The r- and s- process contributions to heavy-element abundances in halo star HD 29907.

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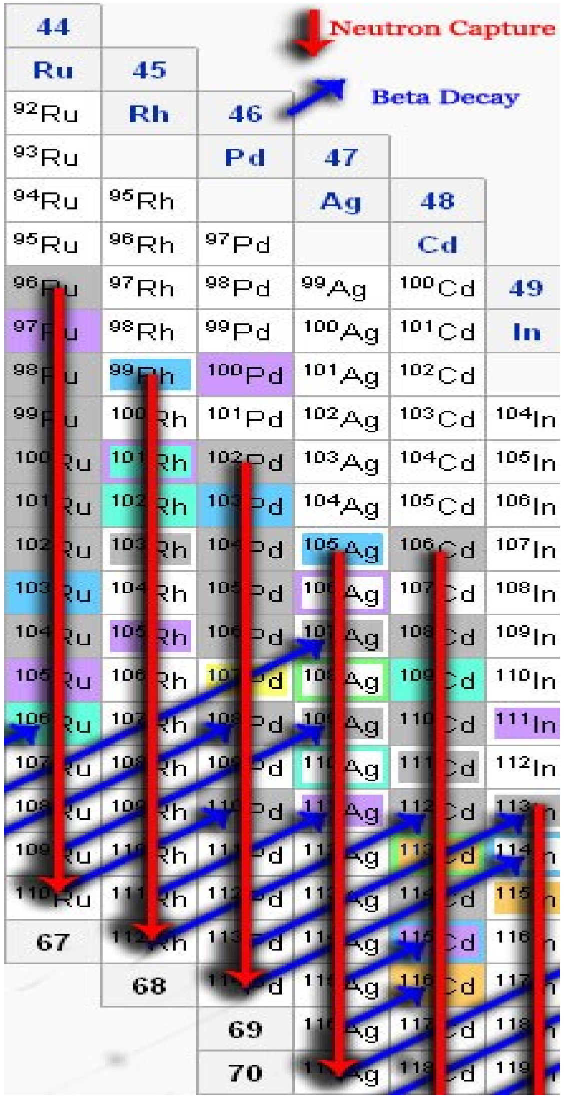
2011

Neutron capture reactions

R-process

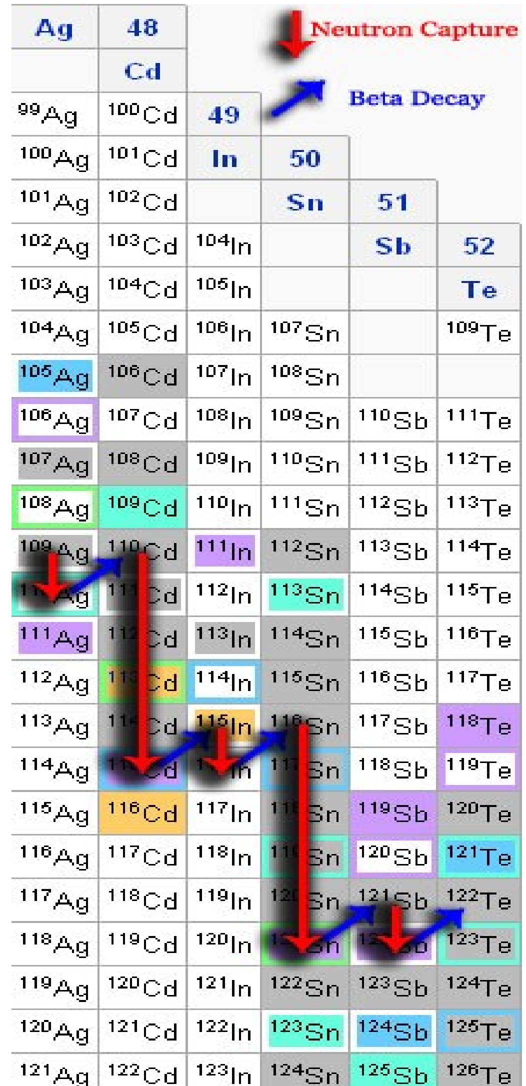


$N_n > 10^{22}\ cm^{-3}$

SN II

r- process began earlier than the main s-process

S-process



$N_n > 10^{8}\ cm^{-3}$

During hydrostatic He burning. Main component in AGB stars of 2-4 Mo s-process contribution to solar abundance *(Arlandini et al. 1999)*

