Discovery of barium star candidates in galactic open clusters?

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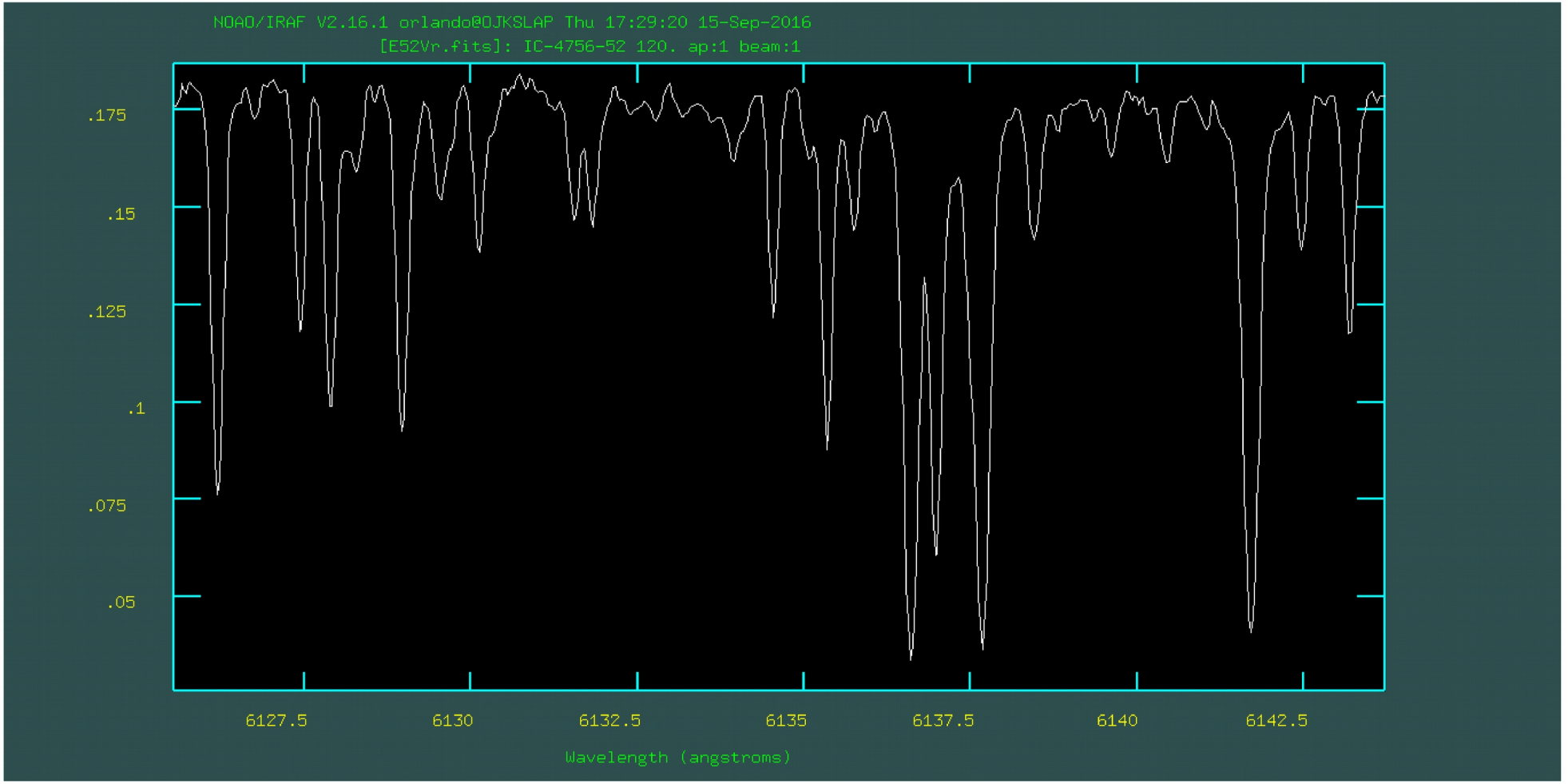
Barium stars

