EAYAM2015

Searching for chemical relics in the Milky Way with LAMOST

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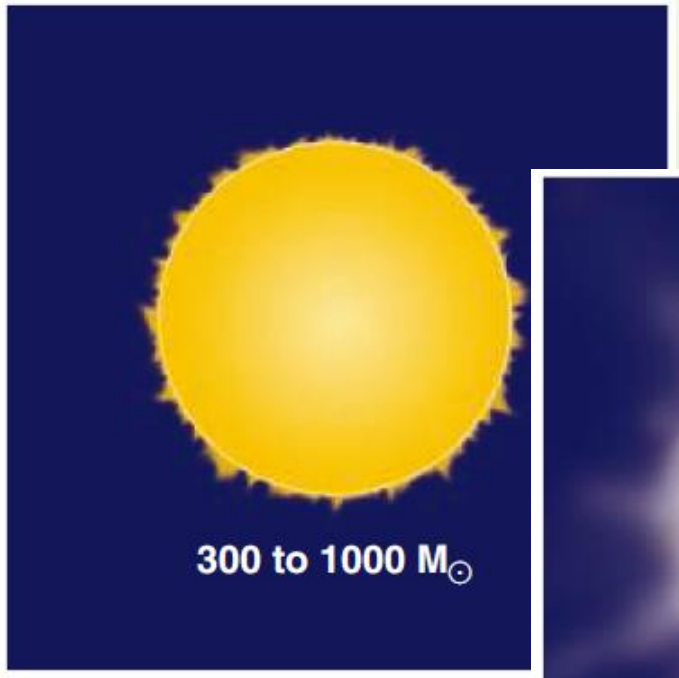
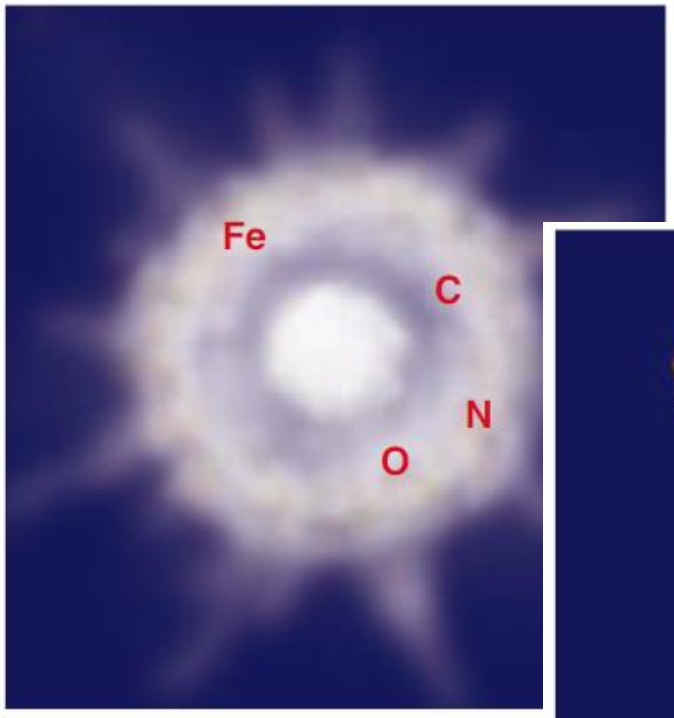
Chemical evolution of stars



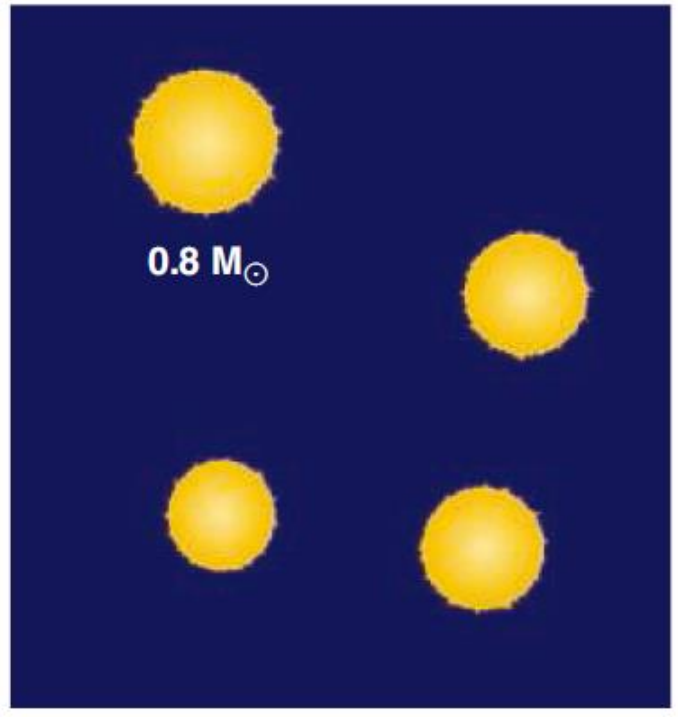
(Beers 2005)