X	Sr	Y	Zr	Mo	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Ho	Er	Tm	Yb
S-, %	85	92	83	50	81	62	77	49	56	29	5.8	15	15	7.8	17	13	33

For example, Ba is called as s-process element,
Eu is called as r-process element.

Beers and Chrislieb (2005):
r-I stars, if 0.3 < [Eu/Fe]<1 and [Ba/Eu]< 0 ,
r-II stars, if [Eu/Fe] > 1 and [Ba/Eu] < 0 (12 stars are known, all have -3 <[Fe/H]< -2.5).

When the s-nuclei synthesis began in AGB stars?
Theory *(Travaglio et al. 1999):* [Fe/H] ≈ -1.5
Observations *(Burris et al. 2000, Roederer et al. 2010)*: [Fe/H] from -2.6 to -1.4.

[X/Fe]= [X/H] – [Fe/H]
$[Fe/H]=\log(N_{Fe}/N_H)_* - \log(N_{Fe}/N_H)_o$

The purpose of this work is to find traces of the enrichment of Galactic matter with s-nuclei from precise analysis of chemical abundances of halo star with metallicity of -1.55

HD29907 – halo star

T_{eff}=5500 K, Log(g) = 4.64, [Fe/H]=-1.55, ξ= 0.6 km/c

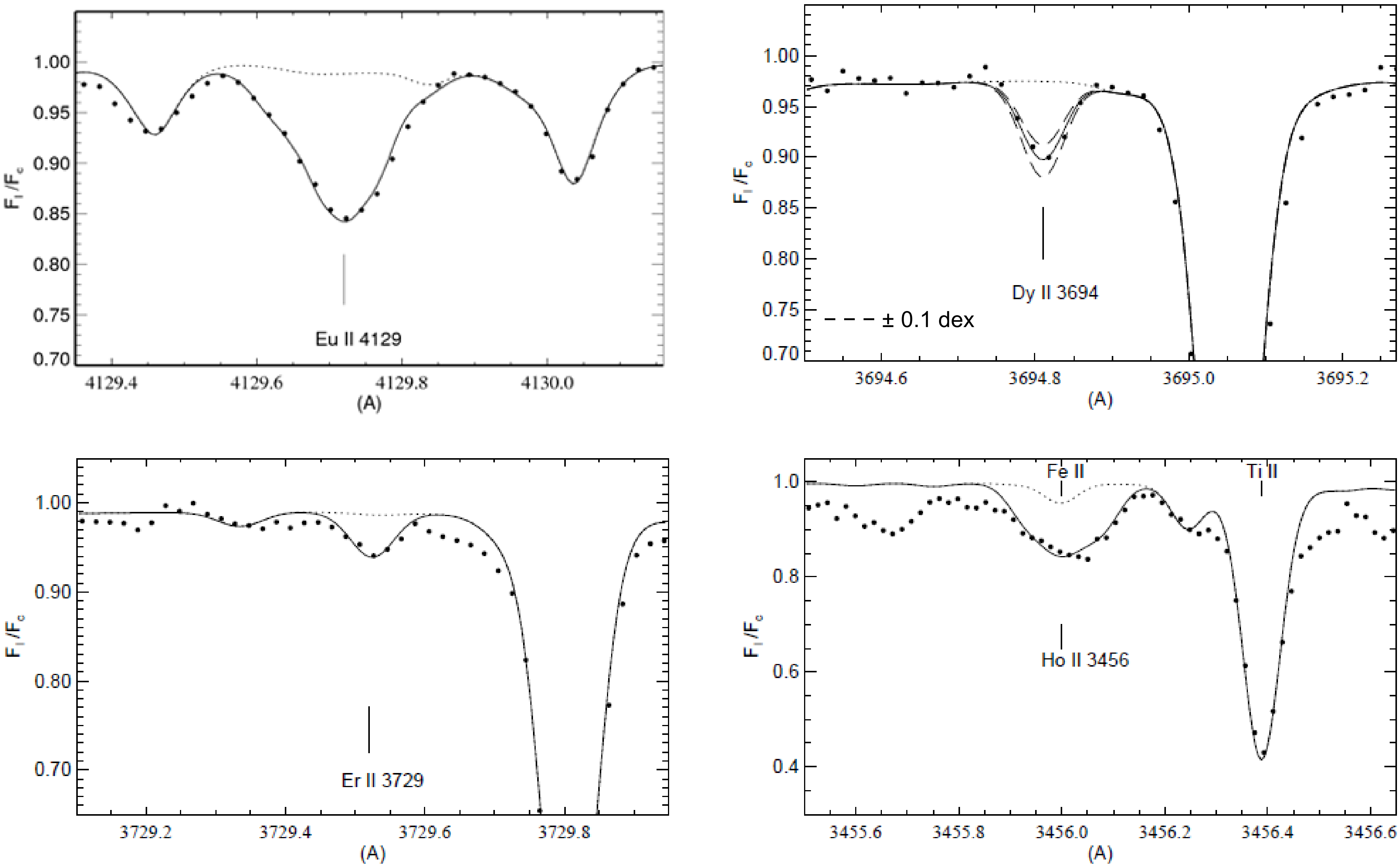
(*Mashonkina et al. 2003)*

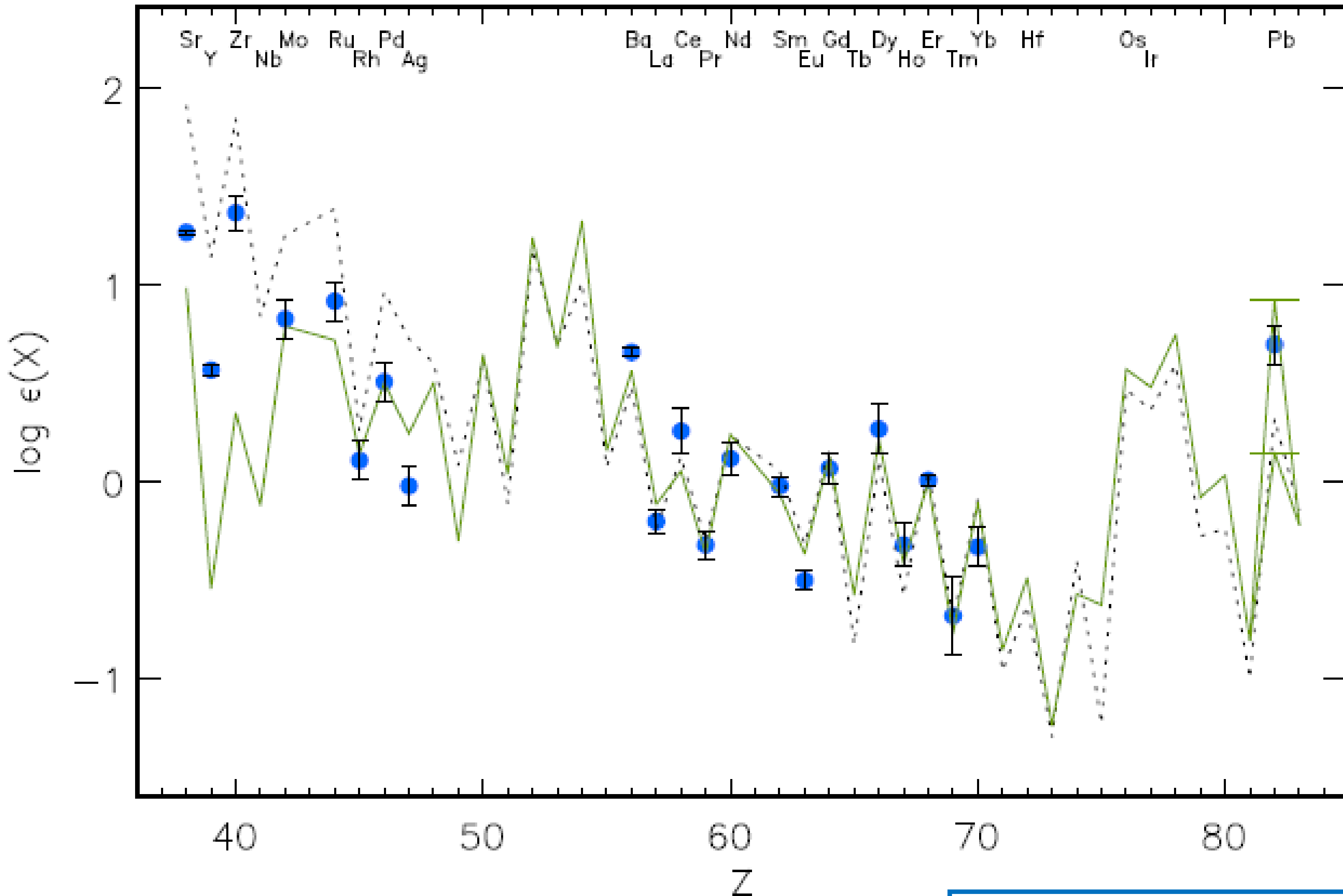
Observations (project no. 67.D-0086A, PI – T. Gehren):
λ/Δλ=60000 S/N>200
VLT2/UVES (Chile)
λ = 3350-4450 A, 4600-5550 A,5650-6650 A

Method: line profile analysis (program SIU),
model atmosphere (program MAFAGS)

Abundances of 22 elements were determined: Sr-Pb and C,N.

