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Lithium in other Suns: no connection between stars and planets

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Abstract. An unbiased sample of solar twins shows that the Sun has a normal Li abundance for its age and that a low Li abundance does not imply the presence of planets. We find a tight correlation between Li and age, which holds for all stars analyzed in our sample: solar twins, stars with and without detected giant planets, and stars that may host terrestrial planets.

Keywords. Sun: abundances – stars: abundances, planetary systems

1. Lithium vs. age for solar twins in the field and clusters

The sample consists of more than one hundred stars similar to the Sun observed at McDonald (2.7m) and Las Campanas (6.5m Magellan Clay telescope). Most of them are from our solar twin survey (Meléndez *et al.* 2009a,b; Ramírez *et al.* 2009). We have also included ~ 20 solar analogs with and without detected giant planets.

Our high quality spectra (R = 60,000; S/N = 200-450) allows the determination of Li abundances in stars as Li-poor as the Sun. Due to the similarity between the Sun and the twins, accurate stellar parameters can be determined, thus reliable ages can be obtained from isochrones. For young stars (<1Gyr) whenever possible we use precise rotation periods to estimate ages. Both methods agree, but the rotational ages are more precise. In Fig. 1 we show only solar twins (open circles) with good ages (3-σ or better).

There is a clear correlation between Li and Age in our sample of solar twins (open circles). The one-solar-mass stars in solar-metallicity open clusters (filled triangles) also follow the same correlation. Note that we have only used clusters with reliable data, which are very few for old solar-metallicity open clusters. For example, the cluster Collinder 261 seems old but its age, reddening and metallicity are very uncertain (Spanò *et al.* 2005). Furthermore, only relatively high upper limits in the Li abundances of solar twins in Cr 261 are available (Spanò *et al.* 2005). NGC 188 is another potentially interesting old solar metallicity open cluster, but there is only one star that may be as cool as the Sun in the study of Randich *et al.* (2003, Fig. 2). Furthermore, according to Sestito & Randich (2005), the NGC 188 stars analyzed by Randich *et al.* (2003) have a S/N of only 20-35, which would be too low to detect the Li feature in a star like the Sun.

2. No planet connection

Our sample of solar twins without detected giant planets follows the same Li vs. Age as other solar twins. We have also studied 18 solar analogs included in radial velocity planet surveys; six of them with detected giant planets and 12 of them without detected giant planets. Both samples seem to follow the Li vs. Age correlation shown in Fig. 1.

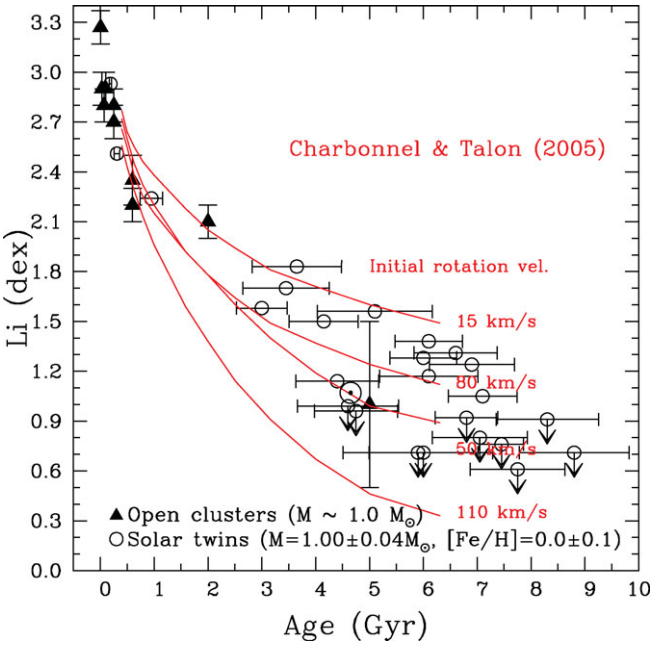

Figure 1. Li for our solar twins with one solar mass (±4%) and solar [Fe/H] (± 0.1 dex), and for one-solar- mass stars in solar metallicity (±0.15 dex) open clusters selected from Sestito & Randich (2005), although for M67 we used the sample of Pasquini *et al.* (2008). Field stars are shown as circles while open clusters with triangles. Figure updated from Meléndez *et al.* 2009b.

We have recently found a signature that may indicate the presence of terrestrial planets around other stars (Meléndez *et al.* 2009a; Ramírez *et al.* 2009). Solar twins showing the same terrestrial planet signature as our Sun also follow the same Li vs. Age relation as solar twins without the signature of other earths.

In conclusion, we find no relation between low levels of Li and the presence of planets. The low Li observed in the Sun is normal for a star of its age, mass, and metallicity.

As already suggested by other authors (see Meléndez *et al.* 2009b for a review), Israelian *et al.* (2009) have recently claimed that planet host stars in a narrow range around solar $T_{\rm eff}$, have enhanced depletion of lithium due to the presence of planets. Our work suggests as alternative explanation that the low Li in planet host stars around the solar $T_{\rm eff}$ may be due an age effect instead of the presence of planets.

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