First stars: massive and short-lived



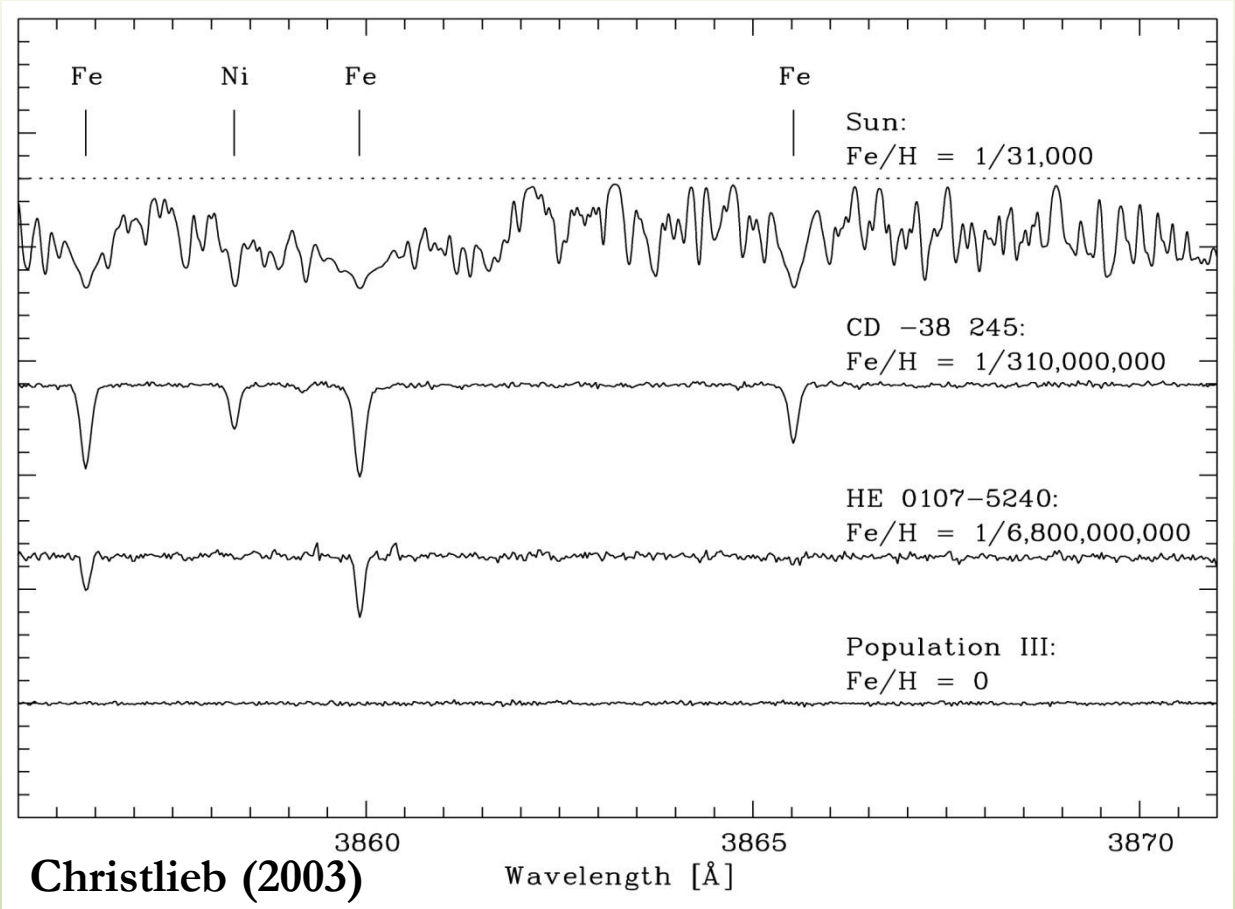
First stars explode: ejecting heavy elements

Second stars: preserve preliminary chemistry



Stellar metallicity

- Metallicities as traces of the evolution timescale



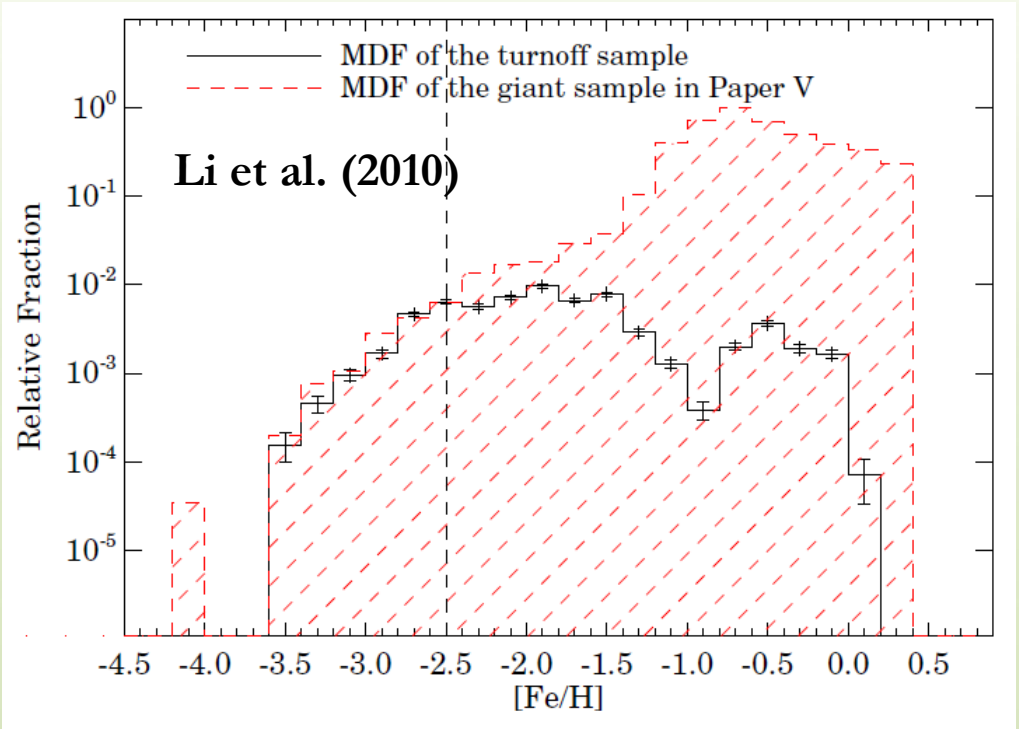
Christlieb (2003)

