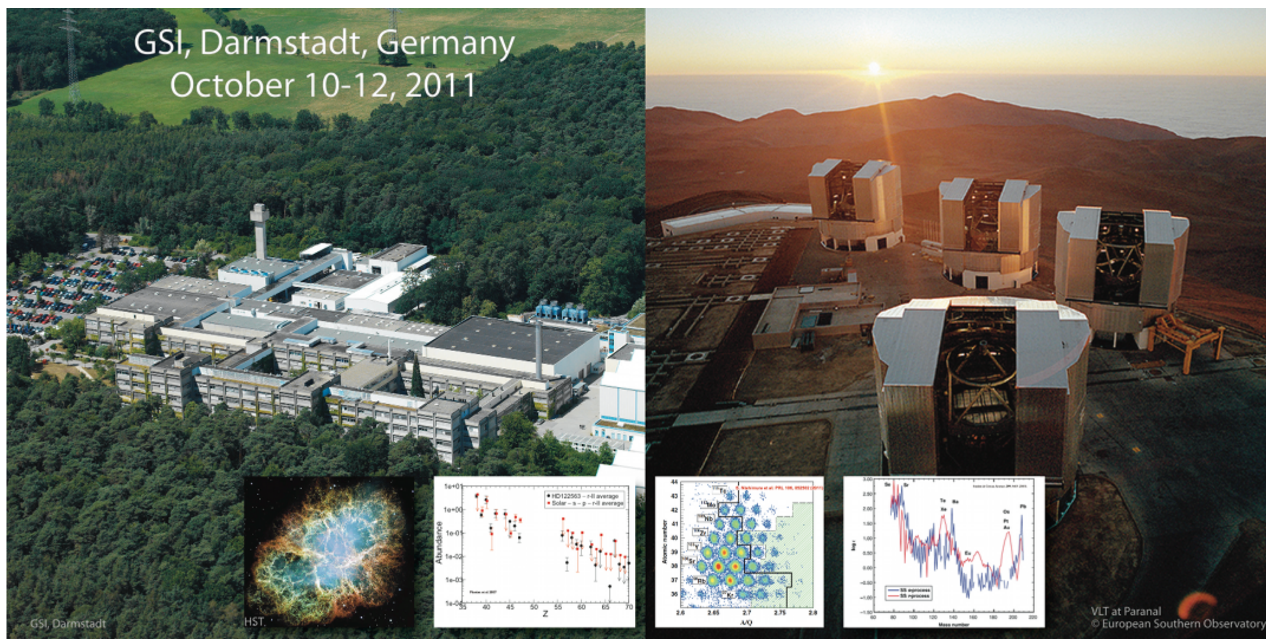
LEPP Farm Market : overview

C. Travaglio

Astronomical Observatory
Turin (Italy)



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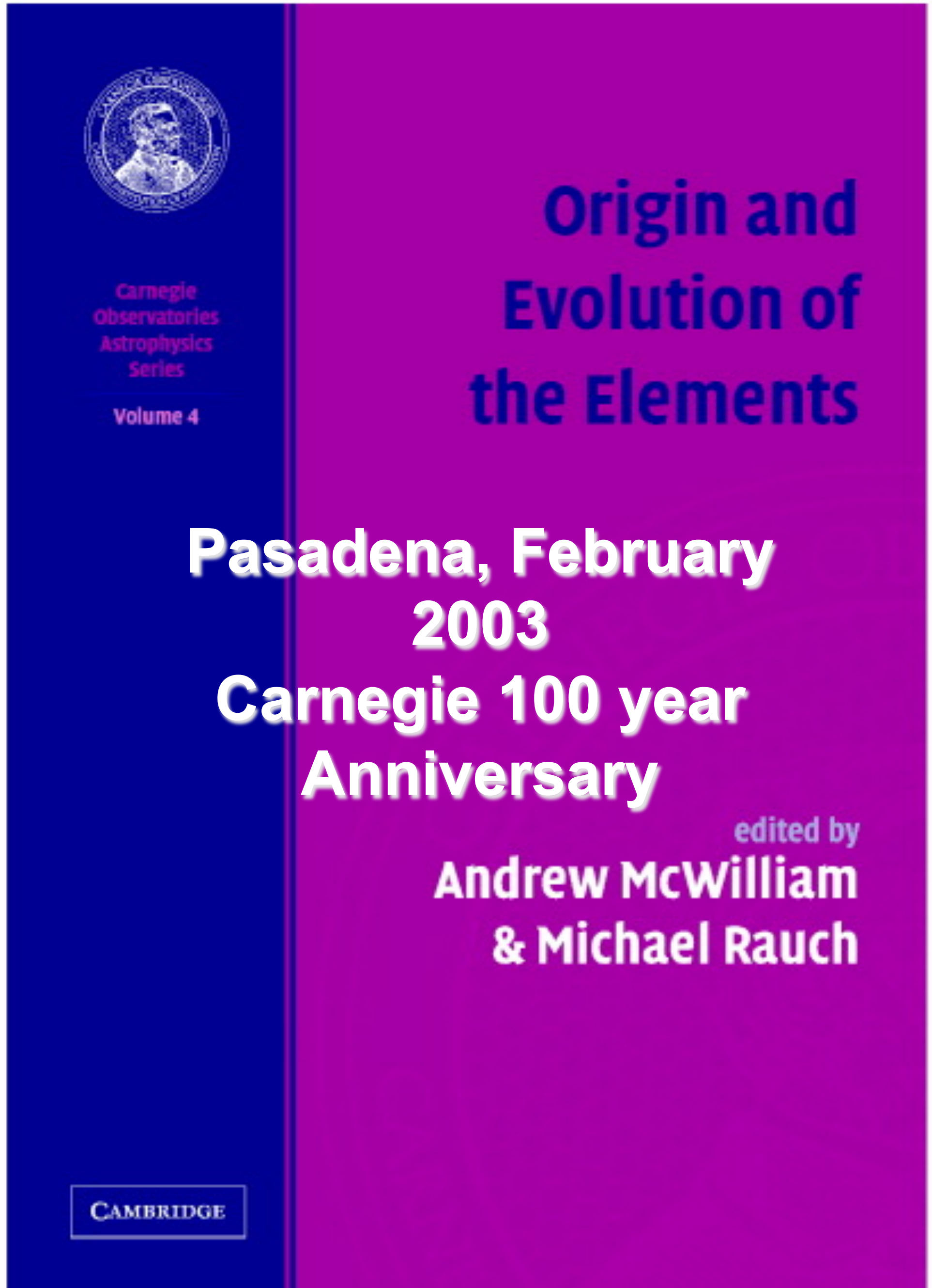

Pasadena, February 2003

Carnegie 100 year Anniversary

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The LEPP farmers

Travaglio et al. 2004

It was shown by *Gallino et al. (1998)* and *Arlandini et al. (1999)* that the solar main component can be reproduced by assuming a standard ^{13}C pocket,
a metallicity of **[Fe/H] = −0.3**, and by averaging between stellar models of 1.5 $M_\odot$ and 3 $M_\odot$.

