Reference stars for atmospheric parameters

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The use of a library of observed stellar spectra implies to have a set of stars with available atmospheric parameters (Teff, logg, [Fe/H]), the most accurate as possible. The primary method for the determination of atmospheric parameters is the detailed analysis of HR, high S/N spectra. Photometric relations can also be used but they are empirical relations which have been calibrated from the primary method. The [Fe/H] catalogue is an exhaustive compilation of detailed analyses found in the litterature. Two editions are currently available. The 1996 edition (Cayrel de Strobel et al, 1997, A&AS 124, 299) includes 5946 determinations of (Teff, logg, [Fe/H]) for 3247 O to M stars, corresponding to 700 papers from 1950 to 1995. The 2001 edition (Cayrel de Strobel et al, 2001, A&A 373, 159) includes similar numbers of determinations and stars (6354 and 3356 rerspectively) but restricted to FGK stars and to 378 papers from 1980 to 2000. It is interesting to note that a great part of the stars in the 2001 edition are also part of the Hipparcos catalogue, 1556 stars having a relative error on parallaxe better than 10%. The distribution of the catalogue in the plane Teff - logg and in the plane Teff - [Fe/H] (respectively Figs. 2 and 3 of the 2001 paper) show that the most studied stars are solar type stars, turn-off and giants. There is a dramatical lack of cold dwarfs. The metal-poor stars are very well represented in the catalogue despite their weak number in the solar neighbourhood.

There is a major drawback when using the catalogue : it is a bibliographical one which means that several determinations of (Teff, logg, [Fe/H]) can be found for a given star (up to 31). Some 35% of the stars included in the catalogue were analysed at least twice. As for a given spectrum in a library we want to have the best set of parameters, the question is : can we adopt as the best set of parameters the weighted mean of the determinations included in the [Fe/H] catalogue ? The specialists of stellar physics do not like to average results of different authors which use different model atmospheres for their analyses or different temperature scales. As a matter of fact, the most recent detailed analyses show a very good agreement authors. The Fig. 1 shows the histogrammes of the standard error on mean parameters for the stars of the catalogue which were analysed at least twice. The median standard error is 26 K in Teff, 0.07 in logg and 0.04 in [Fe/H], with a simple weighting system giving less weight to the older references. These low values demonstrate that averaging different determinations is not such a bad idea.

As a conclusion, the [Fe/H] catalogue is a major source to find the stars with the most reliable atmospheric parameters to be used as reference stars. But there is a strong need to continue the compilation of detailed analyses from the litterature to improve the mean atmospheric parameters and to have more stars in reference libraries. The search of parameters should be extended to hot stars and to other parameters which act on the shape of the spectra, like the rotational velocity, the relative abundance of alpha elements. Thus a systematic compilation of all useful physical parameters of all type of stars should be organised. This is one of the projects of the french Programme National de Physique Stellaire who plans to construct a database of HR echelle spectra from various instruments (UVES, ELODIE, FEROS, MUSICOS..) with dedicated tools to retrieve useful information on the archived stars.

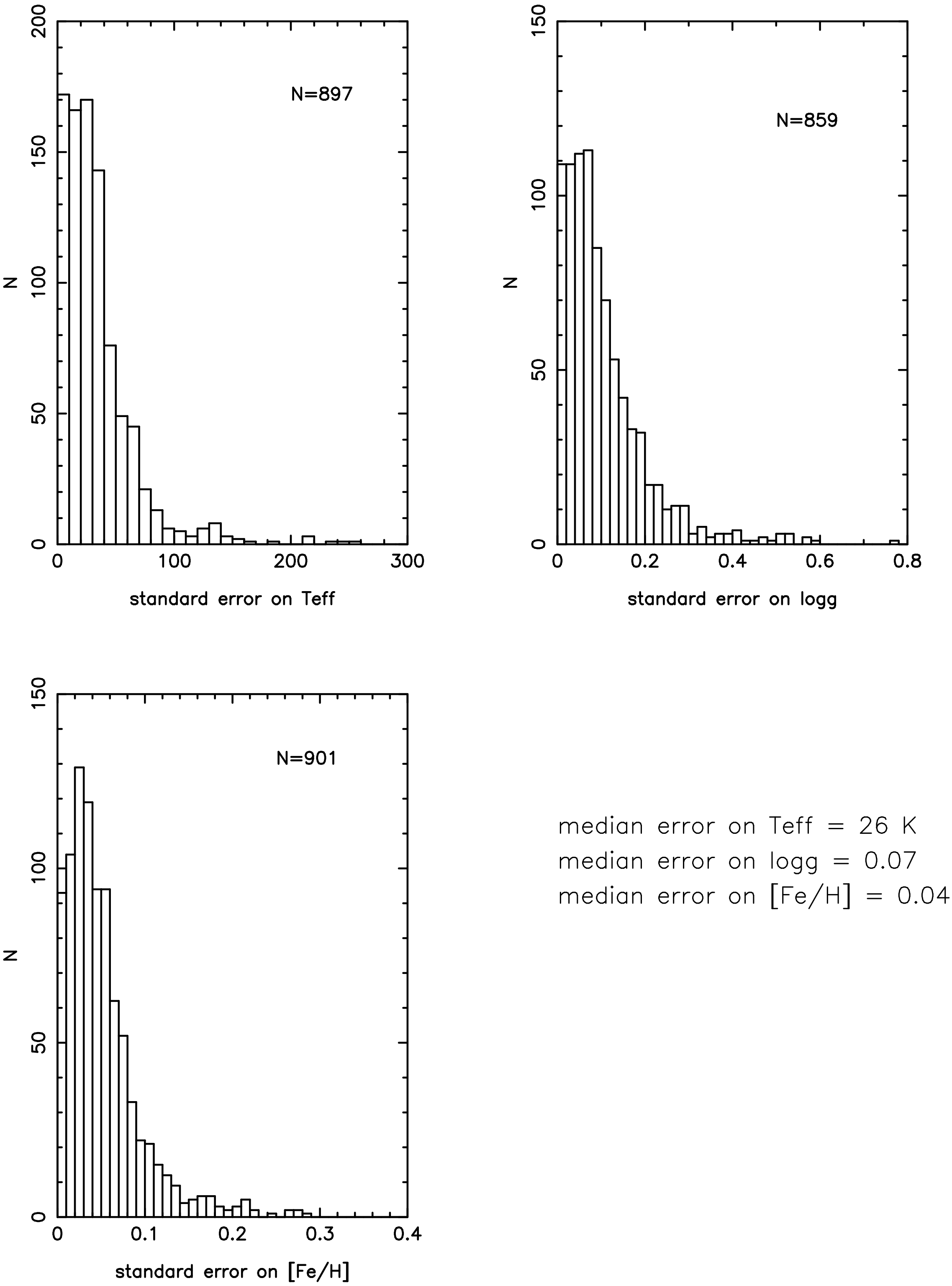

Figure 1: Histograms of the standard error on mean atmospheric parameters included in the 2001 edition of the [Fe/H] catalogue.