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OBSERVED AND COMPUTED FEATURES AROUND Li I 6708 IN NORMAL A AND EARLY F STARS

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ABSTRACT For a set of normal A and early F type stars, we discuss the possible contributors which can affect the Li feature and their effect on the determination of the Li abundance.

INTRODUCTION

A previous study of the Li abundance in some Ap stars shows that the behaviour of the spectrum around the Li I position at 6707.8 A may vary considerably from one star to another (Faraggiana et al., 1986). So far, we raised the problem of a possible confusion between the true Li doublet and very near lines produced by other elements (Gerbaldi and Faraggiana, 1991). So, before to deal with the determination of Li abundance in such a peculiar context, we have observed a sample of non-peculiar stars.

In the present paper we are giving the results obtained for these stars and in particular we discuss the possible contributors which can affect the Li I feature and their effect on the determination of log N_{Li}. Model atmosphere, atomic data and the code for the computation of synthetic spectra are those of Kurucz, implemented at Trieste and Paris-Meudon by one of us (F. C.).

OBSERVATIONS AND BASIC DATA OF THE SELECTED STARS

The observations were made with various instrumentations of similar capabilities : the Coudé Echelle Spectrometer (CES) of European Southern Observatory (Chile) and with the ISIS and AURELIE spectrographs at the Observatoire de Haute Provence (France). The list of the observed stars and their parameters are given in Table I.

We have derived T_{eff} and log g (columns 2 and 3, Table I) from the grid c_o versus $(b\text{-}y)_o$ of the new theoretical colours computed by Kurucz (1991, Data on magnetic tapes). The observed colours (Hauck and Mermilliod,1990) have been dereddened by using an extension of Moon (1985) code UVBYBETA in order to include stars of spectral type later than A3.

The vsini value has been estimated for each star, when possible, by comparing the lines of the observed spectrum with the computed ones broadened for various values of vsini. (Column 4 of Table I)

For each spectrogram, we measured the EW of the feature centered at 6707.8 A or, when no line was detectable, the upper limit of the possible feature at the Li I wavelength.

The EWs, in mA, are collected in Table I (column 5), a mean value is given when several spectrograms have been measured for a star.

COMPUTED Li FEATURE

Since the abundance determination is based on the fit between observed and computed fluxes, it is important to know by which factor lines of other elements could contaminate the spectrum at the location of the Li I feature. We have checked that the Kurucz line list does not overestimate the absorption features in this spectral domain by comparing the observed and computed spectrum for the Sun, Procyon and Vega. None of them contains detectable spurious lines.

The Fe I 6707.44 is not included in the Kurucz line list. We have added it; the energy levels have been taken from Sugar and Corliss (1985) and the log gf=-2.30 from Müller et al. (1975) has been adopted as it gives an upper limit. In measuring the EW of the computed Li I feature we have to take into consideration the contamination by lines in an interval depending on the vsini of the star. The chosen interval is λ6707.0-6708.6 representative of a vsini of 25 km/s.

An array of synthetic spectra with Li abundances ranging from log N[Li]=-8 to log N[Li]=-12 has been computed for each T_{eff}.

TABLE I The programme stars

HD	T_{eff}	log g	vsini	EW
739	6700	4.20	5	24
23878	8700	3.75	20	4
40136	7200	3.95	18	32
60179	9900*	4.00*	15	2
61421	6780	3.75	6	3:
82328	6550	3.80	12	107
128167	6970	4.15	10	2
156208	9700	3.00	25*	4
172167	9500	3.80	20	2
186689	8220	4.20	35	8:
203096	7250	2.35	30	5:
205939	7800	3.40	20	19

* : values taken from the literature

TABLE II Computed EW [λ6707.0-6708.6]

T_{eff}	EW	EW
6250	5.9	1.4
6500	4.9	1.4
7000	3.7	1.7
7500	4.3	2.9
8000	4.3	3.5
8500	3.8	3.5
9000	3.2	3.0
9500	2.5	2.4
10000	2.0	1.9

column 2 : EW with Fe I line
column 3 : EW without Fe I line

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DISCUSSION

We notice that, whatever the value of T_{eff} is, when the Li abundance decreases towards low values, the limit of the total EW of the λ6708 feature is not zero.

The contribution of the Fe I 6707.44 line to the asymptotic value has been estimated by computing the EW of the Li I feature with and without the Fe I contribution and for a Li/H abundance of -12. These EW are given Table II. We notice that the Fe I intensity decreases with T_{eff} and is negligible for T_{eff} larger than 8500 K but for A-type stars the contribution of the others contributors cannot be forgotten.

Only 4 stars out of the 12 observed have a measured value of the 6708 feature higher than 10 mA. For these stars, in the hypothesis that the Kurucz' line list, with the addition of FeI line, is good and our choice of T_{eff} is correct, we obtain the following Li abundances (log N[Li]) :

HD 739 : -9.4; HD 40136 : -9.0; HD 82328 : -8.6; HD 205939 : -8.9.

For the remaining 8 stars the value of the λ6708 feature is less than 5 mA, except for HD 186689 for which we have only a noisy spectrum. The determination of Li abundance is practically meaningless in view of the above discussion.

For stars with T_{eff} higher than 8500 K, Li abundances lower than the cosmic value log N(Li)=-9 are very difficult to determine; they may be possible only for very low rotators and they require spectra at very high resolution and taken with a high S/N.

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REFERENCES

Faraggiana, R.,Gerbaldi, M., Castelli, F., Floquet, M. : 1986, A.A. 158,200
Gerbaldi, M., Faraggiana, R. : 1991, Mem. Soc. Astron. Ital. 62, 97
Hauck, B., Mermilliod, J.C : 1990, A.A.Supp. 86, 107
Kurucz, R.: 1991, Precision Photometry : Astrophysics of the Galaxy A.G. Davis Philip, A.R. Upgren, and K.A. Janes, editors L. Davis Press, Schenectadty
Moon, T.T.: 1985, Comm. University of London Observatory No 78
Muller,E.,A., Peytremann, E., de la Reza, R.: 1975, Sol. Phys. 41, 53
Sugar, J., Corliss, Ch.: 1985, J. of Phys. and Chem. Ref. Data 14, Suppl.2