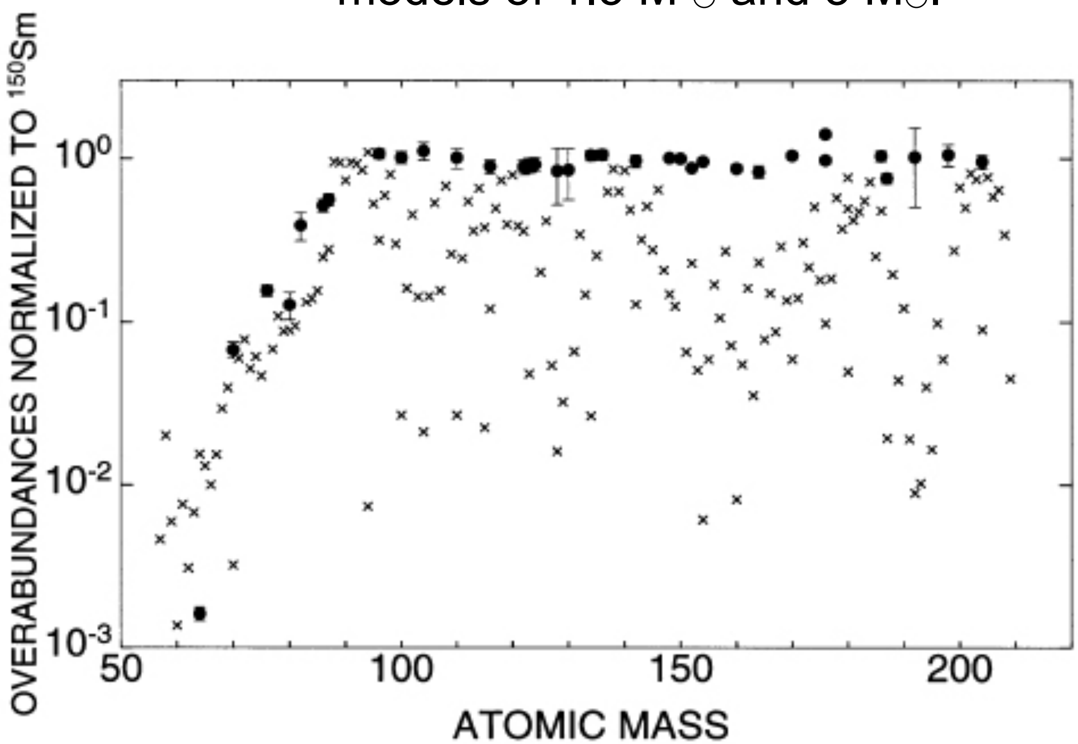
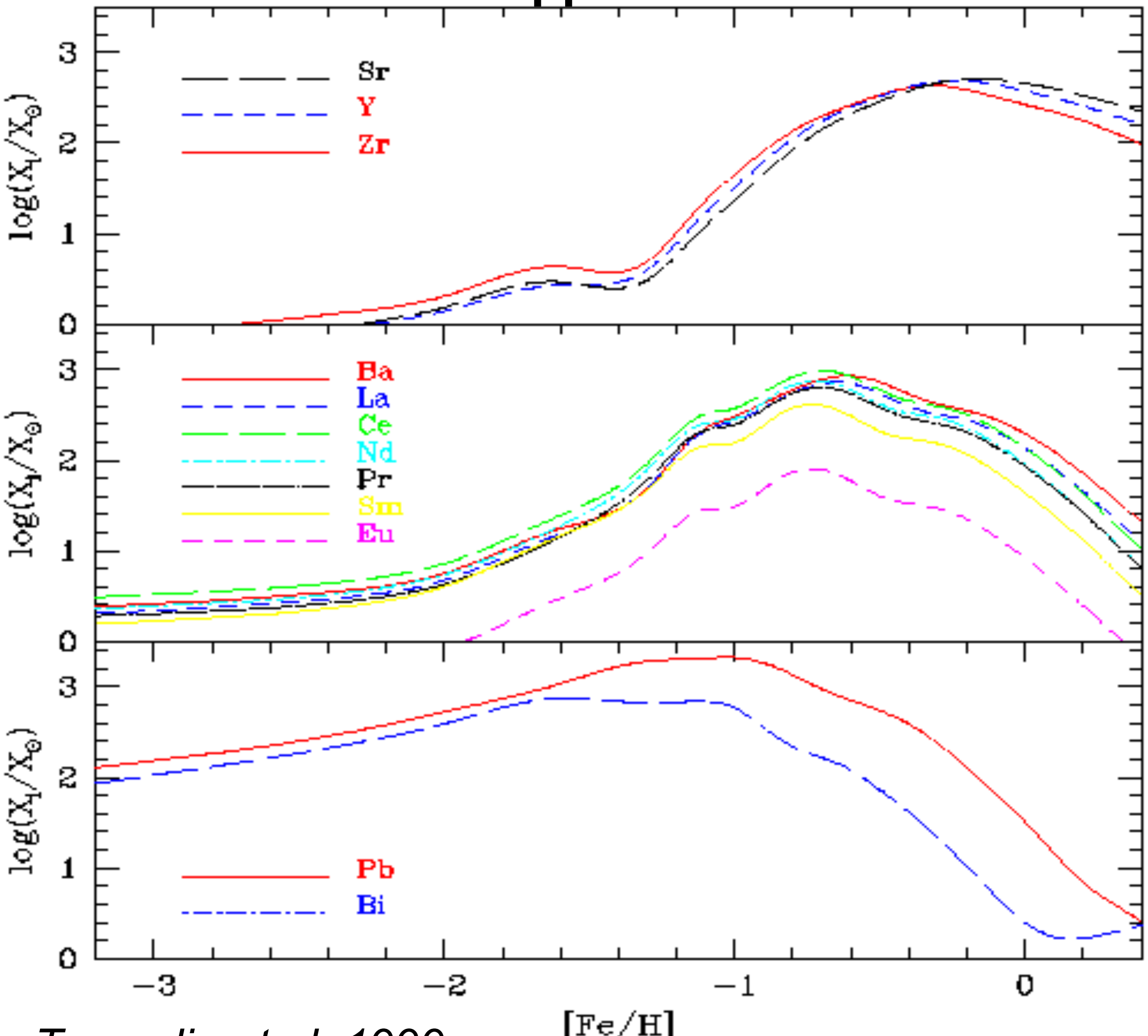


FIG. 3.—*s*-Process abundance distribution that best reproduces the solar system main *s*-component, as obtained by the stellar model for 1.5 $M_\odot$ and $Z = \frac{1}{2} Z_\odot$ ("standard model"), with updated Nd cross sections. The abundances are plotted as overproduction factors with respect to the solar values, normalized to ^{150}Sm. Circles indicate *s*-only nuclei. The uncertainties on both solar abundances and cross sections are taken into account.

LEPP Kitchen Studio

is where you can come and sample some of the delicious products available at **Lepp Farm Market**.



Travaglio et al. 1999

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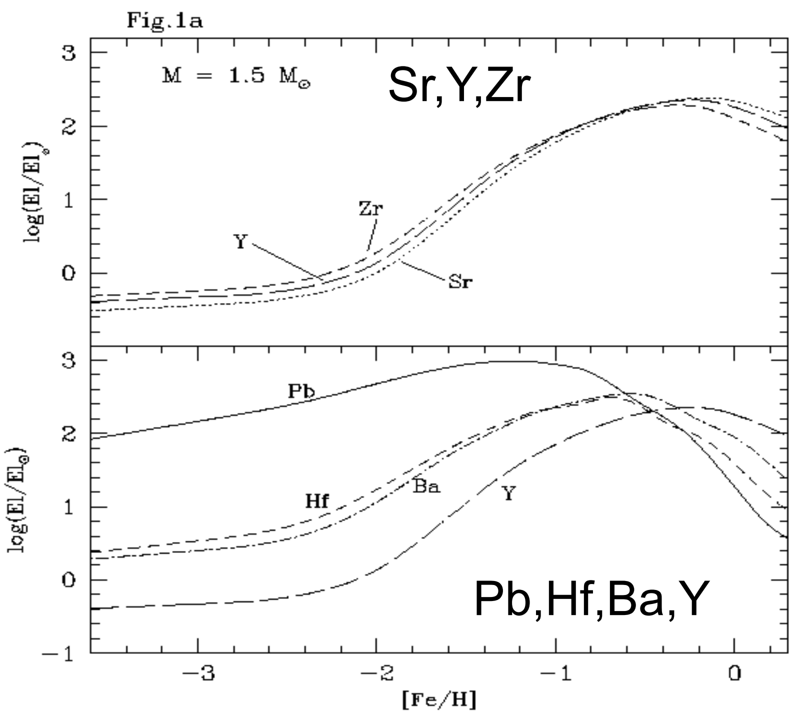
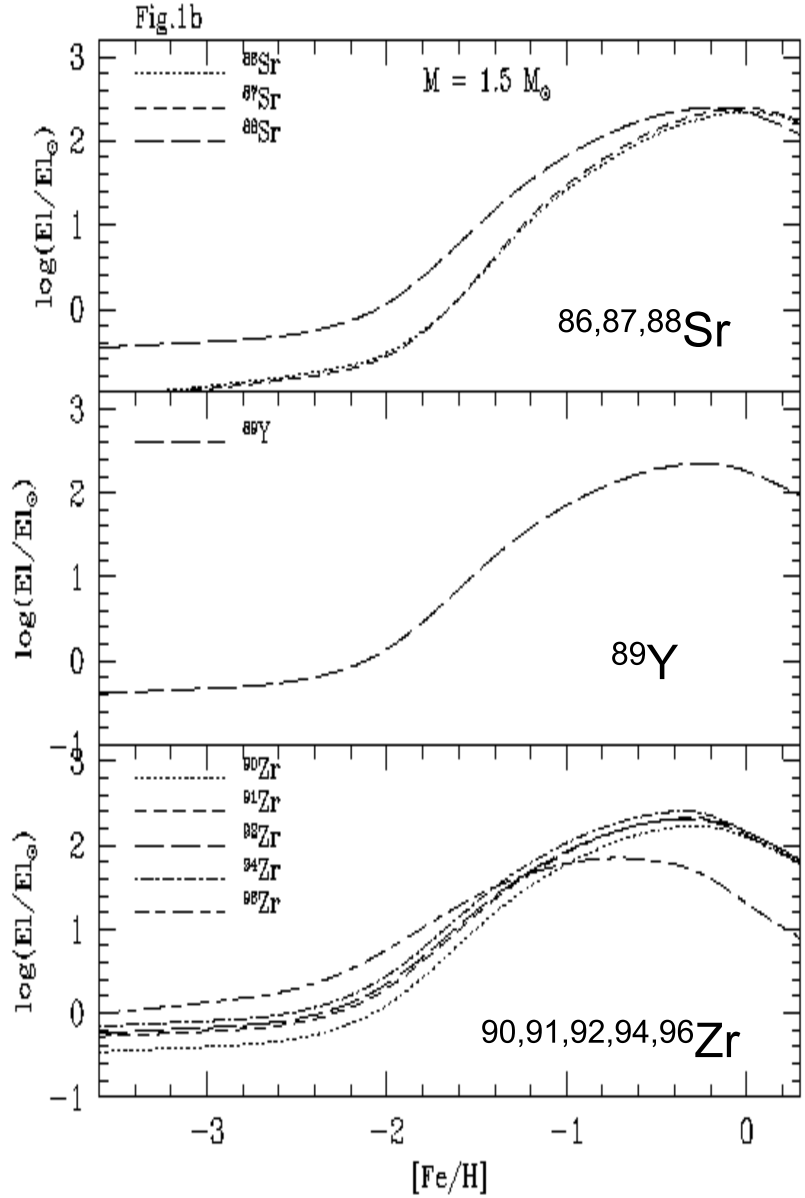
Yields from AGB: elements and isotopes





