROSAT. Realistic modeling of the emergent fluxes of these stars is a prerequisite for a reliable spectral analysis.

2. NLTE Model Atmospheres

The model atmospheres (plane-parallel, hydrostatic and radiative equilibrium) are calculated using the code PRO2 (Werner 1986, Werner 1988). All elements from hydrogen to the iron group are considered (Rauch 1997, Dreizler & Werner 1993, Deetjen et al. 1999, http://astro.uni-tuebingen.de/~deetjen/csc.html).

3. Model Atmosphere Fluxes

The high-energy model atmosphere fluxes strongly depend on the metal-line blanketing. The impact of H – Ca is shown in detail by Rauch (1997). In Fig. 1 we show the additional impact of the iron group.

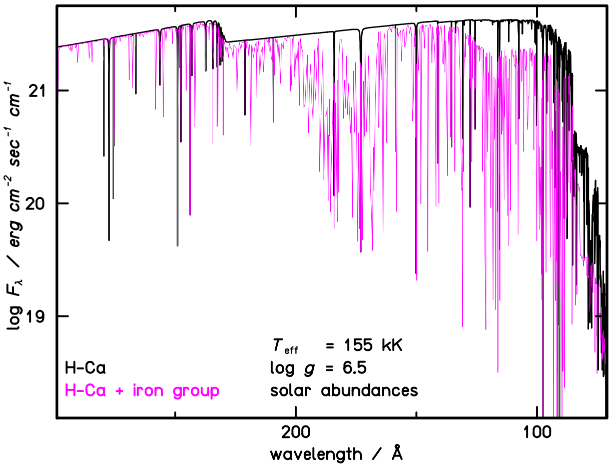

Figure 1. Comparison of two NLTE model atmosphere fluxes without and with consideration of iron-grup elements at solar abundances

A grid of model atmosphere fluxes ($T_{\rm eff} = 50 - 1\,000$ kK, $\log g = 5 - 9$ (cgs), H – Ca, solar and halo abundances) is available at the WWW (http://astro.uni-tuebingen.de/~rauch/flux.html).

4. Conclusions

Emergent fluxes calculated from NLTE model atmospheres which include iron-group line blanketing show a drastic decrease of the flux level at high energies.

For a reliable analysis of extremely hot stars, or the calculation of ionizing spectra from these (e.g. used as input for photoionization models) the consideration of all elements from hydrogen up to the iron group is mandatory.

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