- These objects display enrichment of the s-process elements. However, they are not luminous enough and too warm to be considered AGB stars having undergone a third dredge-up.
- Their overabundances of carbon and s-process elements are explained by mass-transfer in a binary system from a former AGB star (now a white dwarf).
- BS have spectral types G and K, so they are free from the strong molecular opacity from ZrO, CN and C_2 absorption features. This makes barium stars ideal targets to study the s-process nucleosynthesis in stellar atmospheres.
- BS are also important to constrain Carbon Enhanced Metal-Poor stars with s-elements overabundances (CEMP-s), Beers & Christlieb (2005).
- Approximately 1% of the giant field are Barium Stars (McConnell et al. 1972). Only in two open clusters they were discovered: NGC 2420 (Smith & Suntzsef 1987) and NGC 5822 (Katime Santrich et al. 2013).

High resolution spectra

Spectra for giant stars in the Open Cluster IC 4756 were obtained using FEROS (R=48000) in the 2.2mts telescope in La silla/Chile. The wavelength coverage is from (3800, 9200)Å. [S/N] > 100 for all 9 spectra.

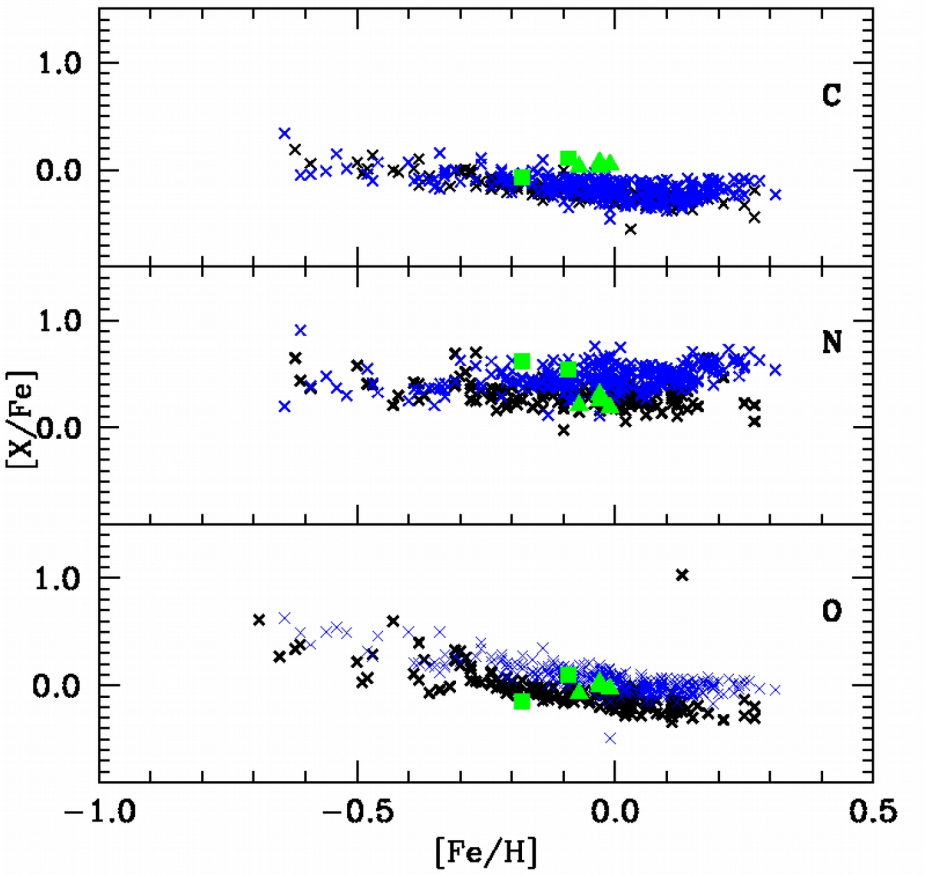


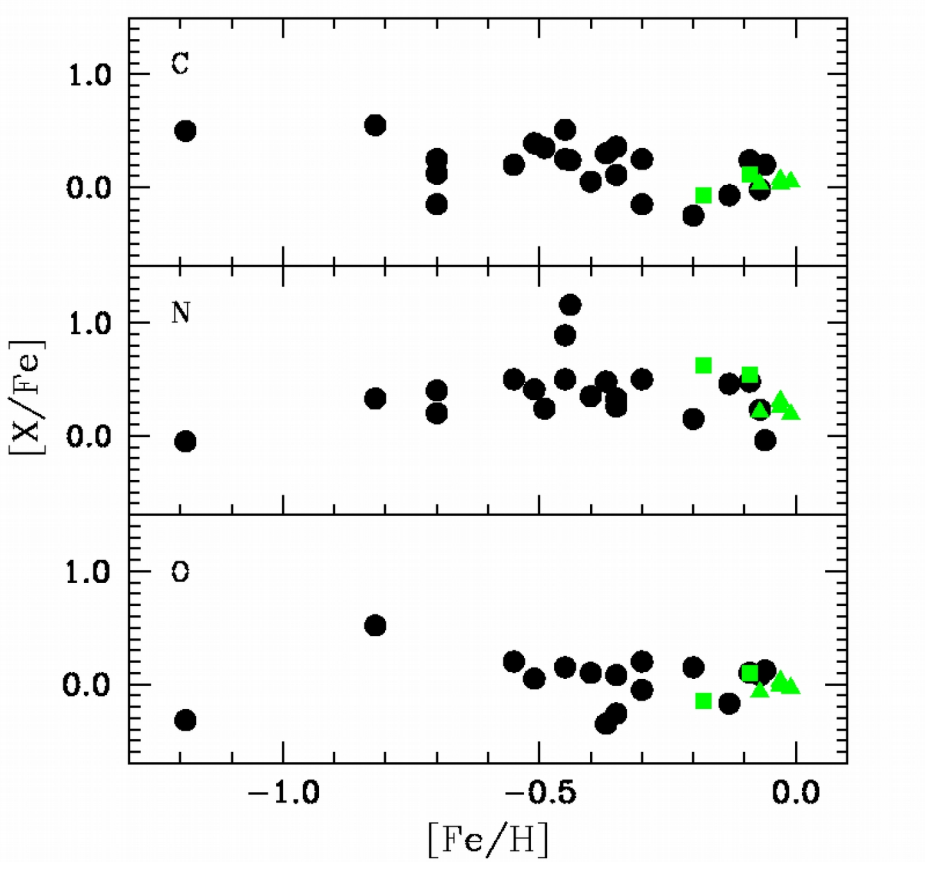
Methodology

- $\delta A_i = A_i^{\star} - A_i^{\odot}$.
- Excitation equlibrium: $r_1 = d(\delta A_i^{FeI})/d(\chi_{exc}) \simeq 0.00$ sets T_{eff}.
- $r_2 = d(\delta A_i^{FeI})/d(EW_r) \simeq 0.00$ sets ξ.
- Ionization equilibrium: $<A_i^{FeII}> - <A_i^{FeI}> \simeq 0.00$ sets $\log g$.
- Assigned errors by: ΔT_{eff} required for 1σ change in r_1; $\Delta\xi$ required for 1σ change in r_2 and $\Delta \log g$ required for 1σ in $<A_i^{FeII}> - <A_i^{FeI}>$.
- Solar model: (5777, 4.44, 1.38, 7.52)

Carbon abundances

Stelllar atmospheric parameters in the range: Teff = [4515, 5150,]K; log g = [2.05, 3.15]dex; Vmt= [1.25, 2.00]Km/s; [Fe/H] = [-0.07, 0.05]dex ΔTeff= ±50K; Δlog g= ±0.06dex; Δvmt= ±0.12Km/s; Δ[Fe/H]= ±0.02dex.