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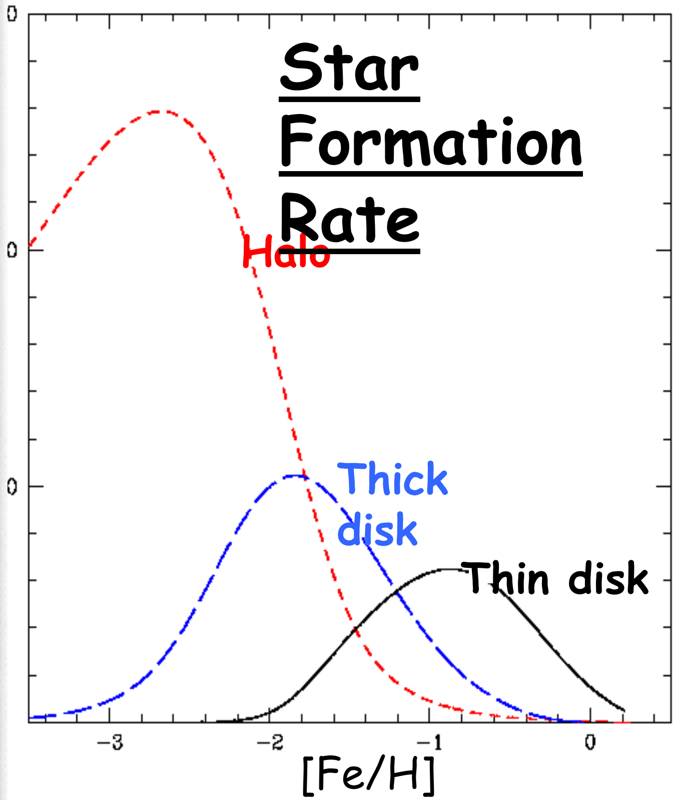
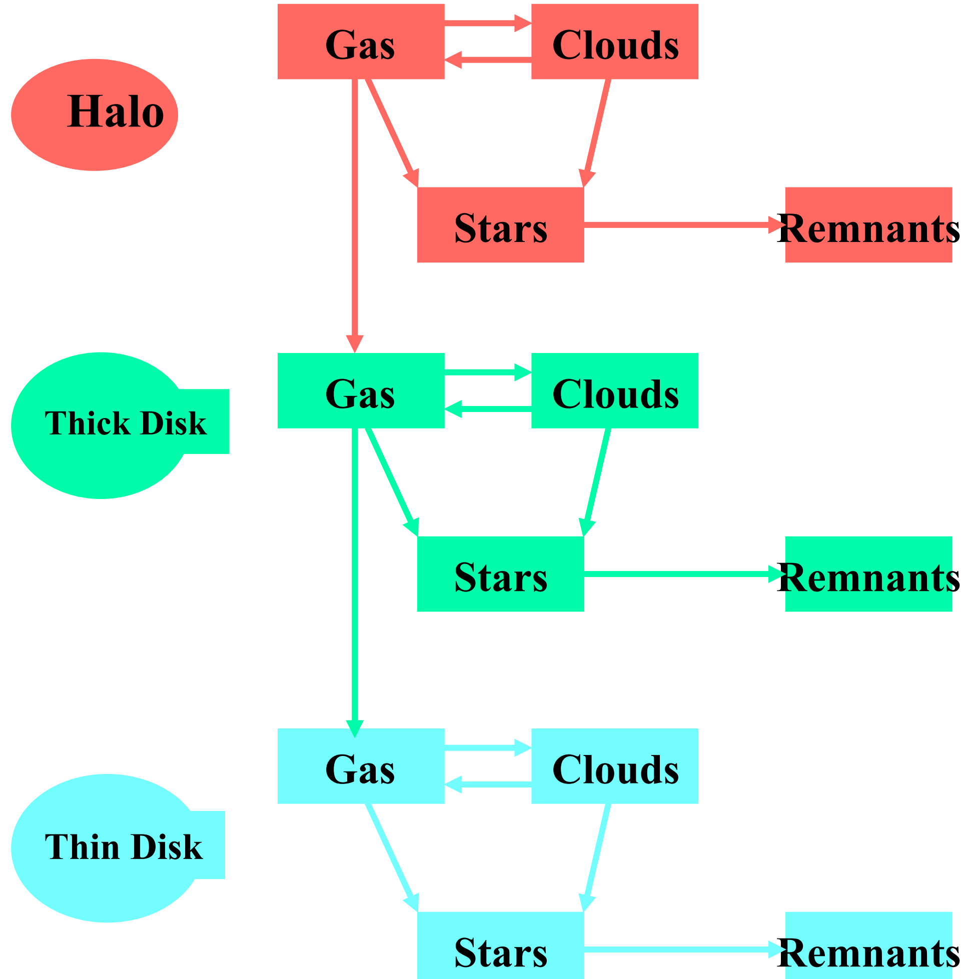
Galactic chemical evolution model
(Travaglio et al. 1999)





LEPP products

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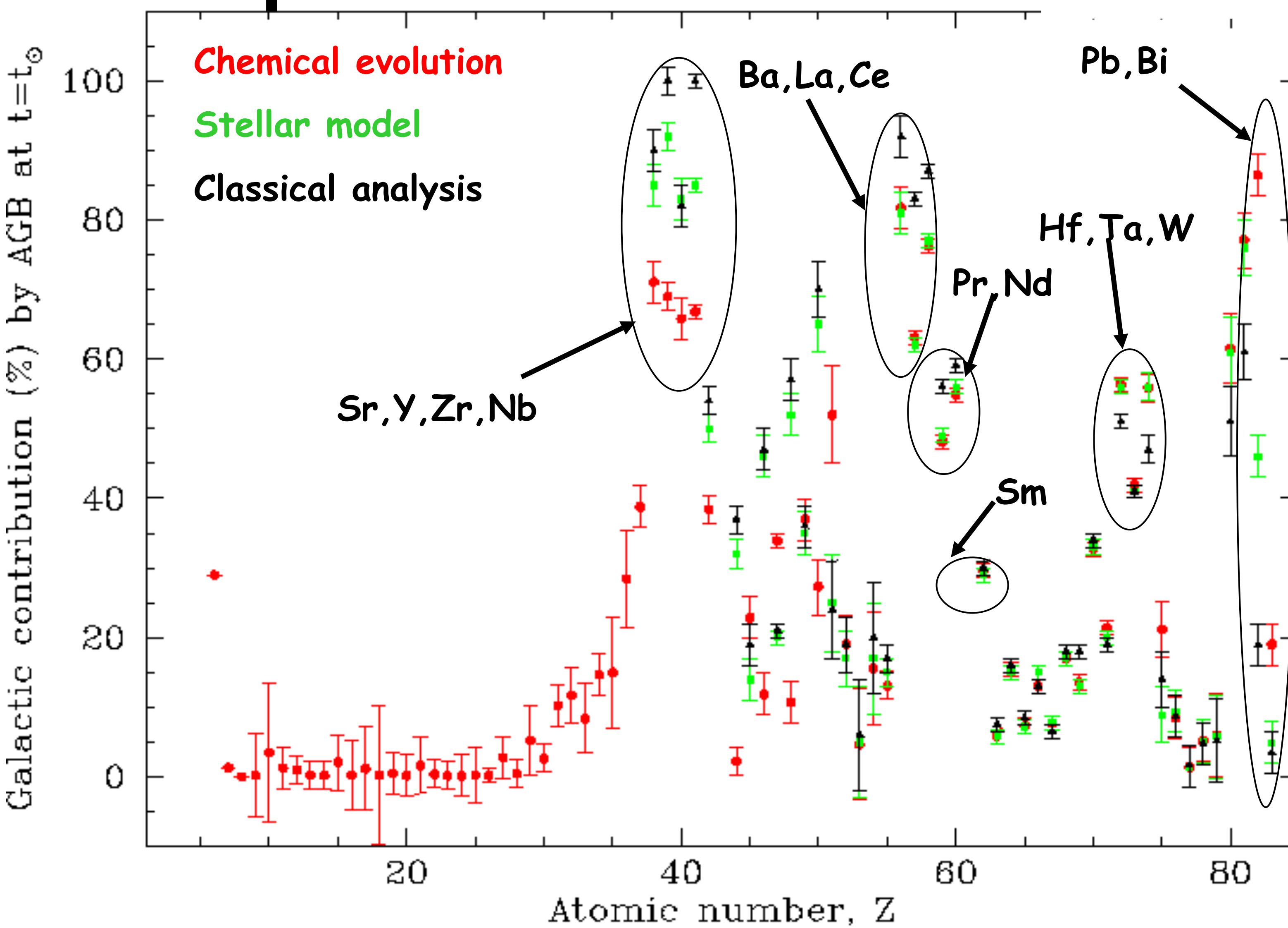

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Travaglio et al. 2004

s-only

TABLE 1

s-Process Fractional Contributions at $t = t_\odot$ with Respect to Solar System Abundances

Element	Solar[a] Atom (%)	Solar[a] σ (%)	GCE[b] IMSs (%)	GCE[b] LMSs+IMSs (%)	Weak s[c] (%)	TOT s[d] (%)
^{86}Sr	9.86	...	8	52	24	76
^{87}Sr	7.00	...	5	54	16	70
^{88}Sr	82.58	...	10	75	7	82
Sr	...	8.1	9	71	9	80
^{89}Y	100	...	7	69	5	74
Y	...	6.0	7	69	5	74
^{90}Zr	51.45	...	6	53	2	55
^{91}Zr	11.22	...	18	80	3	83
^{92}Zr	17.15	...	15	76	3	79
^{94}Zr	17.38	...	9	79	2	81
^{96}Zr	2.80	...	40	82	0	82
Zr	...	6.4	10	65	2	67
^{93}Nb	100	...	12	67	2	69
Nb	...	1.4	12	67	2	69
^{95}Mo	15.92	...	4	39	1	40
^{96}Mo	16.68	...	8	78	2	80
^{97}Mo	9.55	...	6	46	1	47
^{98}Mo	24.13	...	6	59	1	60
Mo	...	5.5	4	38	1	39

[a] Anders & Grevesse 1989.
[b] This paper.
[c] Raiteri et al. 1993.
[d] Total from *s*-process: main *s* plus weak *s*.