Tracking chemical abundances of different generations of stars = exploring the DNA of the Galaxy

Early and ongoing projects

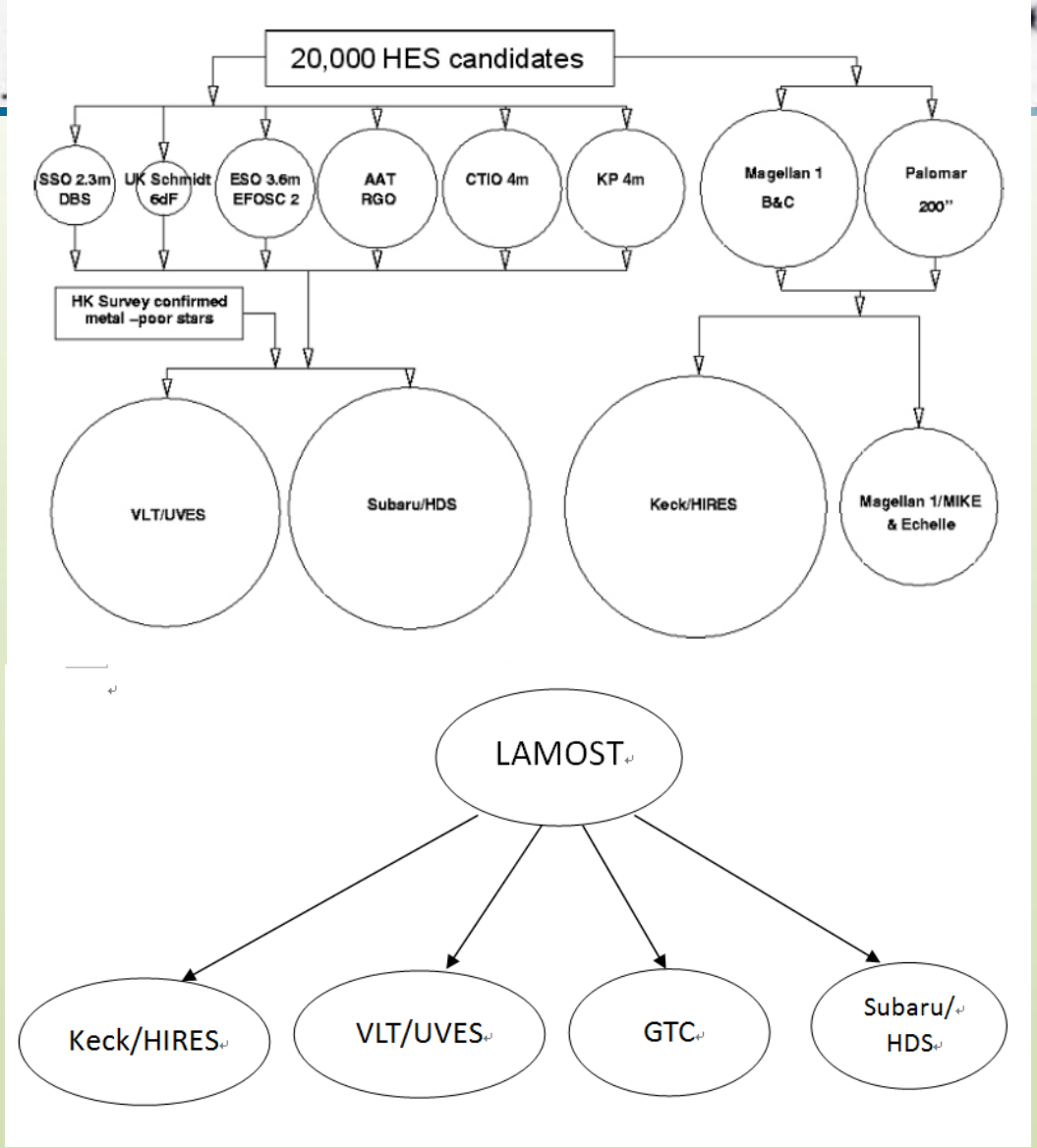
- Survey projects
  - Early HK survey and Hamburg/ESO Survey (HES)
  - Searching with SDSS and SEGUE data
  - Photometric survey with SkyMapper
- Follow-ups with high-resolution spectroscopy
  - HERES (Christlieb et al. 2004; Barklem et al. 2005)
  - First Stars (Cayrel et al. 2004; Francois et al. 2007)
  - CASH (Frebel et al. 2008)
  - 0Z (Cohen et al. 2011)
  - The Most Metal-Poor Stars (Norris et al. 2013; Yong et al. 2013)
  - Extremely Metal-Poor stars from SDSS/SEGUE (Aoki et al. 2013,)

