LITHIUM IN Am AND δ Del STARS

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SUMMARY. High-resolution observations of the doublet LiI-6707 A were made to study the abundance of lithium in a sample of Am, δ Del, and reference stars. It is found that Am and δ Del stars may be underabundant, normal or overabundant in lithium (normal Li abundance meaning log N_{Li} = 3.0 with log N_H = 12).

1. INTRODUCTION

The abundance of the light element Li is not yet known in Am and δ Del stars. The detection of the LiI doublet at 6707A is indeed very difficult for such hot stars with fairly broad lines unless Li is overabundant. Today, high-resolution and good signal-to-noise spectra enable equivalent width measurements of Li in the A star domain. A set of model atmospheres (Kurucz, 1979a,b) is used to calculate the equivalent width of LiI-6707 A as a function of Te in the weak-line limit. The stellar Te, which is of critical importance in the abundance determination, is determined from published high-dispersion abundance analyses or from ubvy,β photometry. The Li abundance follows from the measured λ6707 equivalent width.

2. OBSERVATIONS

Spectra of 9 Am, 4 δ Del and 6 F stars were obtained in the region $\lambda\lambda$6675-6725 with the Coudé echelle spectrometer of the European-South-Observatory 1.4m telescope. The detector was a cooled Reticon array of 1872 photodiodes. The linear dispersion was 1.9 A/mm and the spectral resolution R = $\lambda / \Delta\lambda$ was equal to 100 000. The signal-to-noise ratio of the spectra was generally greater than 200.

Some spectra are shown in Fig. 1; they are flat-field corrected and referred to a hand drawn continuum, the scale is

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Fig 1.

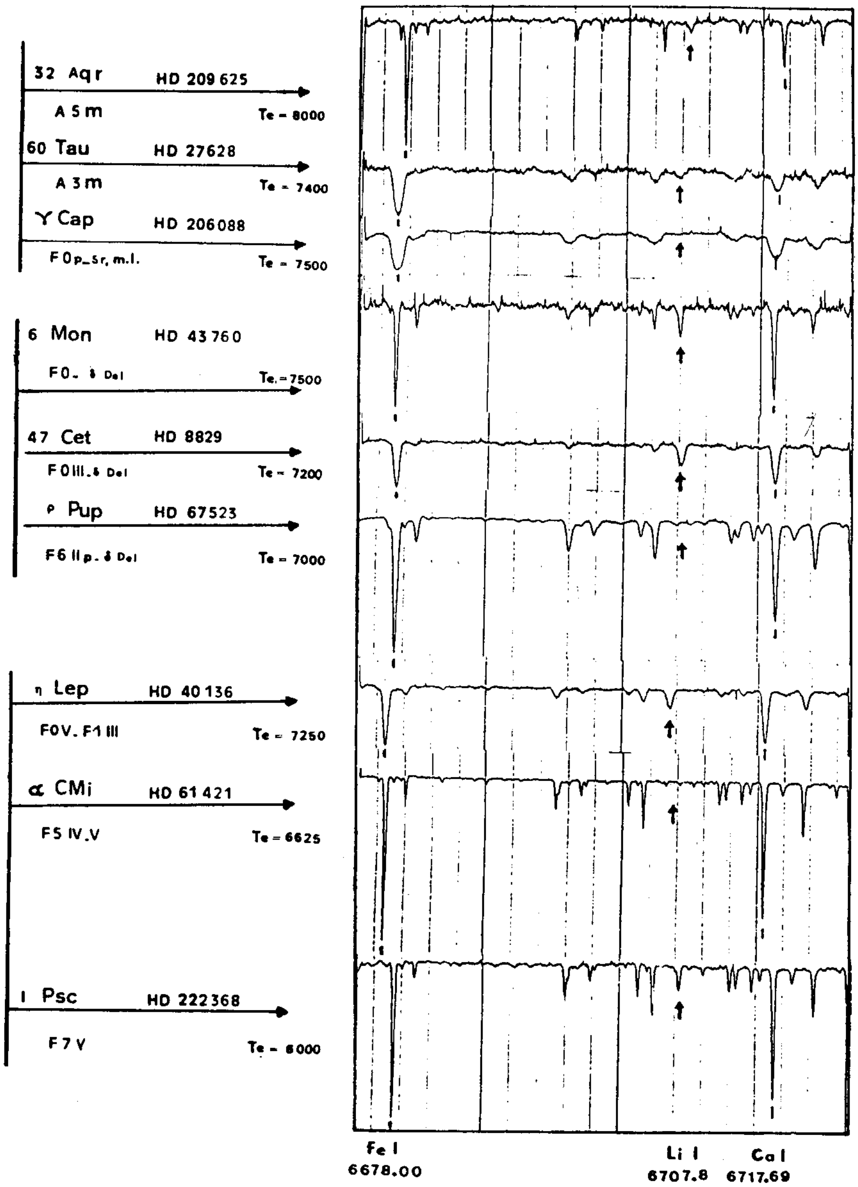
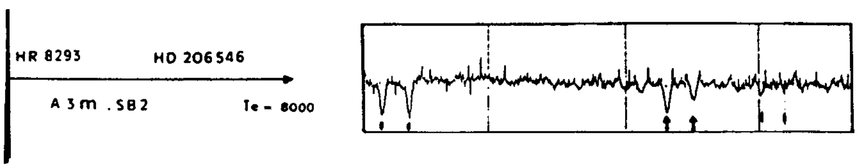