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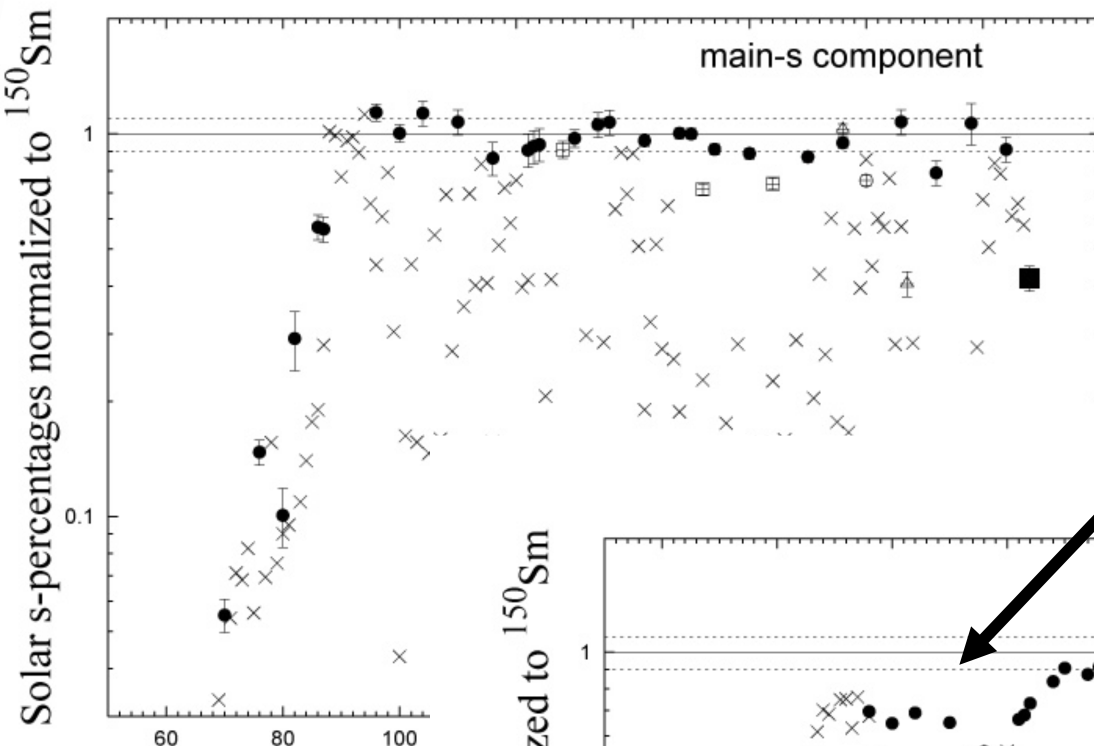
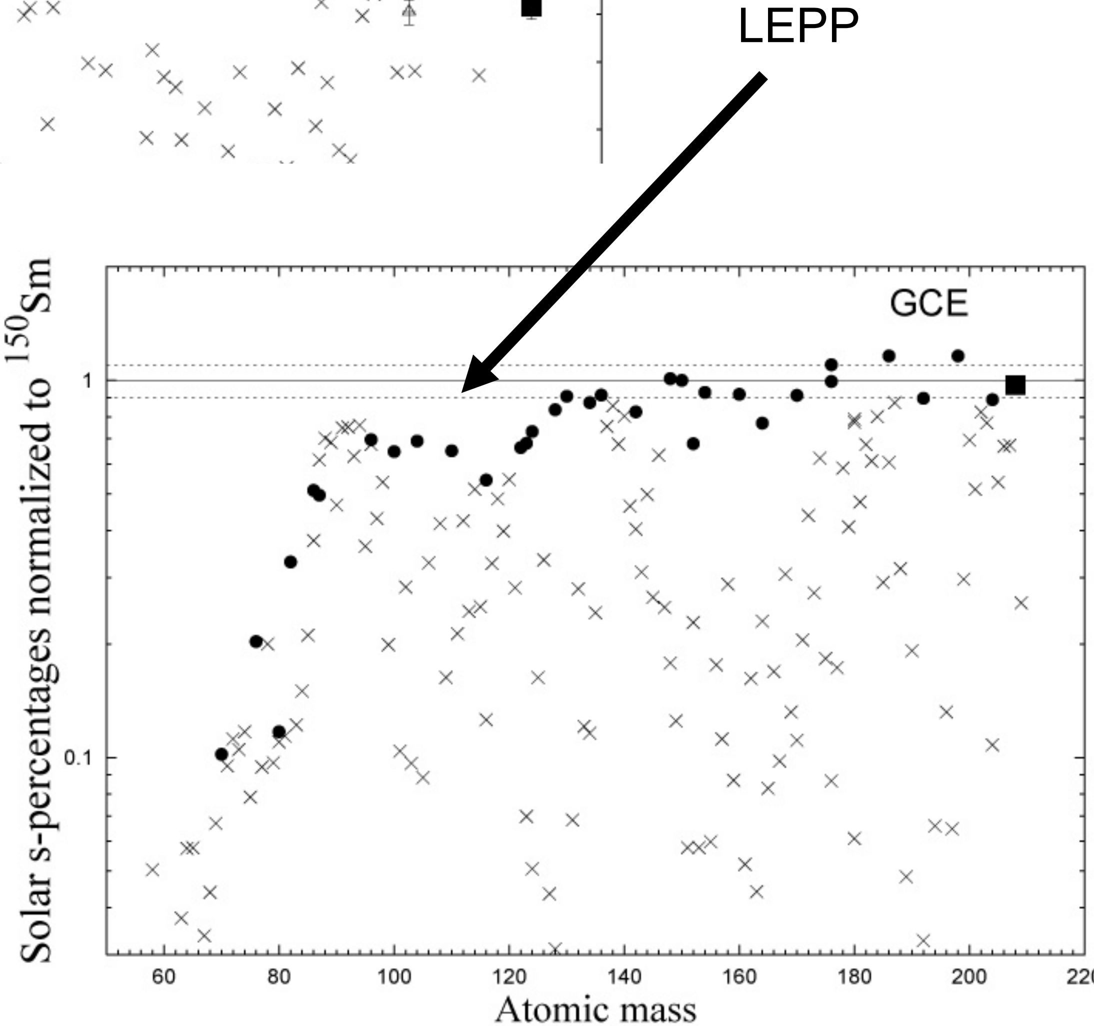
Kaeppeler, Gallino, Bisterzo, Aoki 2011





Updated results with respect to Travaglio et al. 2004 and Serminato et al. 2009

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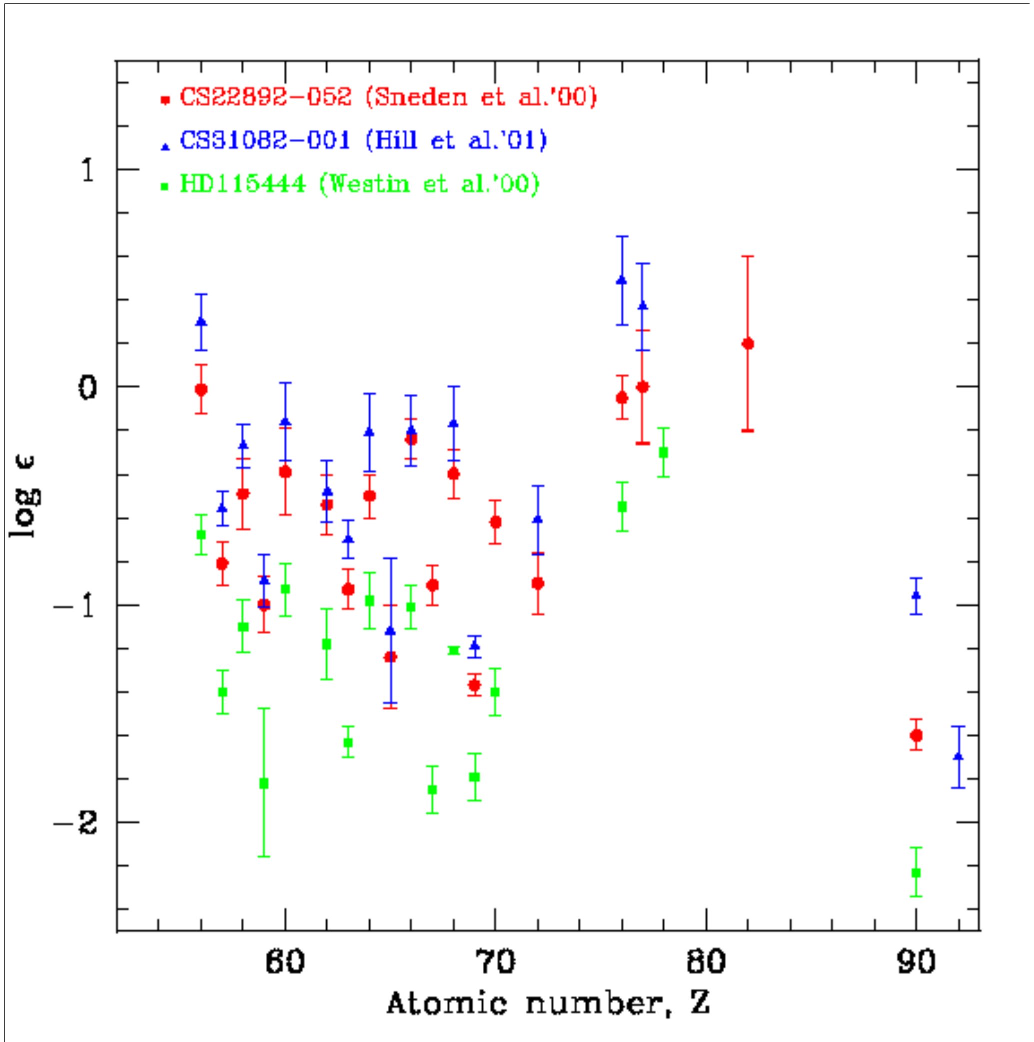
In addition to the Solar System abundance distribution, observations of elemental abundances in unevolved metal-poor halo stars can provide important clues on the early Galaxy, e.g. the famous CS 22892-052 (*Sneden et al. 2000*) and many others more recently



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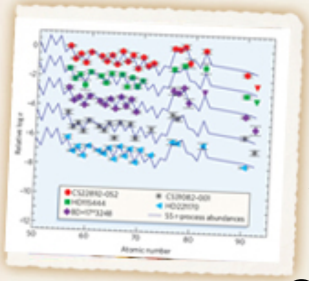
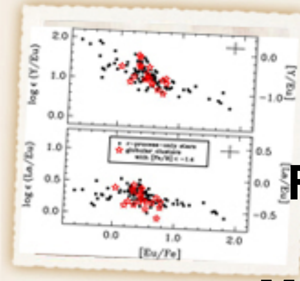


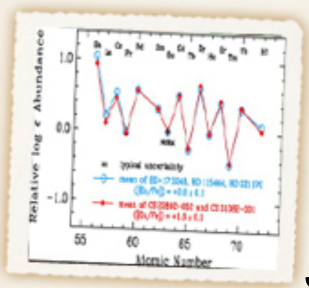
Sneden et al.
Hill et al.
Christileb et al.
Burris et al.
Edvardsson et al.