Status of searching



(extremely) metal-poor stars are important, but also rare

- Extremely metal-poor stars that are confirmed with high-resolution spectral observations
  - [Fe/H] < -3.0: 220; [Fe/H] < -3.5: 63 (EMP)
  - [Fe/H] < -4.0: 21; [Fe/H] < -4.5: 7 (UMP)
  - [Fe/H] < -5.0: 3 (HMP)



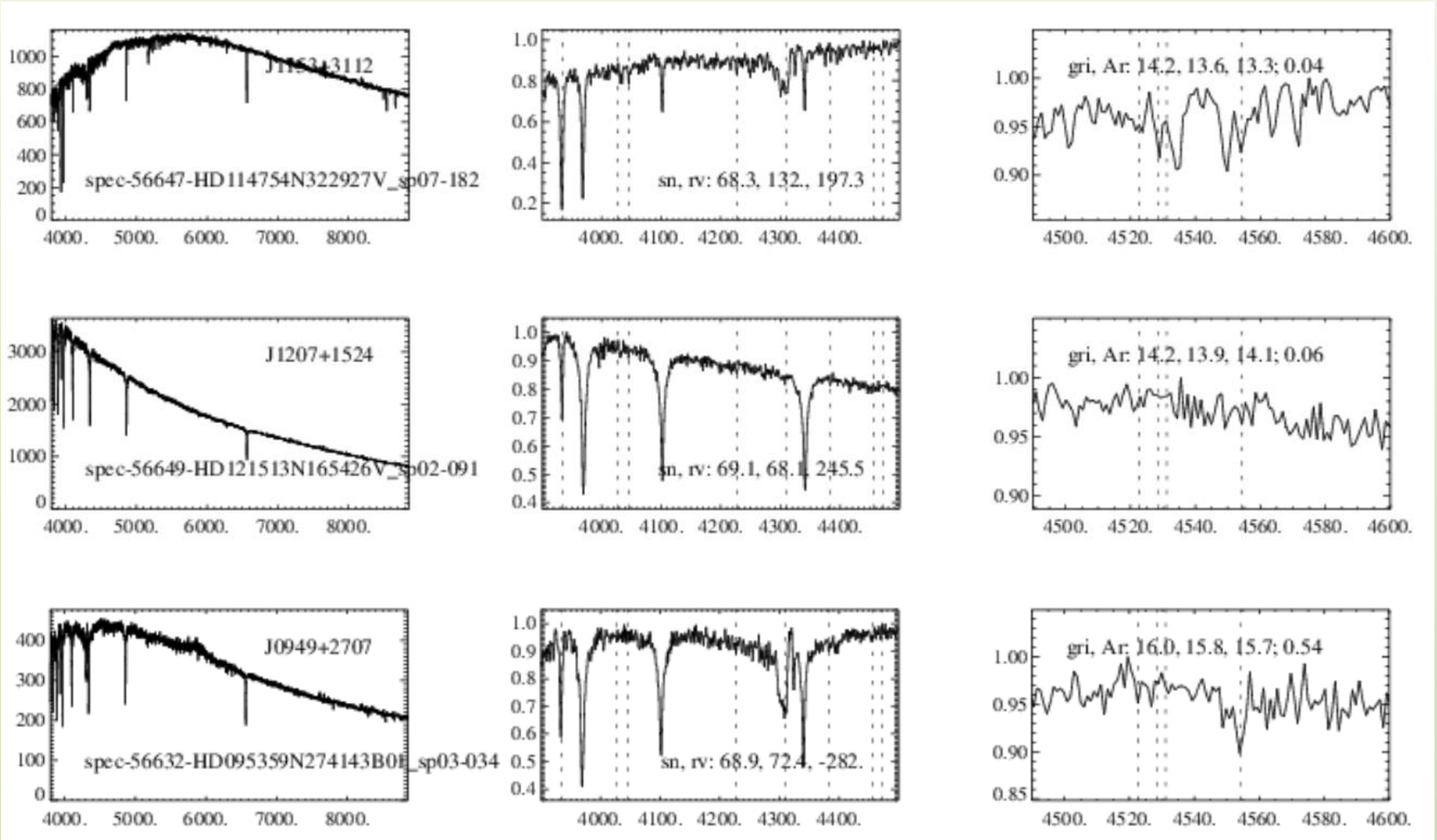
LAMOST is one of the most suitable facilities to search for metal-poor stars