Fig 2.



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the same for every spectrum. With a line profile fitting procedure (Cayrel et al., 1985) equivalent width measurements are possible with a high accuracy and lines as weak as 3 mA can be detected.

There are 3 double-line spectroscopic binary stars in our Am sample. Fig. 2 shows the spectrum of one of them, HR 8293. Besides the rather low quality of the spectrum compared to those of Fig. 1, we see the greater difficulty of continuum setting for a sb2 star than for a single one . The LiI lines of both components are as strong as those of much cooler stars like η Lep or ι Psc and, contrasting with the spectra of Fig.1, are the most prominent lines in the observed spectrum, except the FeI (6678 A) lines. Assuming that both components are just alike (Stickland, 1973) and taking into account the dilution effect, we get the intrinsic equivalent widths multiplying by 2 the equivalent widths as measured on the spectrum, thus leading to much more remarkable overabundances, in fact the highest ones in the star sample.

In our sample of stars, the ratio of the strength of the CaI-6717A line to that of the FeI-6678A line is nearly 1 for all the δ Del and F stars, but always less (sometimes much less) than 1 for all the Am stars (see figs. 1 and 2). This may be put together with the already known fact that the Am stars are underabundant in Ca and overabundant in Fe but that for δ Del or F stars the ratio of the abundances of Ca to Fe is the solar one.

3. LITHIUM ABUNDANCE

The derived Li abundances are plotted against Te in Fig.3 for the 3 groups of stars. The points with downward arrows represent upper limits on the Li abundance of a star where no Li is detected. The points with upward arrows represent lower limits on the Li abundance of 2 of the sb2 stars, this lower limit is obtained when we do not take into account the dilution effect. For the third sb2 star, HR 8293, we represent both the lower limits of each component and the true values if both components are identical stars with Te = 8000 K and if the dilution effect is considered.

In Am stars, Li may be overabundant (up to log N_{Li} = 3.9), normal, or underabundant (down to log N_{Li} < 2.0). The Li abundance dependence with temperature is definitely not simple : around 8000 K, Li abundance results are remarkable by their variety.

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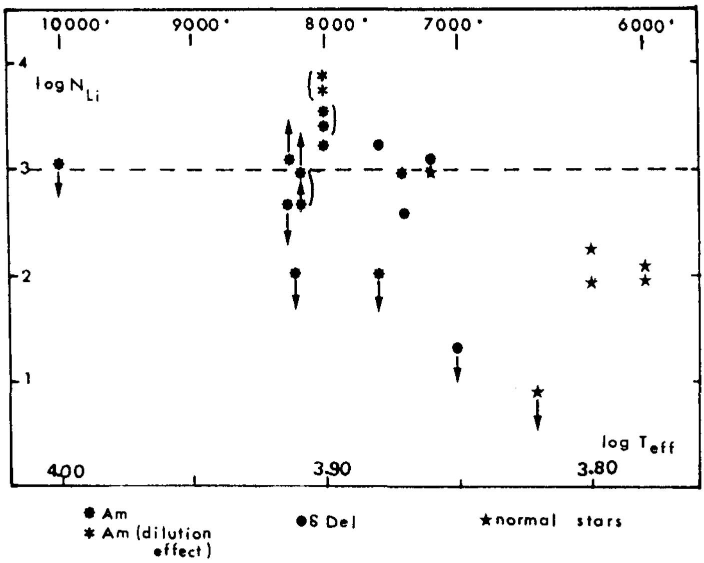

Fig 3

In δ Del stars, Li may be slightly overabundant, normal, or underabundant (down to log N_{Li} < 1.30). We cannot study any abundance trend with temperature because of the few stars observed.

There are not yet enough stars observed to conclude definitely, but those abundance results were expected for the Am stars in the frame of the microscopic diffusion hypothesis in presence of either a laminar meridional circulation or a turbulent diffusion by Vauclair et al (1978). Moreover, could the Li overabundant stars actually be explained by as simple a physical process as microscopic diffusion ?

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