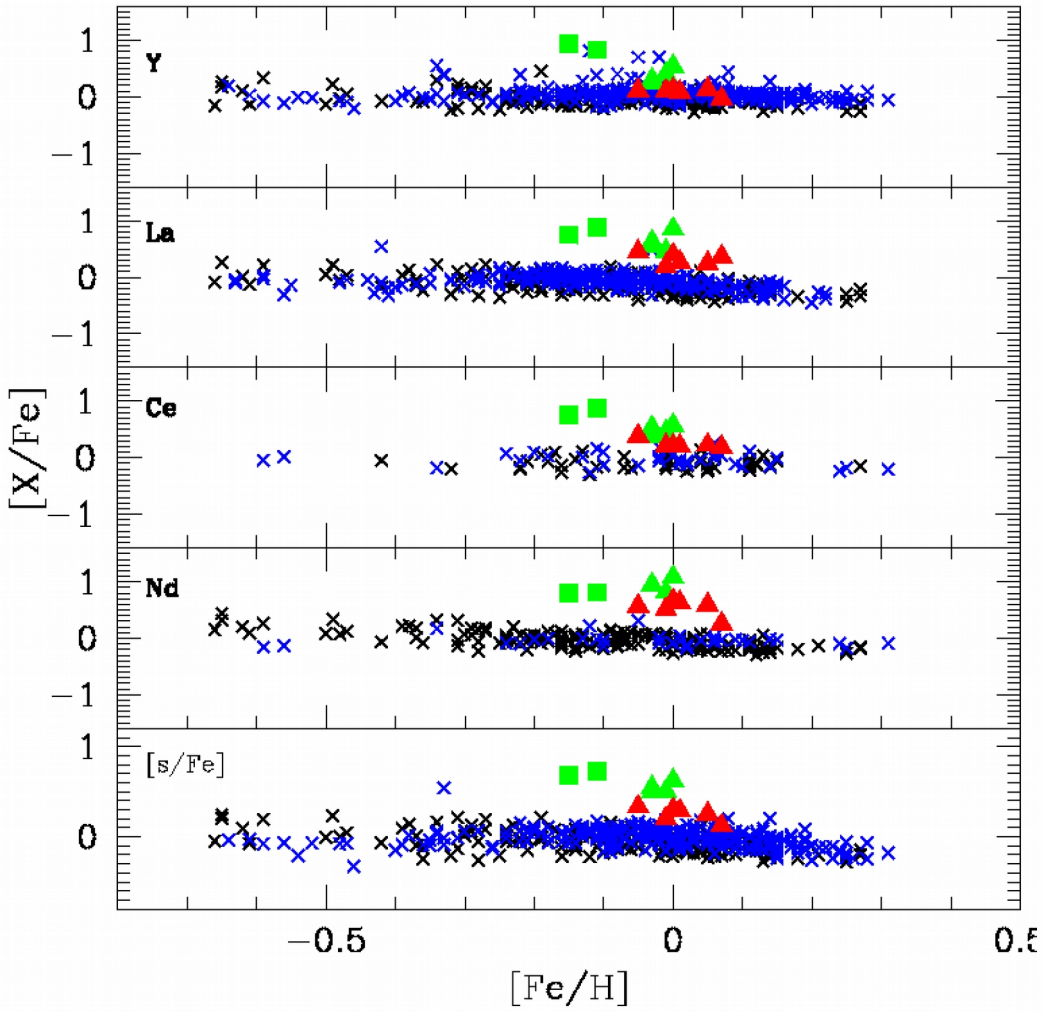


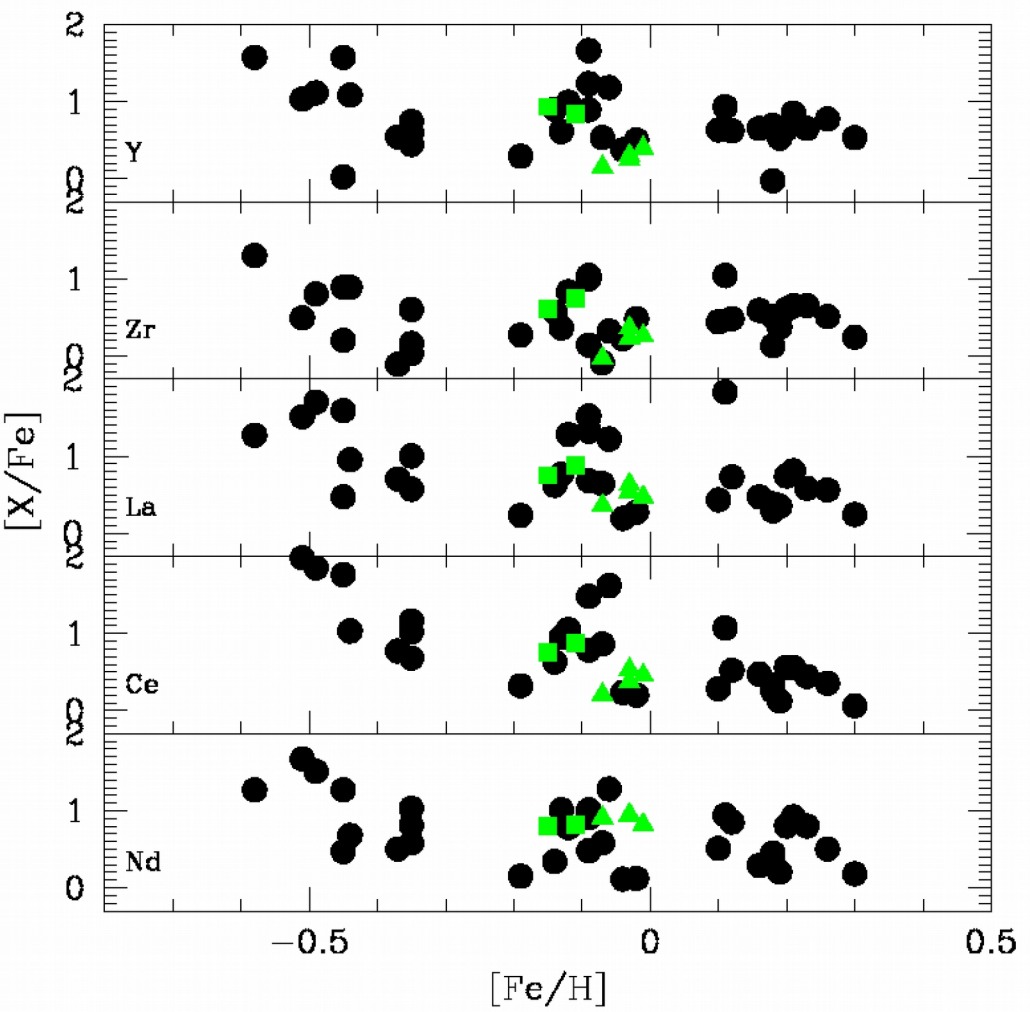
Green squares: Barium stars from Katime Santrich et al. (2013).
Green triangles: Barium star candidates in Open Cluster IC 4756.
Red triangles: Giant stars in IC 4756.
Blue crosses: field giant stars from Luck & Heiter (2007).
Black crosses: clump field giant stars from Mishenina et al. (2006).

Black circles: Barium stars from Barbuy et al. (1992); Allen & Barbuy (2006) and Pereira & Drake (2009).

s-process abundances

Uncertainties for BS candidates ±0.02dex and for another giants ±0.05dex.





Discussions

- Solar luminosities obtained: **262L☼, 67L☼, 47L☼** & **74L☼**. Theoretical luminositiy for first thermal pulse: **1400L☼** (Lattanzio 1986) and **1800L☼** (Vassiladis & Wood 1993).
- Radial velocities and membership confirmed from Mermilliod et al. (2008). HOWEVER THEY ARE NOT BINARIES? So orbits with high eccentricity?
- Contamination of the molecular cloud? High efficiency of the s-process nucleosynthesis?
- More details in Katime Santrich et al. (in prep.).