Advantages of LAMOST

- Large survey area (North 7700 deg^2 + South 3500 deg^2)
- Combination of large aperture, wide field and multiple objects
- Direct identification through survey mode
- High spectra-obtaining efficiency

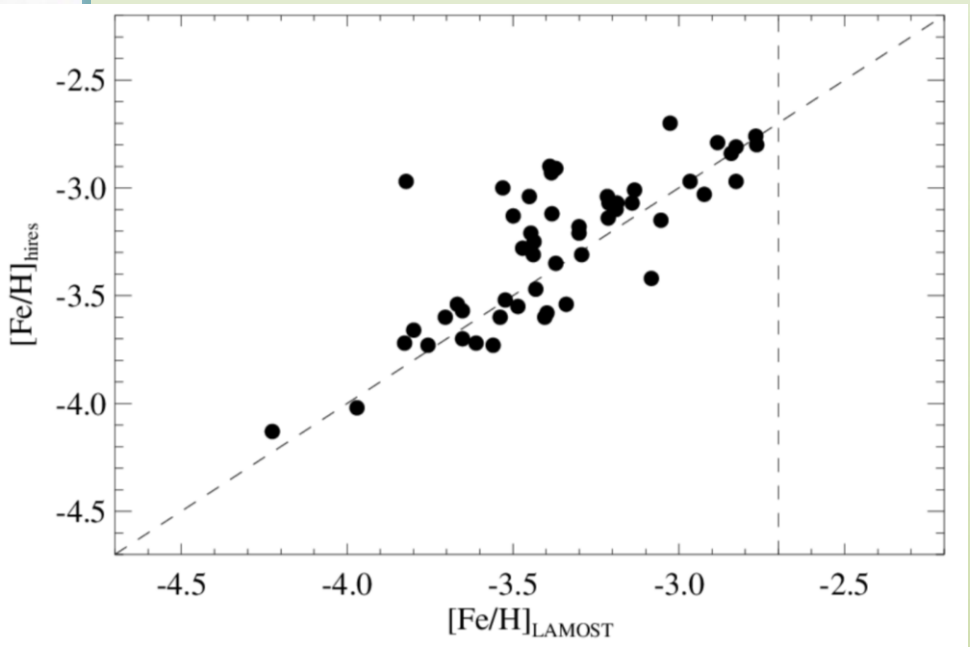
Searching in LAMOST

More than 100 candidates have been selected from LAMOST-DR1

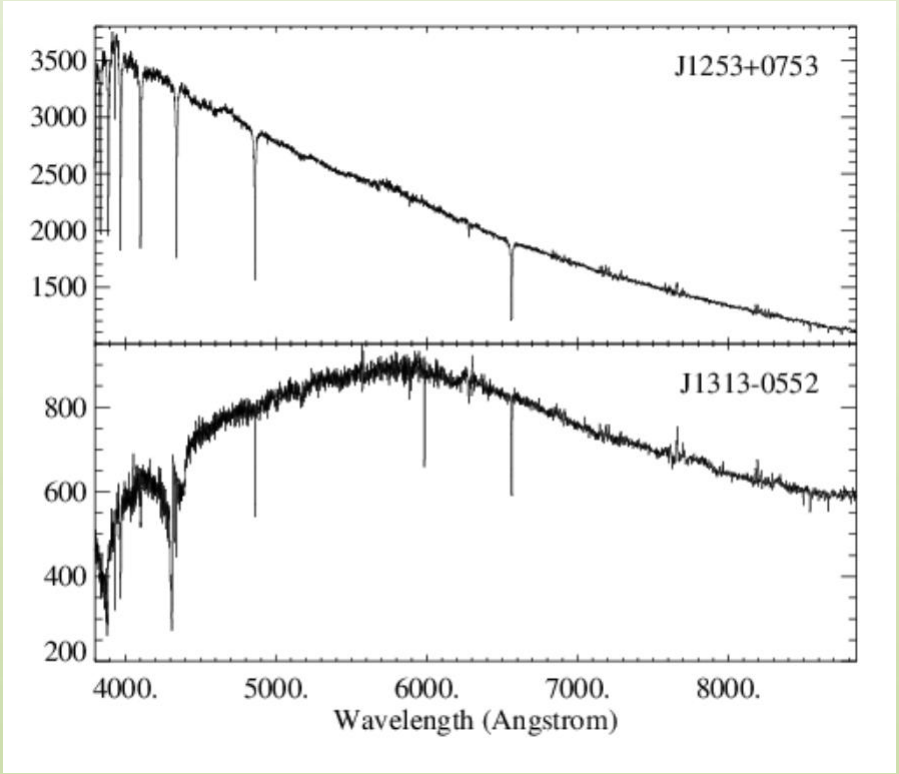


