THE SUPER METAL RICH COMPONENT OF THE GALAXY

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Abstract. We present the results obtained by comparing mid-resolution stellar spectra of super metal rich candidates with synthetic spectra computed in the wavelength range 4850–5400 Å. Atmospheric parameters, derived by using the flux fitting method, are illustrated for a sample of representative stars. The final aim of the project is the definition of a fully consistent metallicity scale for SMR stars.

1. Introduction

Facing the extensive evidence for enhanced chemical evolution among stellar populations in the Milky Way and in external galaxies, we have undertaken a project based on a full comparison between observed and theoretical spectra. We aim at a quantitative definition of the metallicity scale at supersolar regimes in order to better constrain the chemical evolution of the Galaxy bulge and provide a useful interpretative tool for population synthesis studies in external galaxies.

The main requirements of the method are (i) a suitable observational database of stars of super solar metallicity, and, for each star, (ii) a set of reliable atmospheric parameters, namely effective temperature, surface gravity, and overall metallicity (T_{eff}, log g, [M/H]).

2. The Observational Database

We selected a sample of about 200 stars of spectral types from F to M as candidate super metal rich (SMR) stars ([Fe/H] $>$ 0.0) on the basis of the current estimates of metal abundance reported in the literature (Chavez *et al.*, 1996).

Observations were taken during three runs at the 2.12 m telescope of the INAOE 'G. Haro' Observatory in Cananea (Mexico). The Böller and Chivens spectro-

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TABLE I
Atmospheric parameters for 4 representative stars

HD	Sp. Type	V	$B-V$	T_{eff}	log g	[Fe/H]	Ref. (Cayrel *et al.*, 1997)
30652	F6V	3.19	0.45	6300		+0.16	75
30652				6462		+0.18	153
30652				6462	4.5	-0.69	266
30652				6380	4.4	+0.02	294
				6371	**4.15**	**+0.06**	**Present work**
83951	F3V	6.14	0.36	6720	4.0	+0.14	502
83951				6789	4.11	-0.02	565
83951				6840	4.00	+0.03	653
				6810	**4.08**	**+0.16**	**Present work**
182572	G8IV	5.16	0.77	5478		+0.42	154
182572				6000		+0.51	173
182572				5663	4.26	+0.50	188
182572				5727	4.13	+0.44	254
182572				5727	4.60	+0.39	270
182572				5663	4.0	+0.21	294
182572				5380	3.92	+0.15	574
				5448	**3.96**	**+0.13**	**Present work**
187691	F8V	5.10	0.56	6146	4.4	+0.10	315
187691				6146	4.4	+0.13	328
187691				6146	4.4	+0.14	376
187691				6146	4.14	+0.09	624
				6079	**4.14**	**+0.02**	**Present work**

graph was working in the range 4600–5500 Å at mid–resolution (2.5 Å FWHM at 5000 Å). So far we gathered about 250 good quality (S/N in the range 50–200) spectra for 139 stars.

3. Atmospheric Parameters

The catalogue by Cayrel *et al.* (1997), contains 5946 [Fe/H] determinations from high resolution spectroscopic analyses for 3247 stars. The atmospheric parameters for 110 stars of our sample are listed in this Catalogue. Unfortunately, high

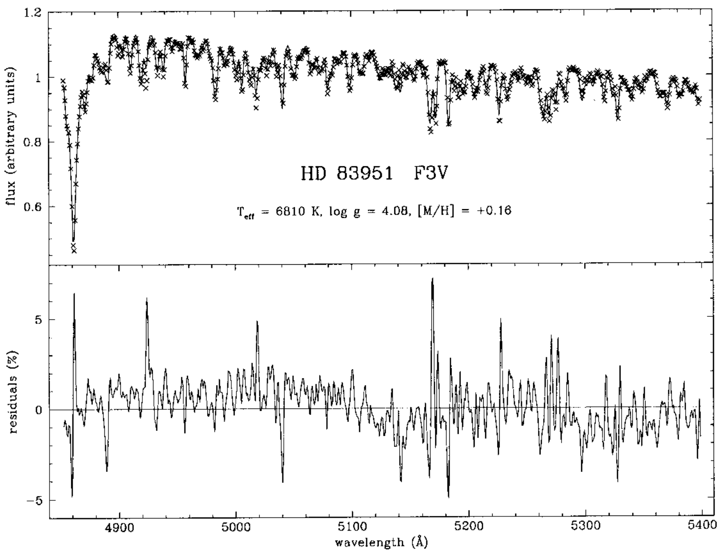

Figure 1. Upper panel: comparison between observations ($\times$) and synthetic fluxes (solid line); Lower panel: percentage residuals.

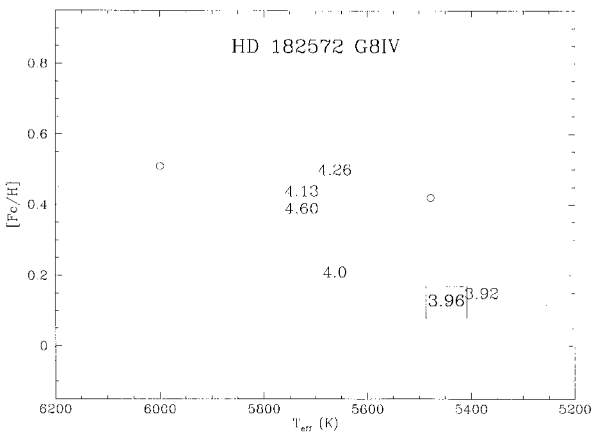

Figure 2. Atmospheric parameters (see Table I) for the G8IV star HD 182572.

resolution observations in the literature cover, with very few exceptions, a limited wavelength range, thus preventing self–consistent determinations of the complete set of atmospheric parameters. To ensure homogeneity and completeness, we chose to derive the set of atmospheric parameters for each star by using our own observations and a grid of ad hoc computed synthetic spectra (Chavez *et al.*, 1997).

We applied the flux fitting method basically described in Malagnini and Morossi (1983), modified in order to derive simultaneously the three parameters (T_{eff}, log g, [M/H]) from mid resolution spectra instead of spectral energy distributions.

A sample of our results, for four representative stars of different spectral type, is illustrated in Table 1 where our fiducial atmospheric parameters are compared with the available estimates from the Cayrel *et al.* (1997) catalog according to different sources in the literature.

The case of HD 83951 (an F3V star) is reported in more detail in Figure 1. A fair agreement is achieved between original observations and synthetic fluxes with a typical scatter in the fit on the order of $\pm 2\%$ at $1 - \sigma$.

A recognized major problem when deriving individual estimates of metallicity, temperature and gravity from stellar spectra is a sort of 'degeneracy' of these fiducial distinctive parameters. An example of the interplay of the 3 parameters is illustrated in Figure 2; in particular, any safe estimate of $[Fe/H]$ is prone to the uncertainties affecting the determination of T_{eff} and log g. To disentangle the problem we should rely on the simultaneous determination of the atmospheric parameters when matching the synthetic fluxes over the whole wavelength range of the observations.

This work is in progress and the final results for the whole stellar sample will be presented in a forthcoming paper (Malagnini *et al.*, 1999).

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