SIDE DISHES



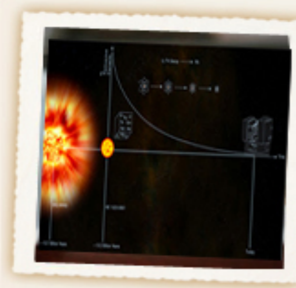
Fullbright et al.
Gratton et al.
Mashonkina et al.
McWilliam et al.
Andrievsky et al.

ENTREES



Ivans et al.
Jehin et al.
Francois et al.
Roederer et al.
Tomkin & Lambert

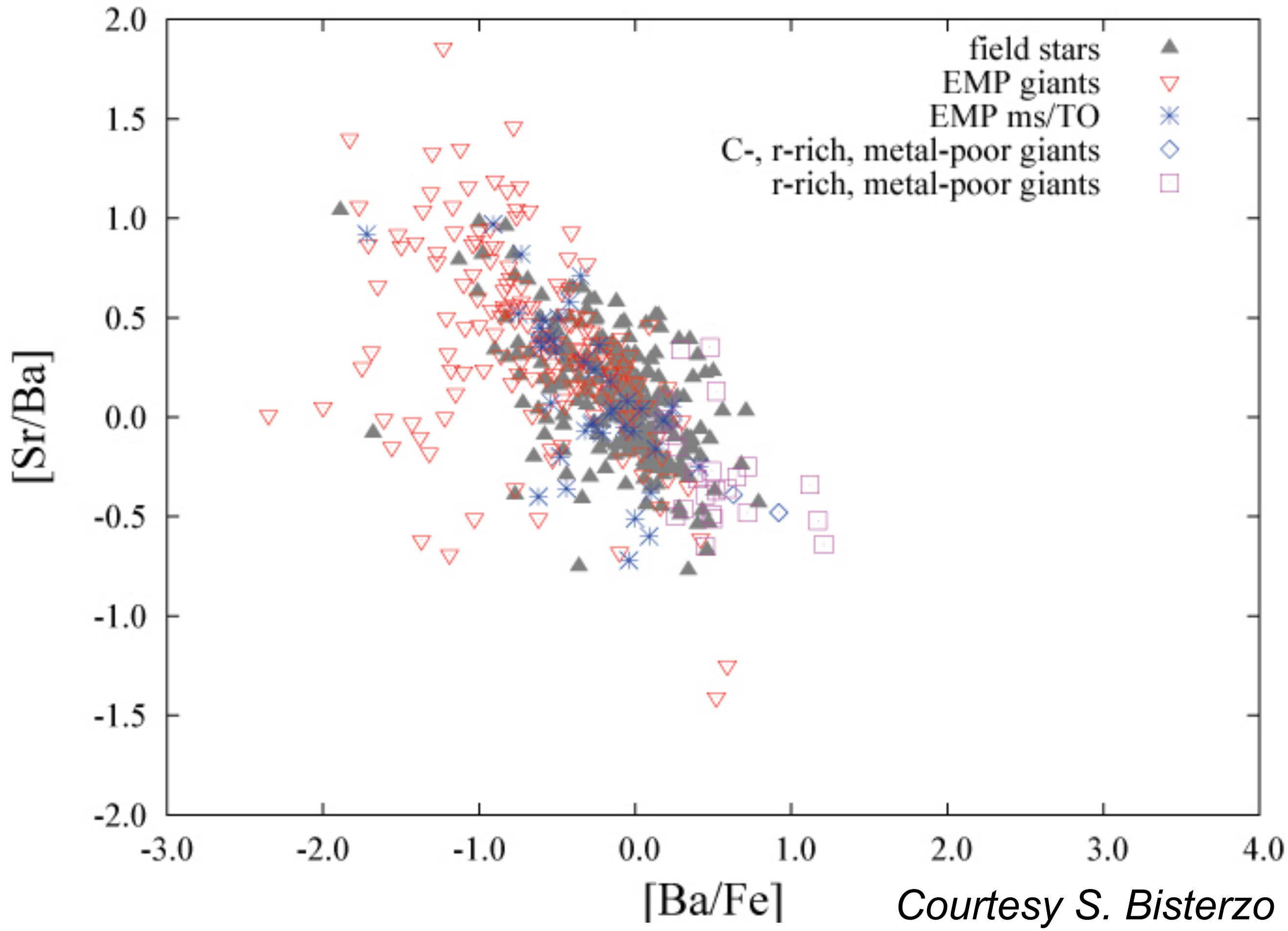
DESSERTS



Frebel et al.
Honda et al.
Westin et al.
Barklem et al.
Suda et al.

.....

A large scatter in **Sr/Ba** observed in low metallicity stars has been interpreted as further evidence for an independent process that produces Sr and not Ba at low metallicities



Courtesy S. Bisterzo
Data from Suda et al. 2008

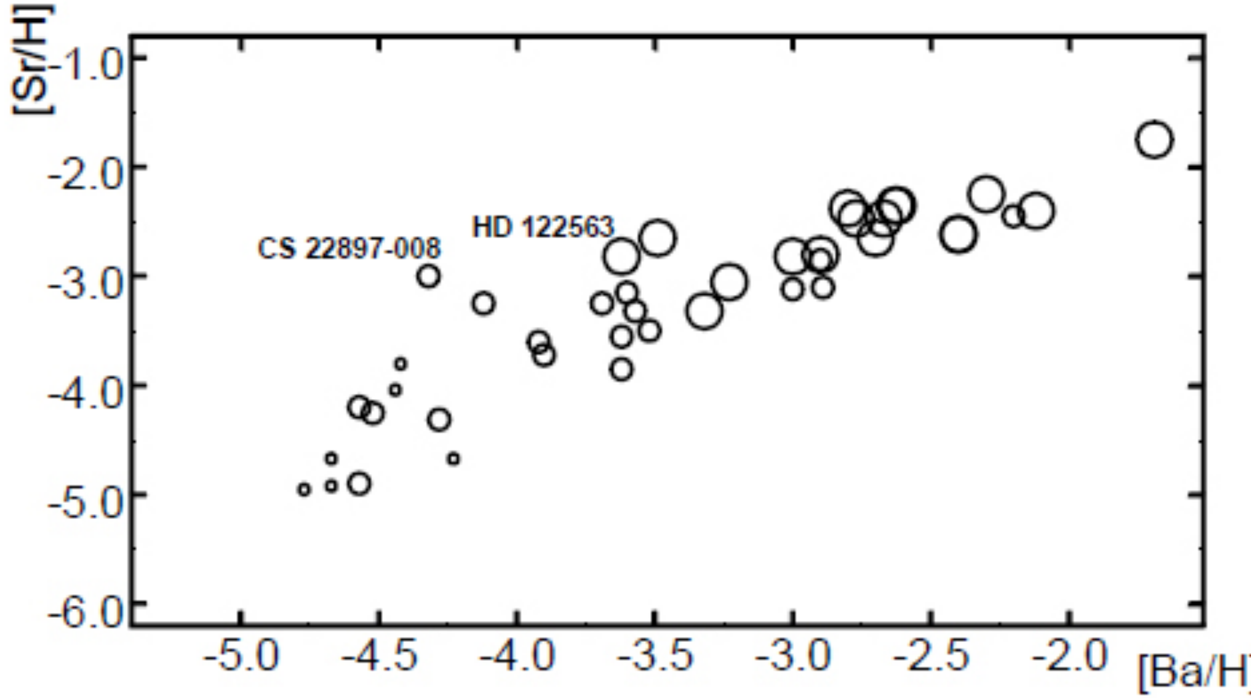


Fig. 12. [Sr/H] vs. [Ba/H]. Stars with [Fe/H] < −3.5 - *small circles*, −3.5 < [Fe/H] < −3.0 -*intermediate circles*, [Fe/H]> −3.0 - *large circles*.