Metal-poor stars in LAMOST

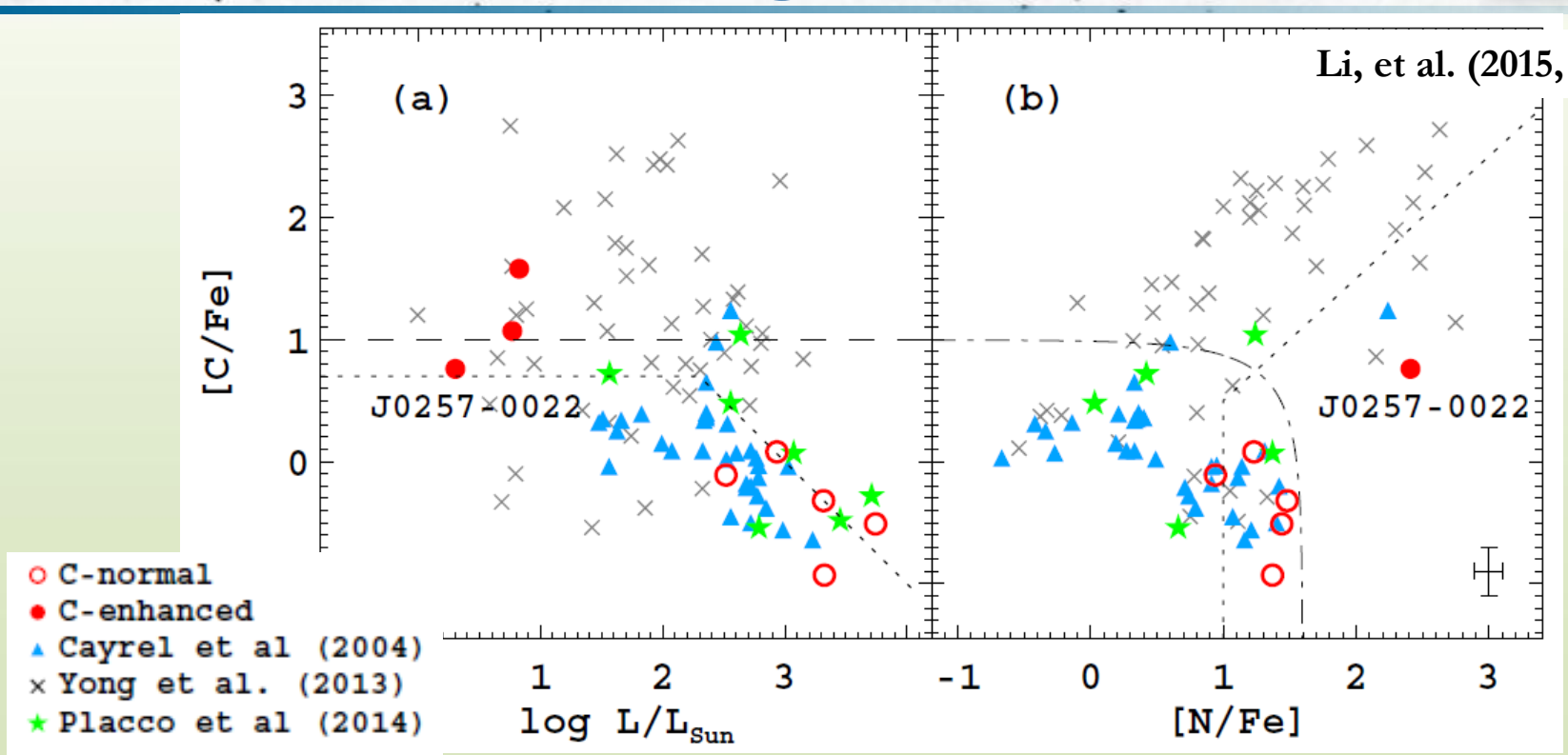
- Follow-up with Magellan/MIKE and Subaru/HDS (on-going)
  - 43 extremely metal-poor stars, including 15 with [Fe/H] < -3.5
  - Two ultra metal-poor stars ([Fe/H] < -4.0)
  - Successful searching with high efficiency (43/56)
  - Reliable parameter determination with LAMOST data



Li, et al. (2015, in preparation)

