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Abundance determination of A, Am and F stars in the Pleiades and Coma Berenices clusters

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Abstract. Abundances of 18 chemical elements have been derived for 27 A/Am and 16 F stars members of the Pleiades and Coma Berenices open clusters. We have specifically computed, with the Montréal code, a series of evolutionary models for two A star members of these two clusters. None of the models reproduces entirely the overall shape of the abundance patterns. The inclusion of competing processes such as rotational mixing in the radiative zones of these stars seems necessary to improve the agreement between observed and predicted abundance patterns.

Key words: stars: abundances – diffusion – open clusters and associations: individual: Coma Berenices, Pleiades

1. Introduction

Stars in open clusters have the same initial chemical composition and age. They are very useful to test the predictions of evolutionary models. Models for F and A stars have already been calculated by Turcotte *et al.* (1998) and Richer *et al.* (2000) respectively. The main thrust of this paper is to compare the derived abundances with new self-consistent models calculated with the Montréal code.

2. Method

Our observing sample consists of 22 A/F star members of the Coma Berenices cluster and 21 A/F stars of the Pleiades open cluster. These stars were observed using ELODIE and SOPHIE échelle spectrographs at the Observatoire de Haute-Provence (OHP). For each star, effective temperature ($T_{\rm eff}$) and surface gravity ($\log g$) were determined using the UVBYBETA code of Napiwotzki *et al.* (1993), based on Strömgren's $uvby\beta$ photometric indices. LTE model atmospheres were computed using Kurucz's ATLAS9 code (Castelli, Kurucz 2003). The linelist was constructed from Kurucz's gfall.dat[1]. The oscillator strengths were checked against more accurate laboratory determinations when available. Synthetic spectra were computed using Takeda's (1995) iterative procedure.

[1]http://Kurucz.harvard.edu

The microturbulent velocities, rotational velocities and the abundances of 18 elements were determined by fitting the line profiles of the observed spectrum.

3. Results

For A stars, we found large star-to-star variations in the abundances of most elements. Evolutionary models that include the effects of atomic and turbulent diffusion were calculated for 2 A stars, HD 23631 (a member of Pleiades cluster) and HD 107966 (a member of Coma Berenices cluster). These clusters have very similar metallicity, therefore we can follow the evolution of the surface chemical composition of a star at the age of the Pleiades (100 Myr) to the age of Coma Berenices (450 Myr). After a series of tests, the adopted model was the T5.3D200k-3 (see Richer *et al.*, 2000 for details). Most of the iron peak elements are well fit by the model (Fig. 1). A few discrepancies exist for the light elements Na, Mg and Si. Part of these discrepancies may arise from non-LTE effects. However, the inclusion of competing processes such as rotational mixing in the radiative zone (or mass loss) should help reproduce the observed patterns.

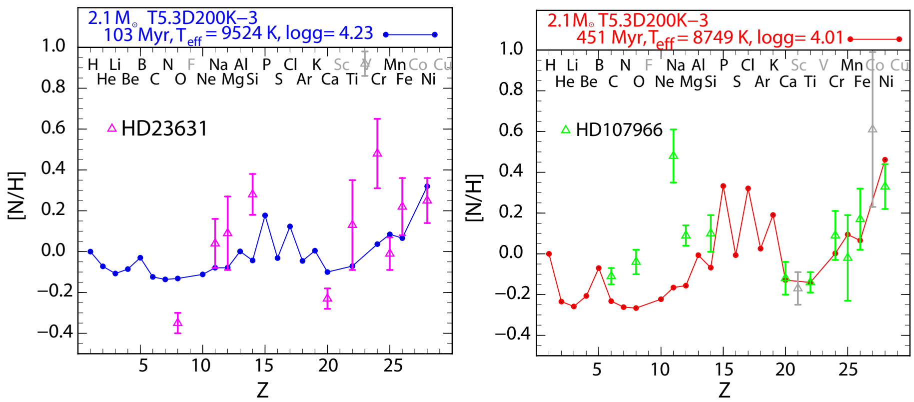

Figure 1. Predicted surface abundances at 100 Myr for HD 23631 (left panel) and at 459 Myr for HD 107966 (right panel). Triangular symbols represent the observed abundances with representative error bars.

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