Quality of line profile fitting





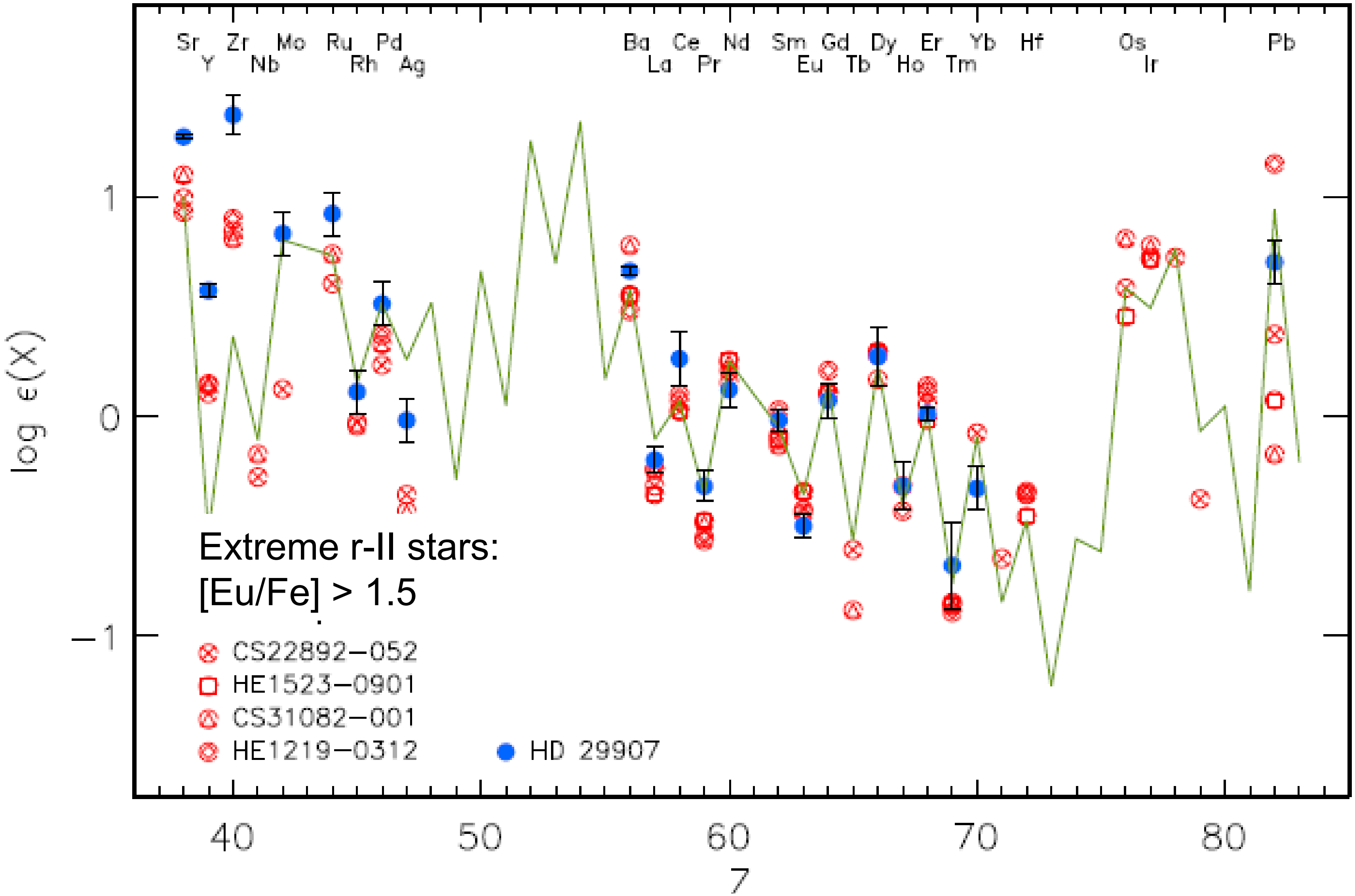
Heavy element abundance pattern of HD 29907

«solar r-process»= total – s

r-process model HEW (Farouqi et al. 2010)