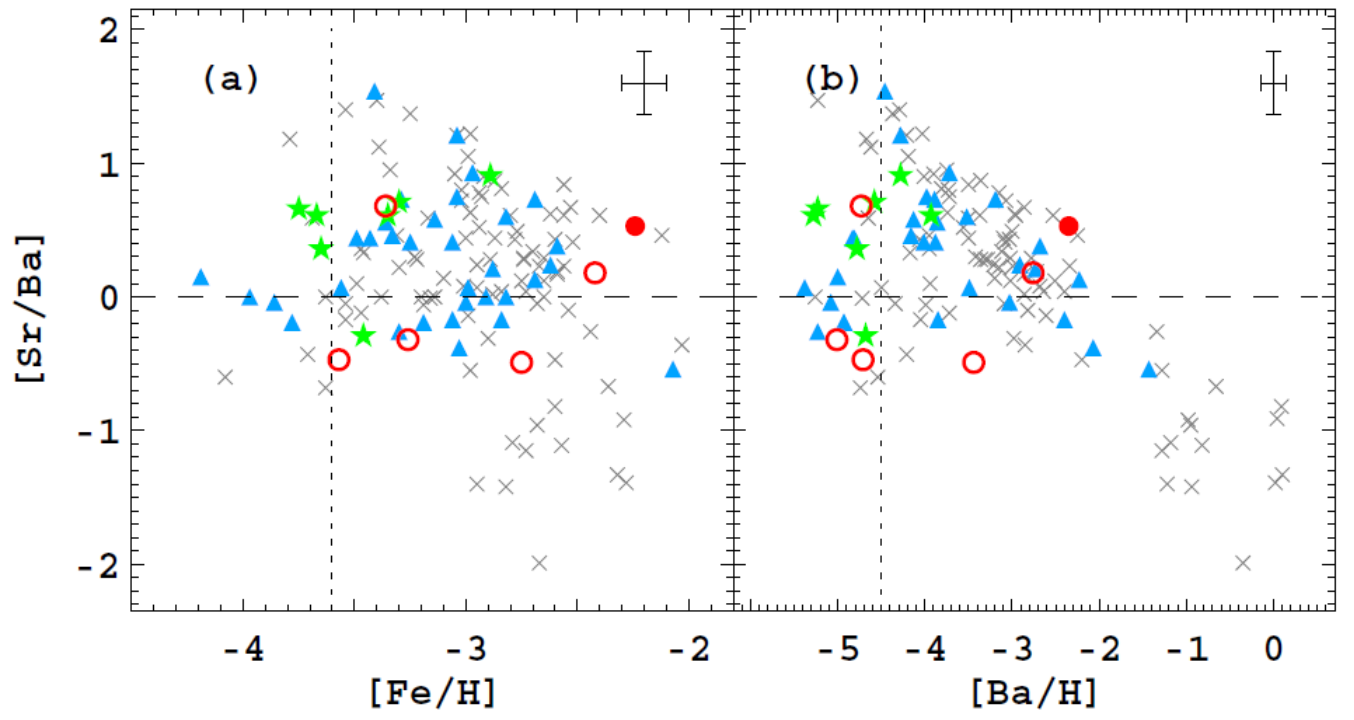


Carbon and nitrogen



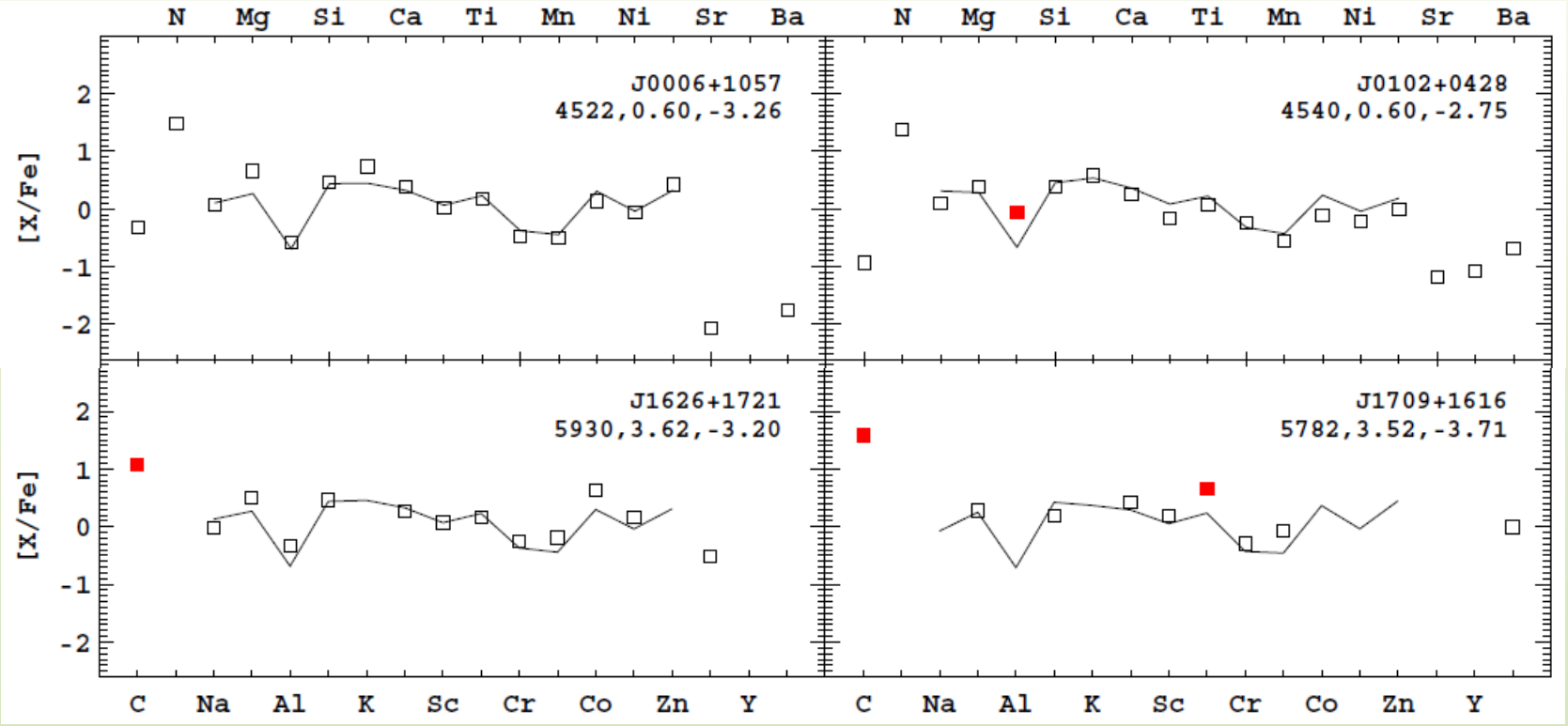
- One carbon-and-nitrogen-enhanced metal-poor star (CNEMP) which is unevolved
- Only two more similar objects have been found, while the origin of these objects are still uncertain

