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The metal–poor end of the Spite plateau: gravity sensitivity of the Hα wings fitting.

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Abstract. We recently presented (Sbordone *et al.*, 2009a) the largest sample to date of lithium abundances in extremely metal-poor (EMP) Halo dwarf and Turn-Off (TO) stars. One of the most crucial aspects in estimating Li abundances is the $T_{\rm eff}$ determination, since the Li I 670.8 nm doublet is highly temperature sensitive. In this short contribution we concentrate on the $T_{\rm eff}$ determination based on Hα wings fitting, and on its sensitivity to the chosen stellar gravity.

Keywords. Nuclear reactions, nucleosynthesis – Galaxy: halo – stars: abundances, Population II

1. Introduction

In Sbordone *et al.* (2009a) we present lithium abundances for a sample of 28 stars in the $-3.6 <$[Fe/H]$<$-2.4 range, 10 of which have [Fe/H]$\leqslant -3.0$. We derived four different $T_{\rm eff}$ scales: Hα wings fitting against a grid of synthetic profiles from 1D models using Barklem *et al.* (2000) or Ali & Griem (1966) self-broadening theories (BA and ALI scales); Hα fitting against a 3D-hydrodynamical grid based on CO^5BOLD models (Freytag *et al.* 2002; Wedemeyer *et al.* 2004) with Barklem *et al.* (2000) self-broadening (3D scale); InfraRed Flux method (IRFM, González Hernández & Bonifacio 2009).

2. The Hα gravity sensitivity

Effective temperature ($T_{\rm eff}$) is the most crucial stellar atmosphere parameter influencing Li abundance determination: Li abundances derived from the Li I 670.75nm line are sensitive to $T_{\rm eff}$ at a level of about 0.03 dex for each 50 K variation in $T_{\rm eff}$. Being mostly temperature sensitive, the Hα wings are also influenced by the adopted surface gravity, to a level which might be significant in the present scope. In this short contribution we

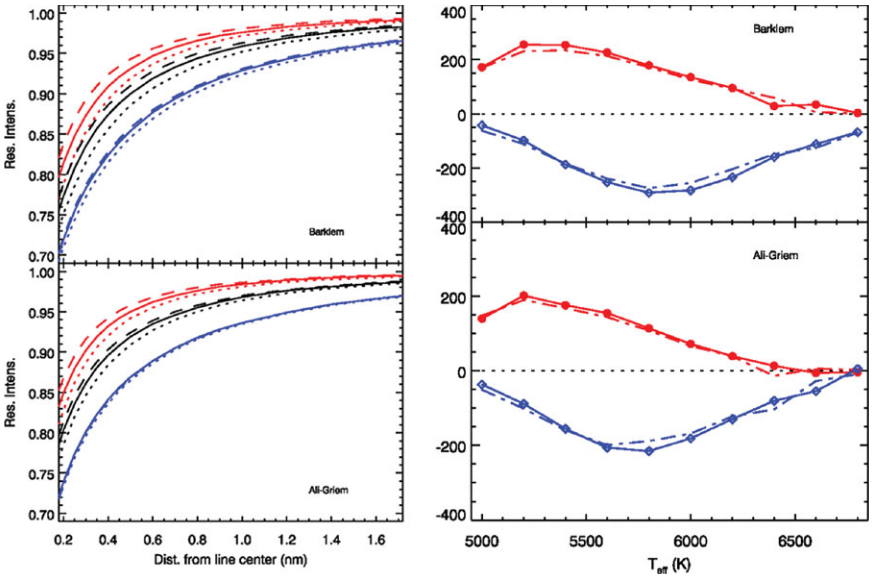

Figure 1. Left panel, for BA and ALI scales, 1D synthetic profiles of the Hα red wing are plotted for $T_{\rm eff} = 5400$ K, 6000 K, and 6600 K (red, black and blue respectively). Line type identify gravity, dashed for log g = 3.5, solid for log g = 4.0, dotted for log g = 4.5. In the right panel, the effect of gravity offsets on $T_{\rm eff}$ estimate are shown. Theoretical profiles computed with log g = 4.0 have been fitted with log g = 3.5 profiles (red lines, filled circles) and log g = 4.5 profiles (blue lines, open diamonds). The temperature difference (recovered-real) is plotted against the real temperature. Solid lines refer to [Fe/H] = -3, dotted to [Fe/H] = –2.5.

concentrate on this effect. Barklem *et al.* (2002) already reported estimates of such a sensitivity down to [Fe/H]=−2. The effect is always in the sense of higher gravity leading to broader profiles, and appears generally stronger at lower metallicities, and for the BA profiles compared to the ALI profiles. The effect is shown in Fig. 1, where we show both the shape of the Hα red line wing and the temperature offset deriving from adopting the wrong gravity estimate in measuring effective temperature. As it can be seen, in the temperature range 6000-6500K, most significant for Li measurement in EMP TO and dwarf stars, significant (>100K) offsets can arise from neglecting the gravity dependence in fitting Hα profiles, which can appreciably skew the results when Li abundances are measured over a fairly broad temperature range (see Sbordone *et al.* 2009b).

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