Andrievsky et al. 2011

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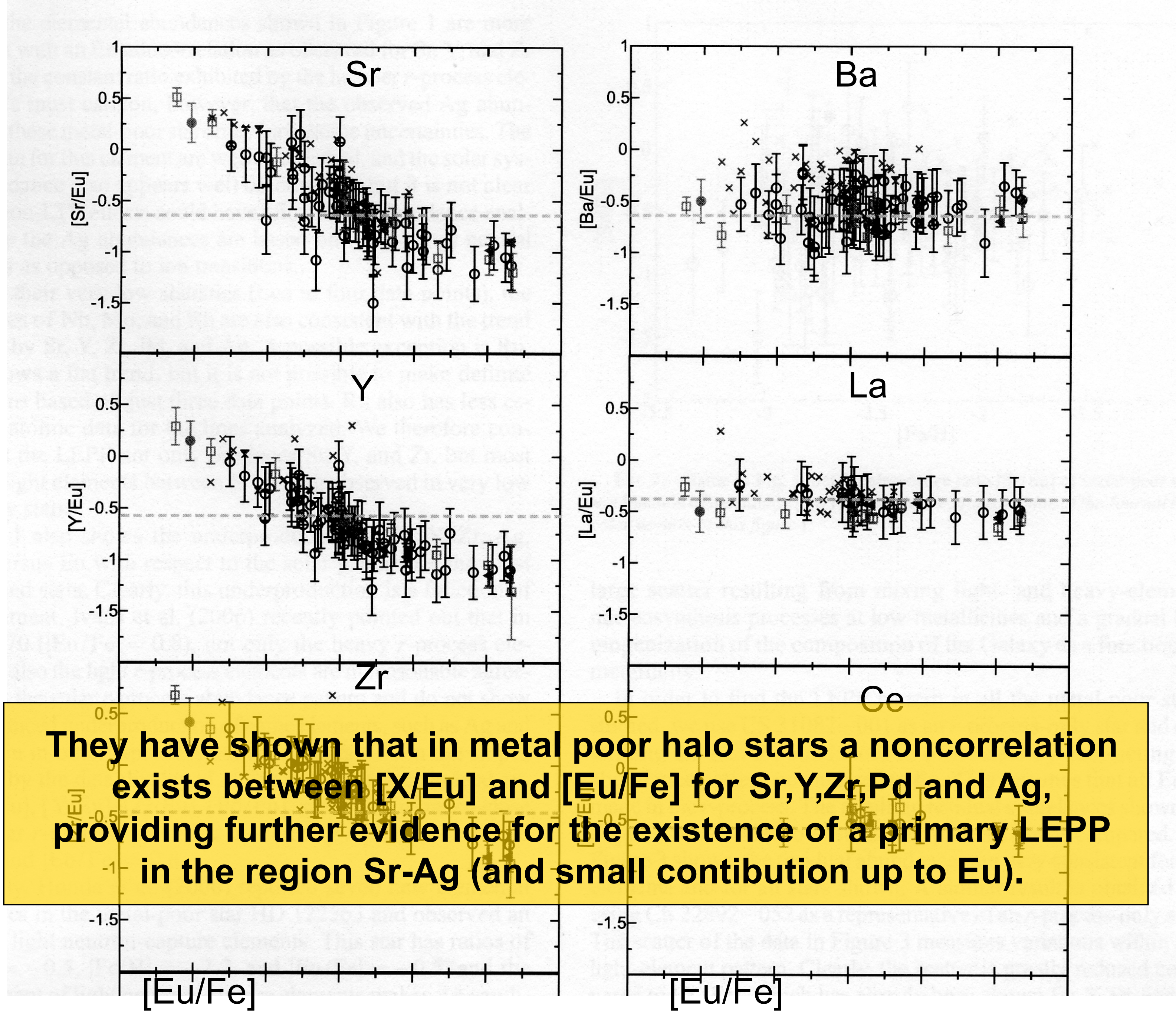

They have shown that in metal poor halo stars a noncorrelation exists between [X/Eu] and [Eu/Fe] for Sr,Y,Zr,Pd and Ag, providing further evidence for the existence of a primary LEPP in the region Sr-Ag (and small contibution up to Eu).

Montes et al. 2007 (J. Cowan coauthor)

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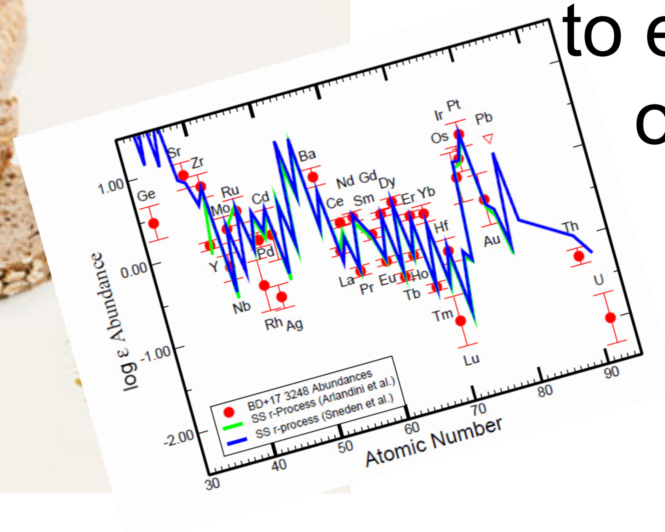

Drive by **Lepp Farm Market** on any morning and you'll smell just-baked goods ready to enjoy on-the-spot or to take in the office for your colleagues' enjoyment.

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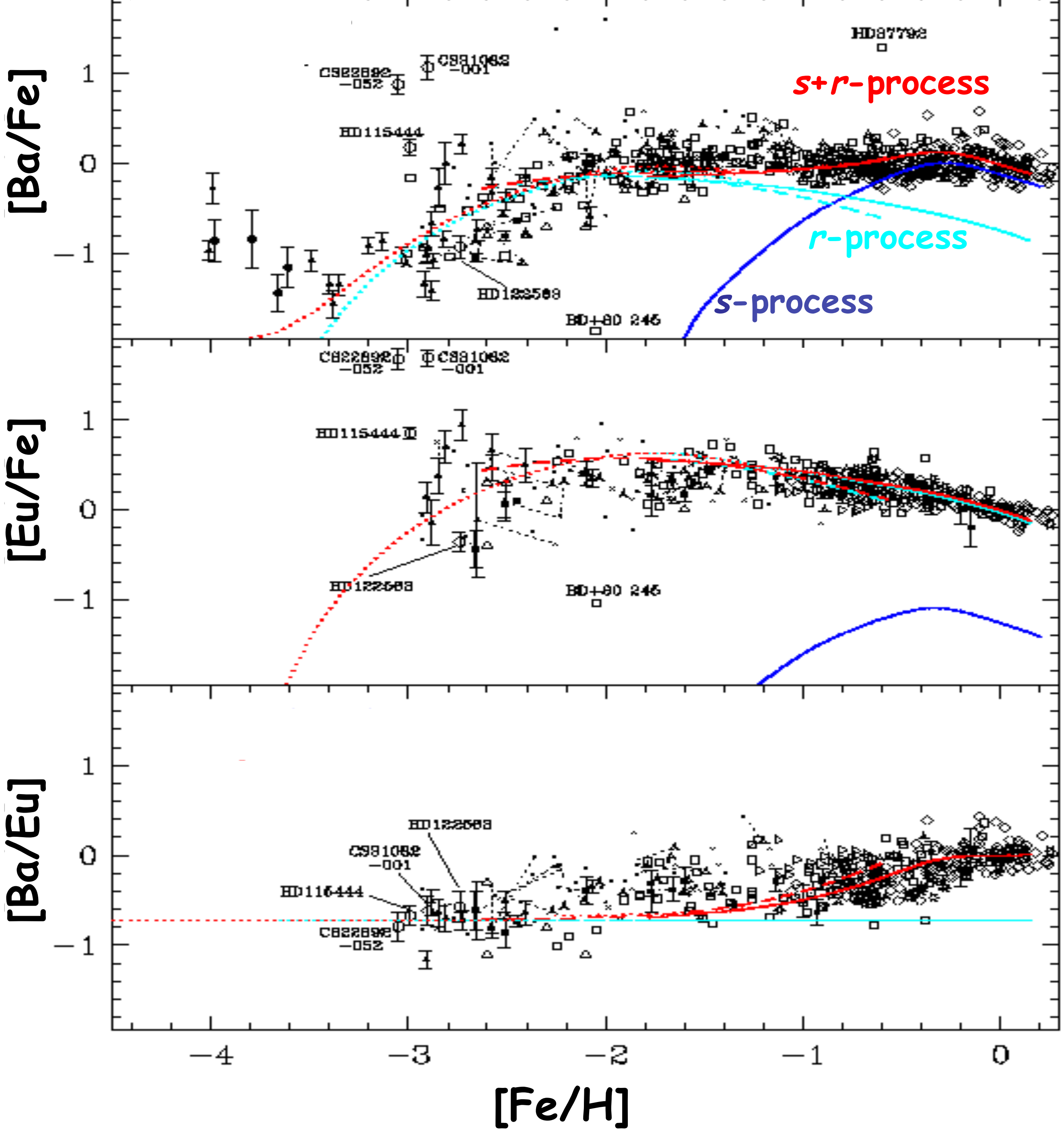