Heavy elements



- [Sr/Ba] vs. [Fe/H]
  - Large scatter, no enhancement at low metallicities, possible cutoff at [Fe/H] < -3.6 or even lower?
- [Sr/Ba] vs. [Ba/H]
  - Linear distribution at [Ba/H] > -4.0, indicative of multiple processes
- Larger sample of stars with [Fe/H] < -3.5

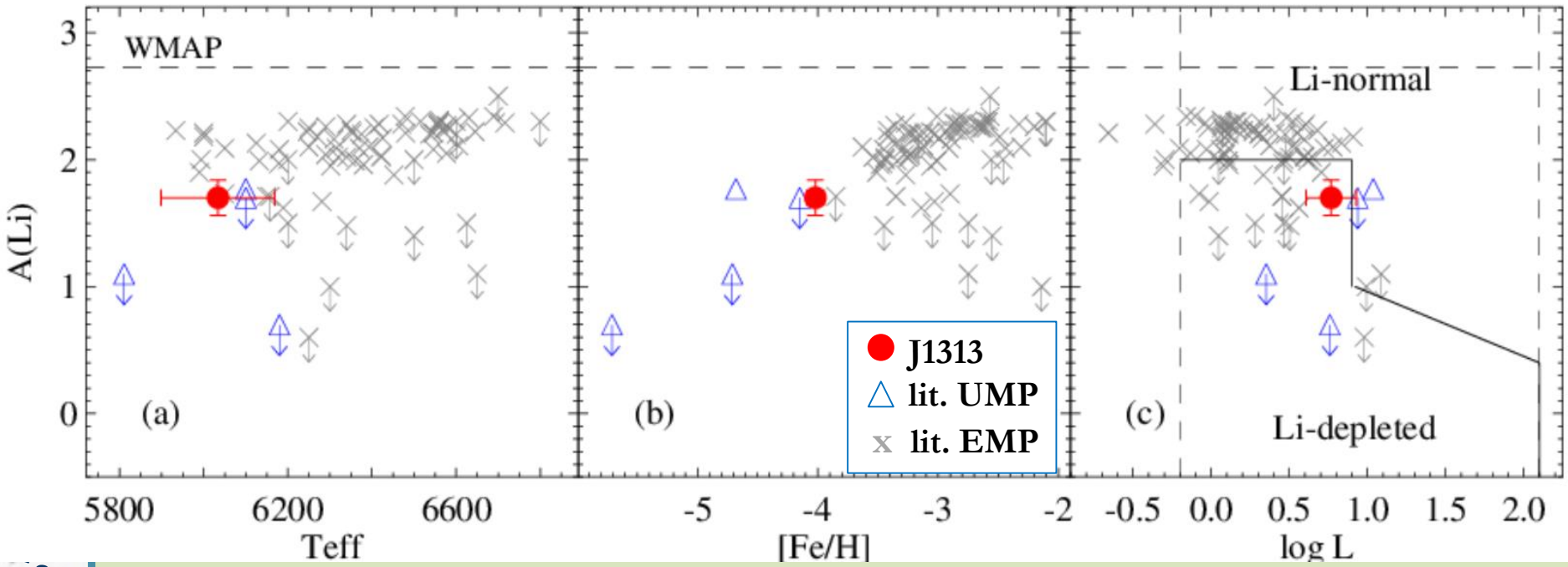
Abundance pattern



- Using abundance patterns to identify peculiar objects
  - Average (general) pattern of abundance ratios – "normal"
  - Comparison with "normal" pattern
- There exists a "normal" population dominating low-metallicity stars

Lithium in old warm stars

Li, et al. (2015, in preparation)



- Second UMP turnoff star with Li detection
- Observed Li plateau lower than the WMAP result by 0.5dex
- "Meltdown" of Li plateau at extremely metal-poor region
- All the known UMP turnoff stars are Li-depleted

Mpstars: LAMOS

Metal-poor stars: LAMOST

- Quite successful survey of metal-poor stars have been carried out with LAMOST
- To enlarge the sample of extremely and ultra metal-poor stars with the huge dataset of LAMOST survey
- To understand the origins of chemically peculiar objects and early evolution of the Milky Way through detailed abundance analysis of the oldest stellar population
- To testify and constrain the theory of the first stars

NEW SCIENCE with OLD STARS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THANKS