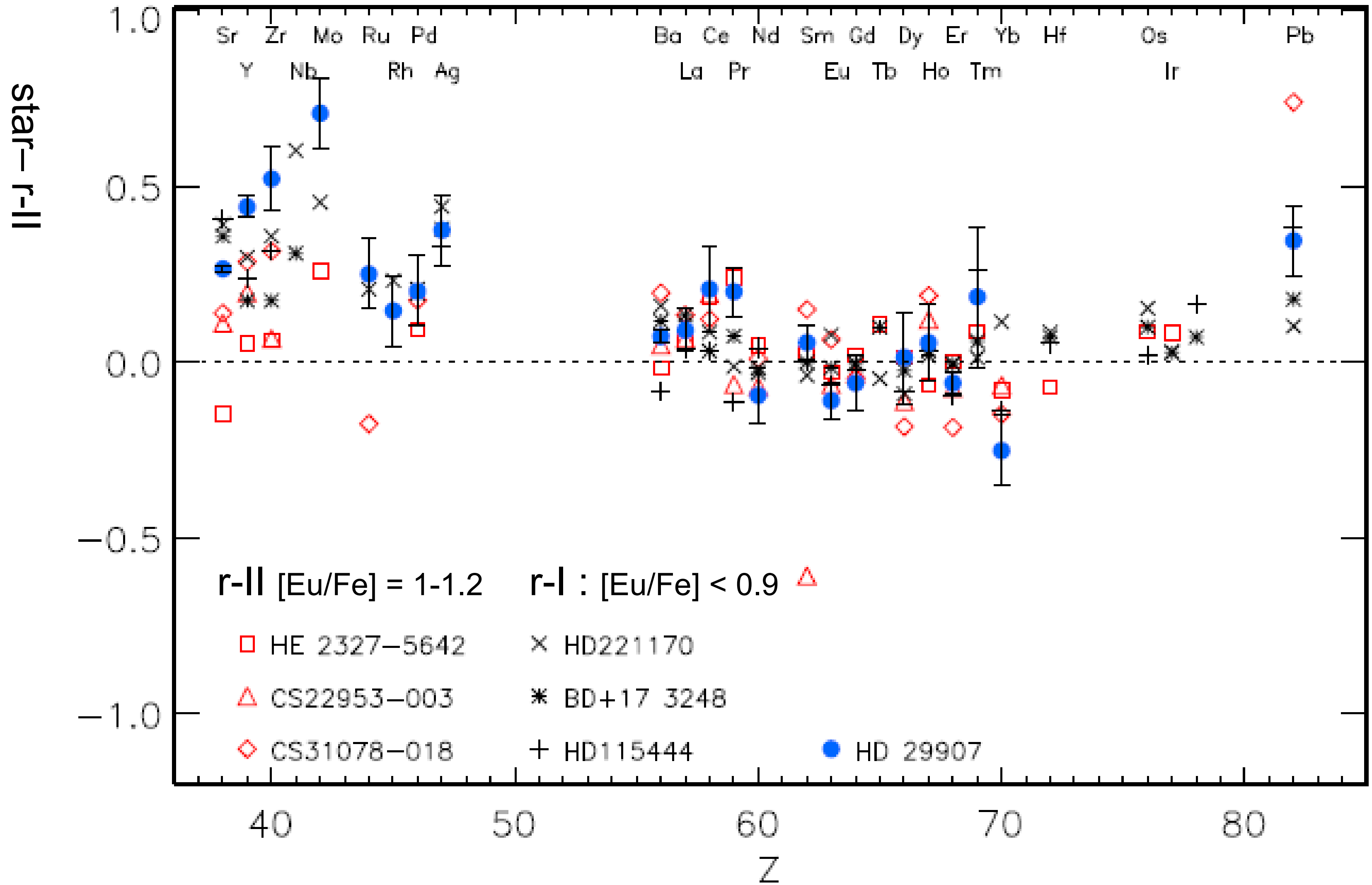
Ba – Yb match solar and theoretical r-process.
[Eu/Fe]=0.53
[Ba/Eu]=-0.49