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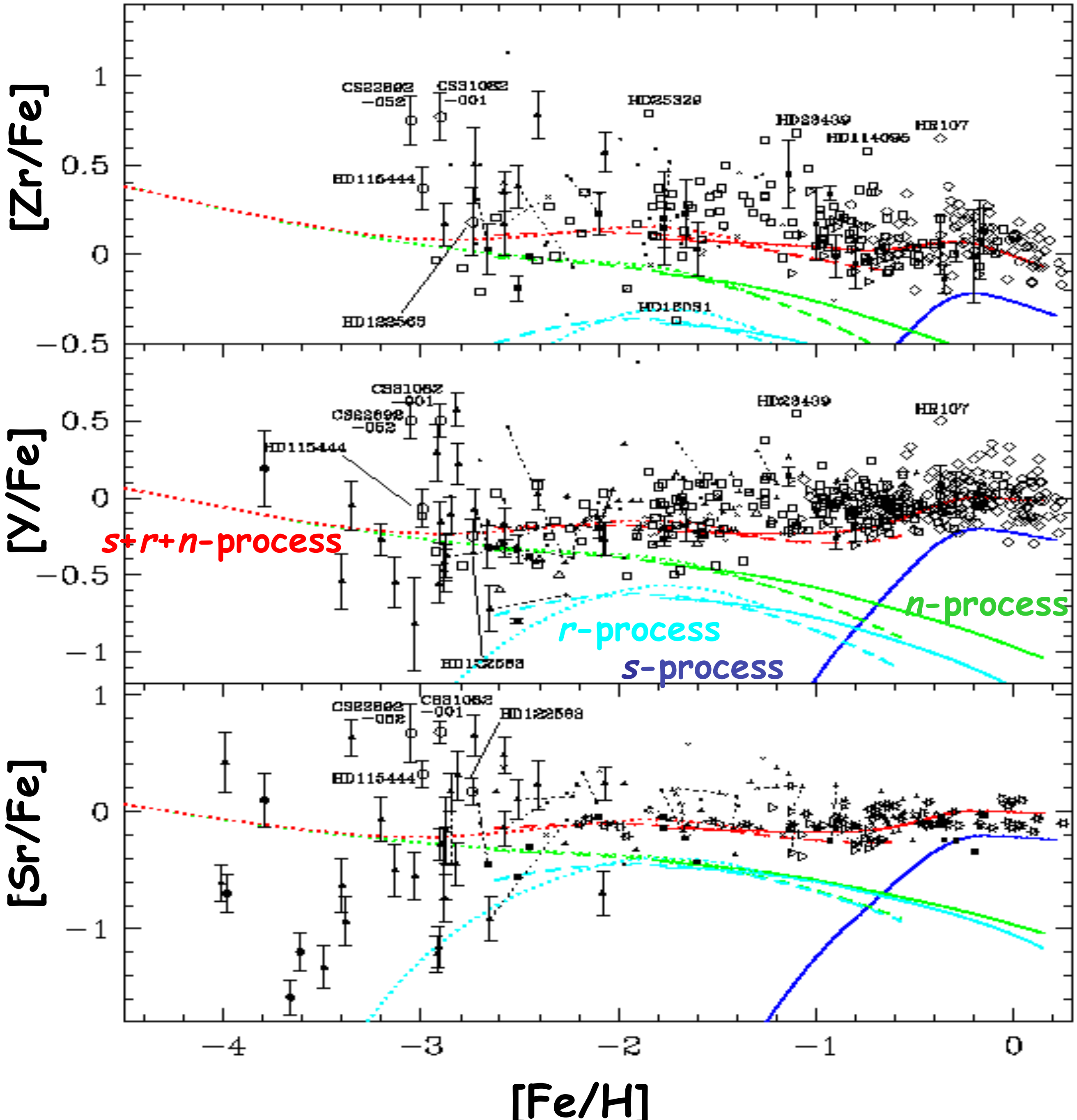

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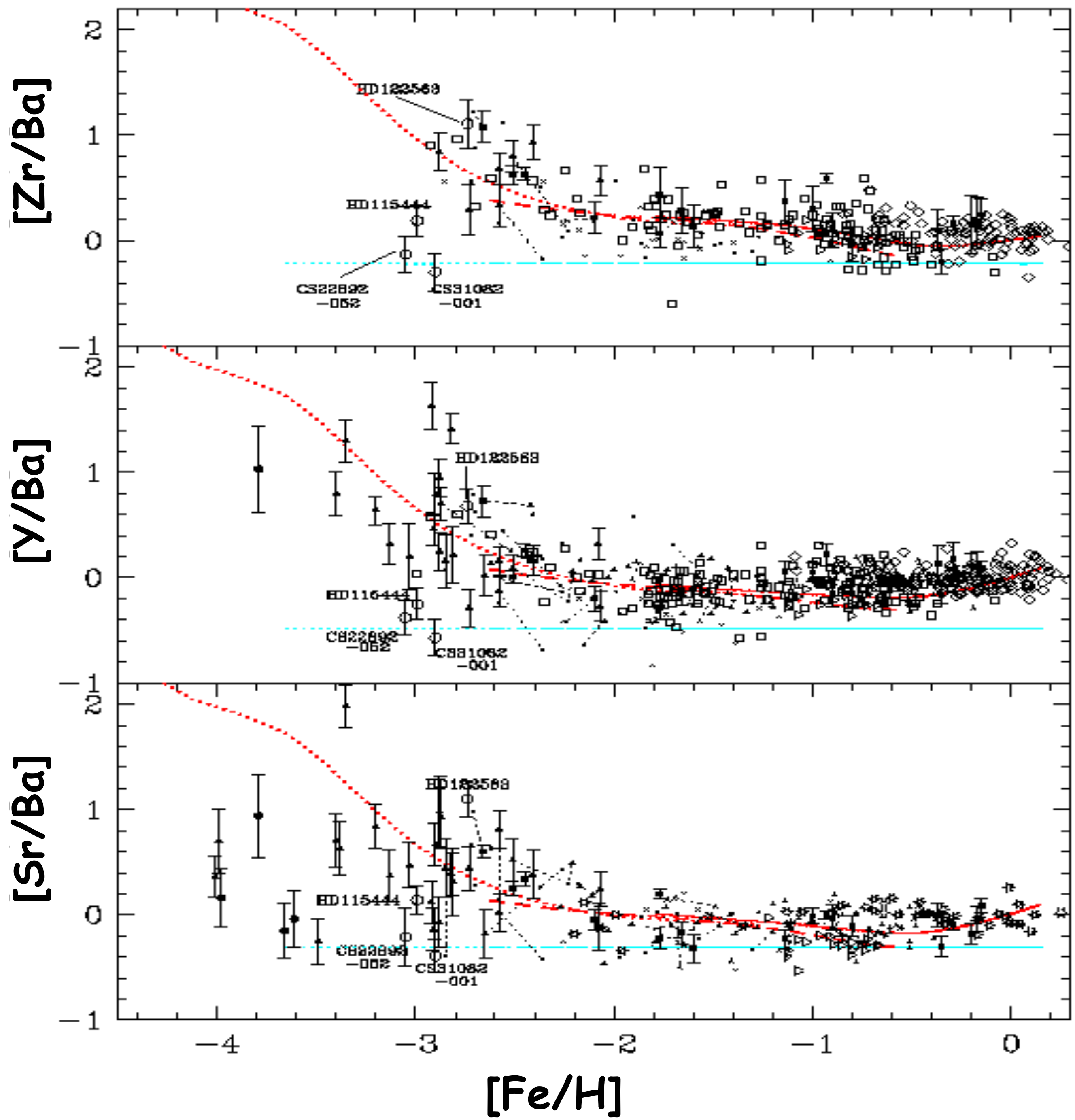

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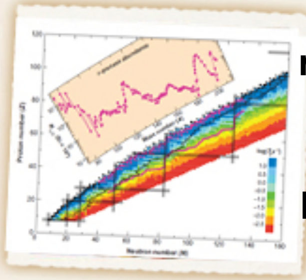
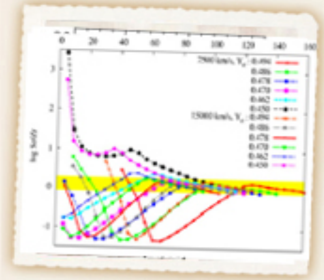


Inhomogeneous mixing of 3 types of nucleosynthesis productions: a phenomenological ‘3-components model’ (Qian & Wasserburg 2008)

Weak r-process (Honda et al. 2007)

SIDE DISHES



Rotating massive stars may produce in some cases a strong Sr/Ba ratio (Pignatari et al. 2008)

High-entropy wind of SNII (Farouqi, Kratz et al. 2009)

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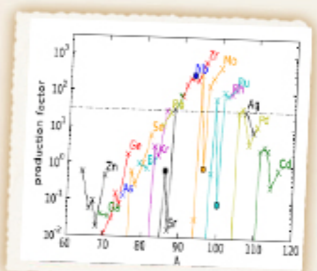
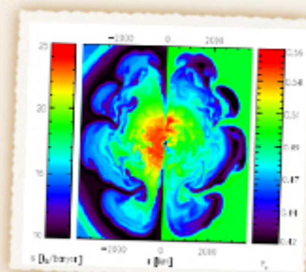


Variation in the r-process (Roederer et al. 2007)

Neutrino driven winds, exploring the sensitivity to the electron fraction, νp-process (Froelich et al. 2007, Arcones&Montes 2011)

DESSERTS



Wanajo et al. 2011, comparing 1D and 2D simulation of collapsing O-Ne-Mg core.

Calculating nucleosynthesis in 2D with tracer particles they found n-rich lumps of matter being dredge-up by convection and formed during early stages of the explosion.

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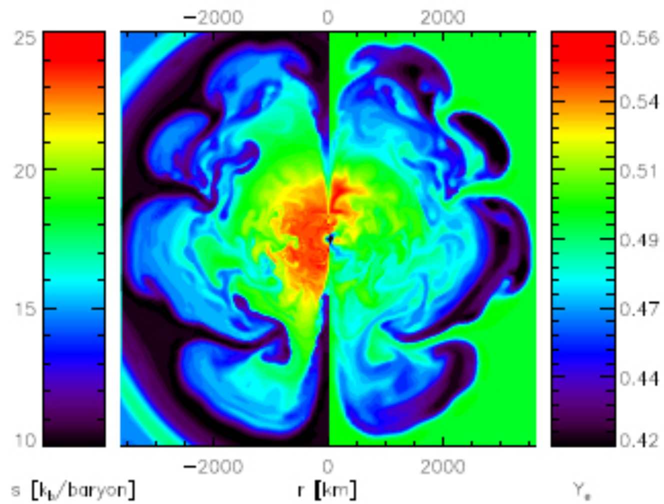

FIG. 1.— Snapshot of the convective region of the 2D simulation of an ECSN at 262 ms after core bounce with entropy per nucleon (s; left) and Y_e (right). Mushroom-shaped lumps of low-Y_e matter are ejected during the early phase of the explosion.

