Lithium abundance in K/G giants

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Investigation of the Li abundance as a function of metallicity, effective temperature and stellar mass in a large sample of giant is helpful to understand the chemical evolution history of the Galaxy, as well as in the study of the mixing process in stellar interiors.
MOTIVATION II:

• **1% Li-rich G/K giants** from literatures

Standard stellar evolutionary models predict Li dilution by a factor of about 30-60 for 1-5 solar-metallicity stars. Therefore, RGB stars are expected to show lithium abundance with 1.3-1.7 dex.

• **Find Li-rich giants**, to provide essential material for testing hypotheses about Li-enrichment.
Dwarfs:

Lithium in stars with and without planet had conflicting conclusions:

- Lithium dilute more in stars with planet (Israelian et al. 2004, Chen et al. 2006)
- There is no different between PHS and non-PHS

Giants:??

- Have not been explored for such big sample of giants
Chemical composition is different in the thin and thick-disk stars, particularly for alpha and oxygen.

Dwarfs:
Ramirez 2012 investigate for dwarfs and sub-giants, and observe a differences.

Giants:??
With a catalog supplement of Luck 2007, can be used to explore the difference properties
SAMPLE SELECTION

321 targets from Okayama Planet search program, stellar parameters are taken from Takeda et al. (2008)

57 targets from Xinglong Planet search program, stellar parameters are taken from Liu et al. (2010)

= 378 targets
Wavelength coverage: 400-754 nm

R-67000, S/N>200

I$_2$ superposed spectra, the stellar spectral lines located in the region of 500-630nm were heavily blended with the absorption feature of I$_2$. The uncertainty of EW cause by I$_2$ around 670nm is estimated be 2mÅ.
Spectral synthesis with the IDL/Fortran SIU package developed by Reetz (1998)

Best fits obtained between observed and synthetic spectra for three typical stars.
LITHIUM ABUNDANCE FROM SPECTRA WITH I$_2$ AND WITHOUT I$_2$

$A(Li\_with\ I_2) - A(Li\_without\ I_2) = 0.0 \pm 0.06$
ERROR ANALYSIS

Systematic errors introduced by the atmospheric parameters

100k in Teff,

0.1 dex in logg, \[ \rightarrow 0.1 \text{ dex} \]

0.2 in microtubulence

Uncertainty in the stellar continuum \[ \rightarrow 0.1 \text{ dex} \]

The overall uncertainty in A(Li) is less than 0.14 dex
NLTE CORRECTION

Based on interpolation code of Lind et al. 2009

NLTE correction is very sensitive to the temperature 0.05–0.28 dex, average of 0.18 dex for most sample
Far more depleted than theoretical predicted
3 Li-rich stars
36 Li-normal stars
339 Li-depleted stars: may have already existed at the main sequence phase
8/23 compared with 273/355 have detected Li value, suggest Li is easy to deplete in PHS.
HD65228 just began to develop a Convective envelope.

For the other two Li-rich giants, the most reasonable explanation is that they have undergone a Li-production period.
A(Li) VS. EFFECTIVE TEMPERATURE

- Detecting limit increase with increasing Teff
- 4800-5100K: there is no clear relationship
- >5100K: Li increase with increasing Teff
A(LI) VS. ROTATIONAL VELOCITY

<10km/s: no trend
All PHS < 4.0 km/s
Lithium abundances are lower in thick-disk stars than those in thin disk stars. **Li is more depleted in thick-disk**, since they are more older.

**No notable difference between SWPs in thin- and thick-disk.**
CONCLUSIONS

The Li deplete far excess compared with theoretical prediction, suggesting Li deficiency may have already existed at the main sequence stage. Less than 1% of giant are Li-rich.

For SWP, Li is easy to deplete. All SWP have a slow rotational velocity due to lower rotational velocity showing a suitable pattern to detect planet by radial velocity method.

For stars within 4800-5100K, there is no clear relationship of Li and T_{eff}.

Lithium abundances are lower in thick-disk stars than those in thin disk stars. Li is more depleted in thick-disk, since they are more older. No notable difference between SWPs in thin- and thick-disk.