r-I star

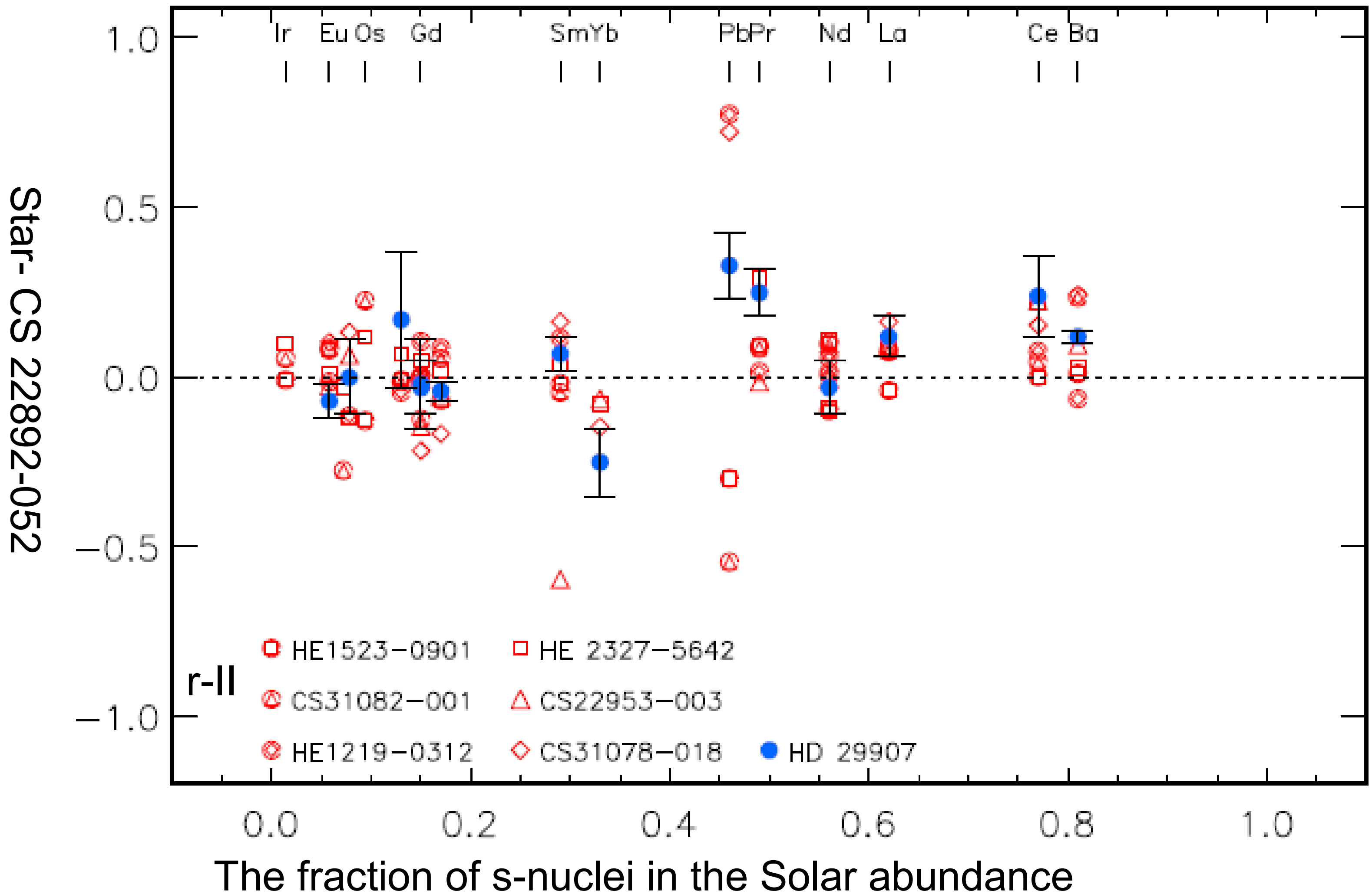


Ba-Yb in HD 29907 match “empirical” r-process based on r-II stars.

Sr-Zr : higher abundances



r-I stars: Sr-Ag are higher than in r-II, but not due to s–process !
Additional source of their synthesis in early Galaxy was discussed
(Truran et al. 2002,Travaglio et al. 2004)



Pr, La, Ce, Ba : the fraction of s-nuclei >49 % ,

(HD 29907 – CS 22892-052) > 0, but no trend in their behavior.

We didn't found convincing evidence for s-nuclei presence in HD 29907.

Conclusions

- HD 29907 is a r-I star ([Fe/H] = -1.55 and [r / Fe] = 0.63).
- Ba to Yb in this star match the scaled Solar r-process and empirical r-process abundance pattern very well, their origin is connected with a pure r-process
- HD 29907 shows enhanced abundance of Sr to Zr supporting the idea of the existence of LEPP in the early Galaxy.
- Even if there was a contribution of AGB stars to Galactic heavy elements at the epoch [Fe/H] = -1.55, it was small, at the level of the abundance errors.