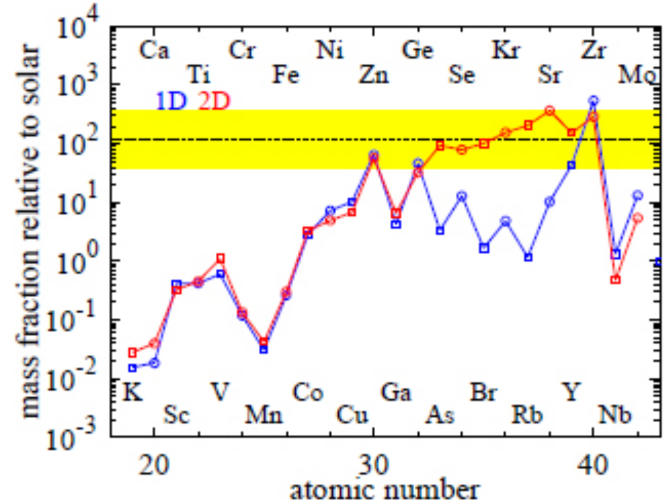

FIG. 3.— Elemental mass fractions in the ECSN ejecta relative to their solar values (Lodders 2003), comparing the 2D results (red) with the 1D counterpart (blue) from Wanajo et al. (2009). Even-Z and odd-Z elements are denoted by circles and squares, respectively. The normalization band (see text) is marked in yellow.

Wanajo et al. 2011

LEPP Farm Market is open

LEPP Farm Market contacts:

J. Cowan

Travaglio et al. 2004, ApJ, 601, 864

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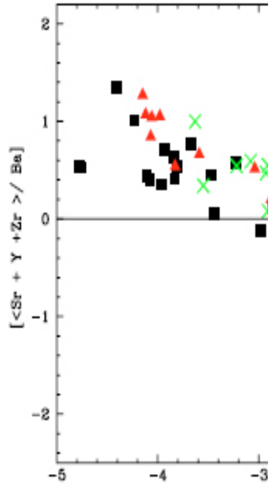


Fig. 4. [⟨Sr, Y, Zr⟩/Ba] vs. [Ba/H

Francois et al. 2007

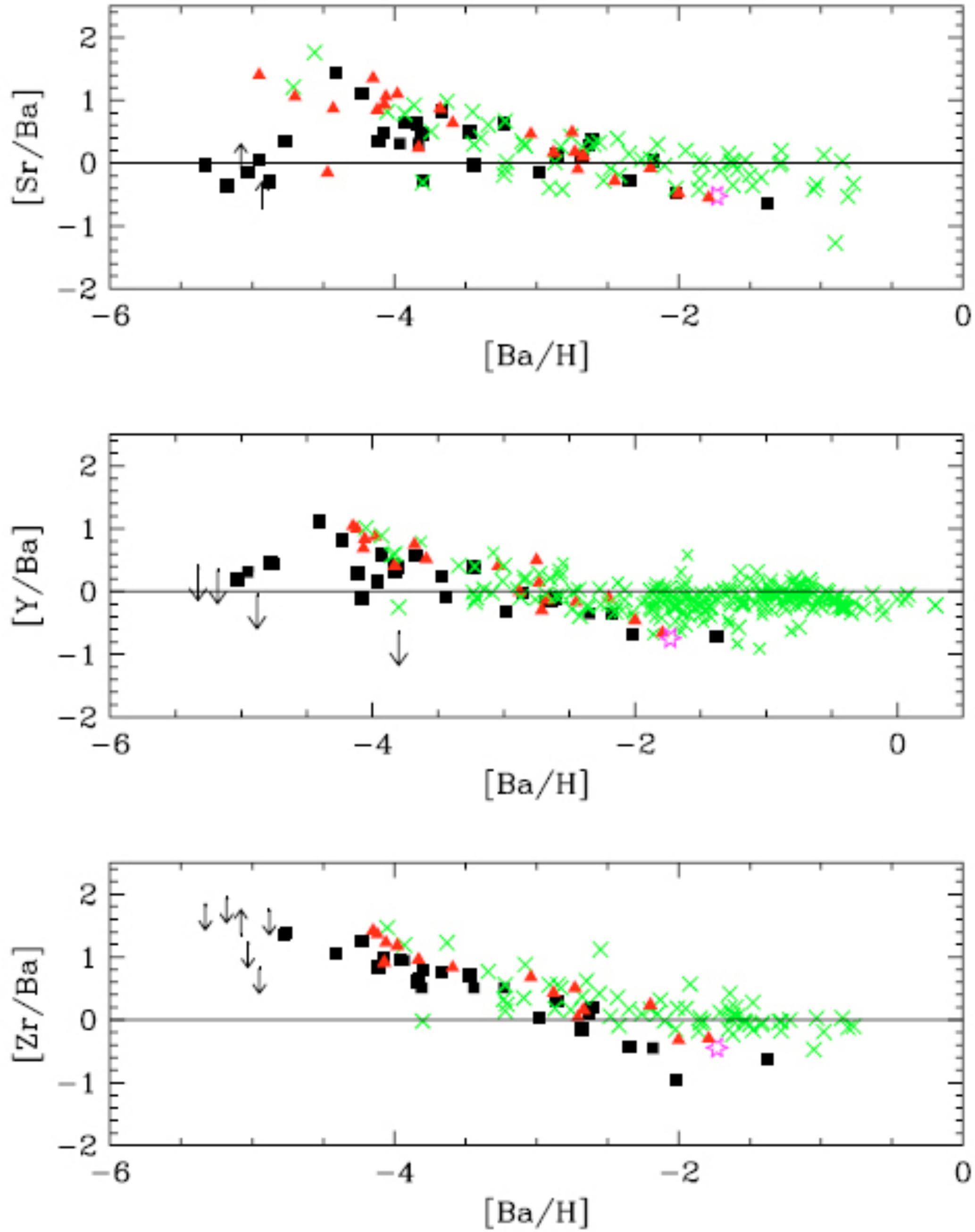
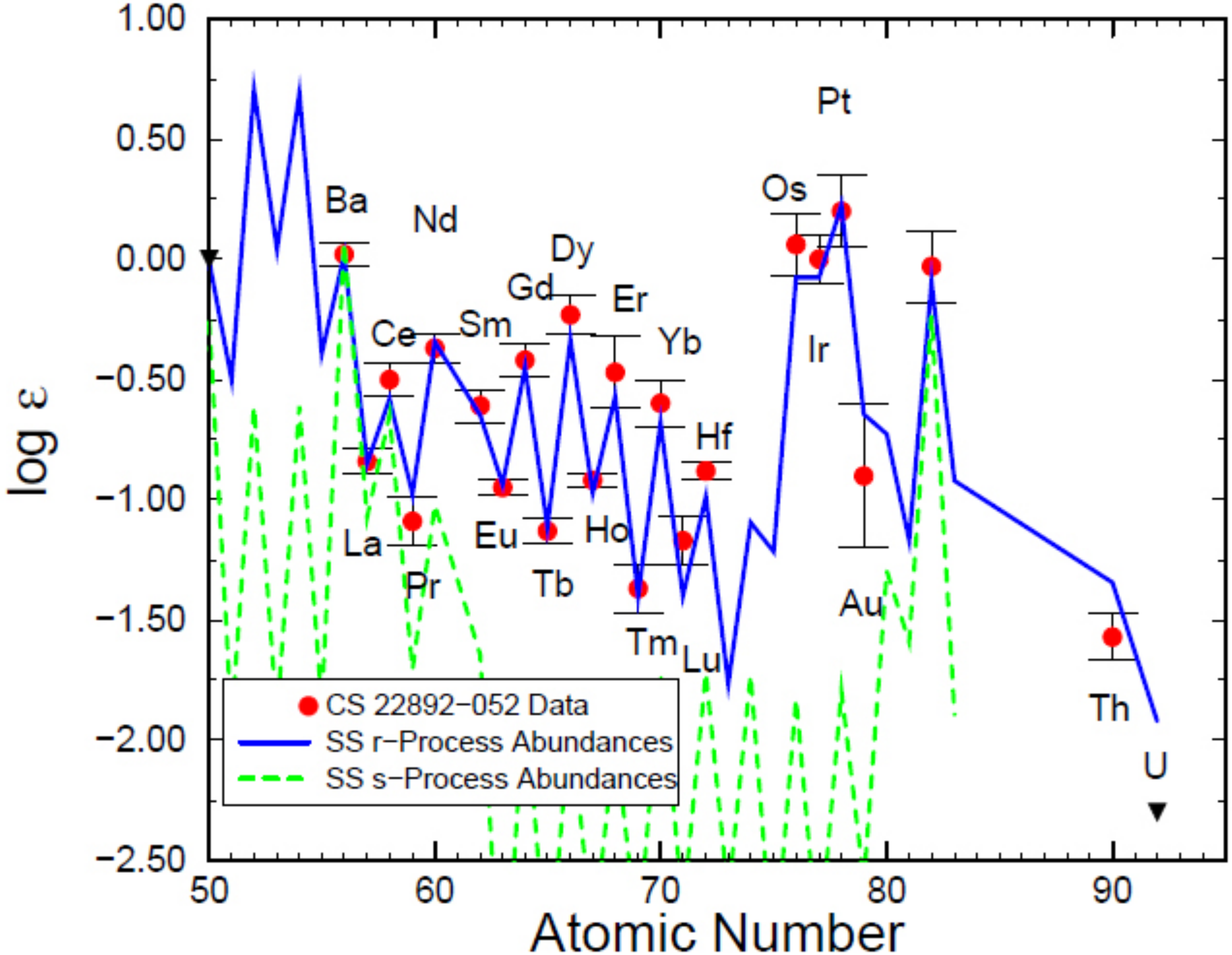


Fig. 15. [Sr/Ba], [Y/Ba], and [Zr/Ba] vs. [Ba/H]. Symbols as in Fig. 1.



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Ir
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Th
U
CS 22892−052 Data
SS r−Process Abundances
SS s−Process Abundances

Pasadena, February 2003

Carnegie 100 year Anniversary

'Origin and Evolution of the Elements', by A. McWilliam & M. Rauch