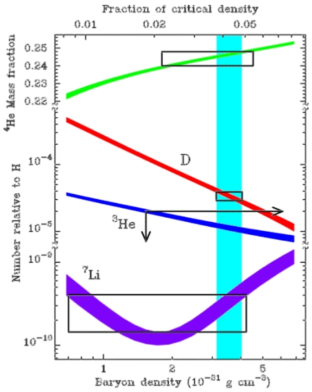
Lithium in the population II stars



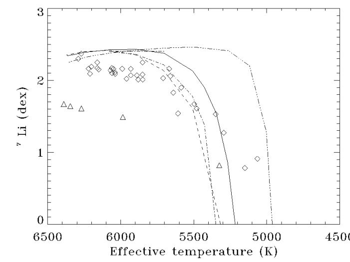
Light elements primordial nucleosynthesis vs the baryon density

For a long time lithium has been recognized as a powerful tool to investigate the internal mixing of low mass stars. Because its isotopes are destroyed by proton capture at low temperatures they allow us to probe directly the depths of the outer mixed envelopes. The lithium is at the same time related to the Big Bang nucleosynthesis (BBN) through its isotope ^{7}Li and to interstellar medium nucleosynthesis through its isotope ^{6}Li. New observations performed by the VLT/UVES spectrometer or similar facilities have recently made possible precise determination of the lithium abundances of population II stars for both isotopes.

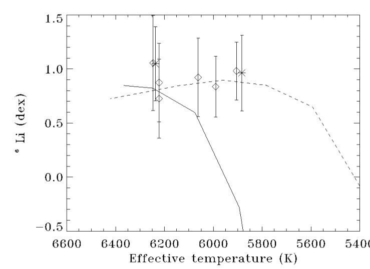
These observations cannot be reconciled with the predictions of the current standard stellar models: the ^{7}Li abundance expected from BBN exceeds by a factor $\sim$3 the observations in halo stars whereas the stellar evolution codes predict no lithium depletion during stellar history if only the convective mixing is accounted for. The possibility we explored to solve the discrepancy is the so-called tachocline rotational mixing. This mixing is related to the rotational history of the star and has given excellent results in the case of the Sun regarding ^{7}Li and helioseismic issues. At the same time the new ^{6}Li observations are at odds with predictions from the interstellar medium evolution with metallicity. We show how the tachocline mixing is able to explain the main features of both ^{6}Li and ^{7}Li evolution during the main sequence. We moreover investigated the pre-main sequence evolution of lithium. Finally we showed how small variations in the repartition among metals in the halo stars could create a scatter on the lithium abundance there if combined to the tachocline mixing.

This work studies a process that is robust with repect to the most recent observations in lithium isotopes abundances. It moreover makes predictions of correlations between [Fe/O] and lithium in the coolest stars where this element can be investigated. Our results have been submitted to the Astrophysical Journal (astro-ph 0511402).

This work was supported by the Joint Institute for Nuclear Astrophysics under the NSF Grant PHY 02-16783.



$T_{eff}-{}^{7}$Li MS relation in tachocline models at 13 Gyr and for [Fe/H]=-2 dex compared to observations. solid line, dashed line, dot-dashed line: various possible rotation histories. dash-three dotted line: pure microscopic diffusion models



$T_{eff}-{}^{6}$Li relation for tachocline diffusion models. Solid line: [Fe/H]=-2 dex and halo repartition among metals. Dashed line [Fe/H]=-2 dex and solar repartition among metals. Diamonds and stars : observational data.

Researcher : L. Piau

Unversity of Chicago