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The Determination of Stellar Parameters of Giants in the Galactic Disks and Bulge

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Abstract. Here, we present our on-going work on the determination of stellar parameters of giants in the Galactic Disks and Bulge observed with UVES on the VLT. We present some preliminarily results.

Keywords. stars: abundances, stars: fundamental parameters, stars: late-type, Galaxy: disk

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Our project aims at discerning whether the Galactic bulge and the thick disk are evolutionarily connected, by differentially studying their respective chemical evolution. Here, we present our initial step dealing with the detailed determination of the fundamental parameters of our target stars: metal-rich ($-0.5 <$ [Fe/H] < -0.1), late-type ($4000\,\mathrm{K} < \mathrm{T} < 5000\,\mathrm{K}$) giants. This step is important for the subsequent step of accurately determining the abundances from these rich spectra.

One advantage of our project is that it is a strictly differential analysis of spectra, with homogeneously determined stellar parameters. Thus, the stars will be analysed in an identical way in order to firmly establish the picture of the abundance evolution of the two populations in relation to each other. We will analyse standard stars, thick disk and bulge stars.

Here we present the analysis of a sub-sample of our stars: 8 thick-disk and 8 standard stars. We are currently working on more thick disk and bulge giants. The spectra were recorded with UVES at S/N= 75 and $R = 60\,000$, and were reduced with REDUCE (Piskunov & Valenti, 2002). The Fe line measurements were done in IRAF and the line synthesis and analysis was done in the MARCS model-atmosphere environment. Our analysis is based on the discussions in Fulbright *et al.* (2006), who analysed bulge giants.

Equivalent widths for more than 120 Fe I absorptions lines in the middle and red parts of the spectra were measured. To be able to determine the surface gravities also eight Fe II lines were analysed. By requiring that the iron abundance should be independent of the excitation potential, we modified the temperature of the models (increments of 25 K). The $\log g$ was estimated by studying the difference in the abundance for Fe I and Fe II. Finally, diagrams with abundance vs $\log W/\lambda$ for Fe I were constructed to determine the microturbulence velocity. When these parameters are defined it is possible to assign to the star its metallicity. For the standard stars, it is possible to get accurate starting values from photometry for T_{eff} and $\log g$ and then iterate and find the spectroscopically based parameters. For the thick disk stars more iterations were required.

Table 1. Preliminary fundamental parameters of a sub-sample of our programme stars

Star	$T_{\rm eff}$ (phot)	# of colors	$T_{\rm eff}$ (spec)	$\log g$ (Hipp)	$\log g$ (FeII/FeI)	$\xi_{\rm micro}$ [kms^{-1}]	[Fe/H] (spec)	[Fe/H] (phot)
Standard stars:								
HD113226	4974 (22)	3	4961	2.80	2.80	1.5	0.07	
HD123139	4753 (51)	1	4740	2.76	2.50	1.5	-0.15	
HD124897	4240 (37)	7	4270	1.93	1.35	1.7	-0.62	
HD138716	4743 (43)	4	4683	3.02	3.02	1.1	-0.14	
HD139663	4233 (15)	2	4377	1.83	1.83	1.7	0.03	
HD161096	4503 (15)	2	4534	2.48	2.46	1.5	0.16	
HD171443	4223 (51)	1	4276	1.85	1.55	1.5	-0.12	
HD175190	4176 (21)	6	4259	1.00	1.50	1.6	-0.22	
Thick Disk stars:								
HD 1378	4007 (51)	1	4148		1.00	1.5	-0.10	-0.13
HD 2763	4169 (78)	3	4246		1.50	1.5	-0.23	-0.22
HD 3356	4142 (16)	4	4272		1.25	1.5	-0.50	-0.35
HD 3524	4016 (51)	1	4029		1.00	1.3	-0.34	-0.47
HD 3709	4254 (9)	4	4327		1.75	1.6	-0.16	-0.05
HD 4303	4575 (22)	6	4625		1.75	1.5	-0.20	-0.14
HD 4955	4043 (51)	1	4135		1.00	1.5	-0.38	-0.40
HD 8349	4029 (51)	1	4154		1.25	1.4	-0.20	-0.27

The photometrically and spectroscopically determined parameters for the standard stars agree well, which is reassuring for our analysis of the thick disk sample. Finally, we compared the spectroscopically derived iron abundances for the thick disk stars with iron abundances derived from DDO photometry using the calibration by Holmberg & Flynn (2004). The agreement is in general good. Table 1 summarizes our results.

Our full project includes three sets of stars, local standards, thick disk stars, and stars in the Galactic bulge. The aim with the current study is to investigate how well we can trust different methods for derivation of the stellar parameters. For the Bulge stars we will have significantly less good information as compared to our data for the local standard stars. Differential reddening will be one of the greatest problems there. With the current results it does appear that $\log g$ can be derived using excitation balance in iron (see Table 1 for the standard stars). This is in agreement with what was found by Kraft & Ivans (2003).

We will also further investigate possible departures from the assumption of LTE in the derivation of the iron abundances in such cool giant stars. For this we plan to use e.g. the methods and model by Collet *et al.* (2005)

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