Stellar Rotation
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Rotation and Lithium Abundances in Evolved Stars

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Abstract. For a sample of 57 evolved stars (spectral type from F5III to G5III), typically stars located near and along the Hertzsprung gap, we derived lithium abundances from spectral synthesis method compared to new high resolution spectroscopic data. Lithium is detected for about half of this large sample stars and high Li-contents ($A_{Li} > 2.8$) are reported for 8 stars. We examined the Li abundances along $T_{\rm eff}$, $v \sin i$, the single/binary status and along the stellar mass and the evolutionary status (inferred from the HIPPARCOS data).

1. Observations and Lithium Abundance Determination

The spectral region around the lithium line (@ 6707.81 Å) was observed for a sample of 57 evolved stars, with two different telescopes and instrumentations: the AURELIE spectrograph (1.52 m telescope, Observatoire de Haute Provence, France), for northern stars (R = 45 000 and S/N > 60), and the CES (1.44 m CAT telescope, La Silla/ESO), for southern stars (R = 95 000 and S/N > 100). These stars have also been observed with the CORAVEL spectrometers (OHP and ESO) for precise radial and rotational velocity measurements (Vrad and $v \sin i$) and binarity signatures (De Medeiros & Mayor, 1999).
For the sample stars, synthetic spectra were computed (Lèbre et al. 1999) using ($T_{\rm eff}$, log g, [Fe/H]) available from literature. When necessary, in order to improve the fit quality (for giants with measurable Li abundance), $T_{\rm eff}$, [Fe/H] and $v \sin i$ were then slightly corrected. $T_{\rm eff}$ were derived with $\Delta T_{\rm eff} < 200$ K, leading to an error < 0.2 dex on the derived metallicities and lithium abundances. According to Carlsson et al. (1994), non-LTE effects can be neglected for the studied stars since they are always much smaller than 0.1 dex.

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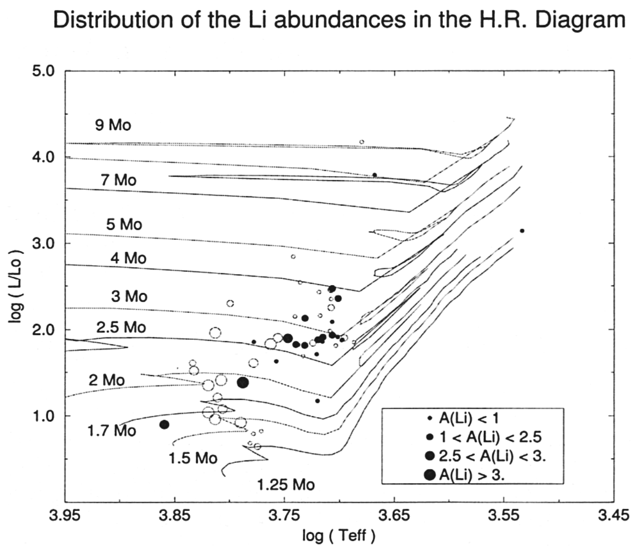

Figure 1. Distribution of Li abundances in HR diagram. Binary systems are indicated with filled symbols.

2. Lithium Abundance and Rotation

We used HIPPARCOS parallaxes to infer stellar masses and evolutionary status of our sample stars. Fig. 1 displays the resulting HR diagram with evolutionary tracks from the Toulouse-Geneva code (for solar metallicity). The distribution of Li abundances presents a sudden decline in A_{Li} near G0III (De Medeiros et al., 2000), reflecting the dilution effects along the Hertzsprung gap. For this evolutionary stage, no Li production is therefore seen, suggesting that such production may become efficient in more evolved stars. The behavior of rotation and Li content in the Hertzsprung gap strongly depend on stellar mass. Stars with 2 to 3 $M_\odot$, located to the right of the G0III spectral type show a factor of dilution of at least 600, far in excess from the theoretical predictions. This points to an extra-mixing mechanism prior to the beginning of the ascent on the red giant branch. The less massive giants show the same scenario (disagreement between predicted and observed abundances). The binary systems follow the same tendency presented by single stars. In spite of the limited number of binary systems with high $v \sin i$ value, the dependence of lithium on rotation seems to follow the same trend observed for the single stars.

References

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