NEW N-CAPTURE ABUNDANCE DETECTIONS IN AN R-PROCESS ENRICHED STAR

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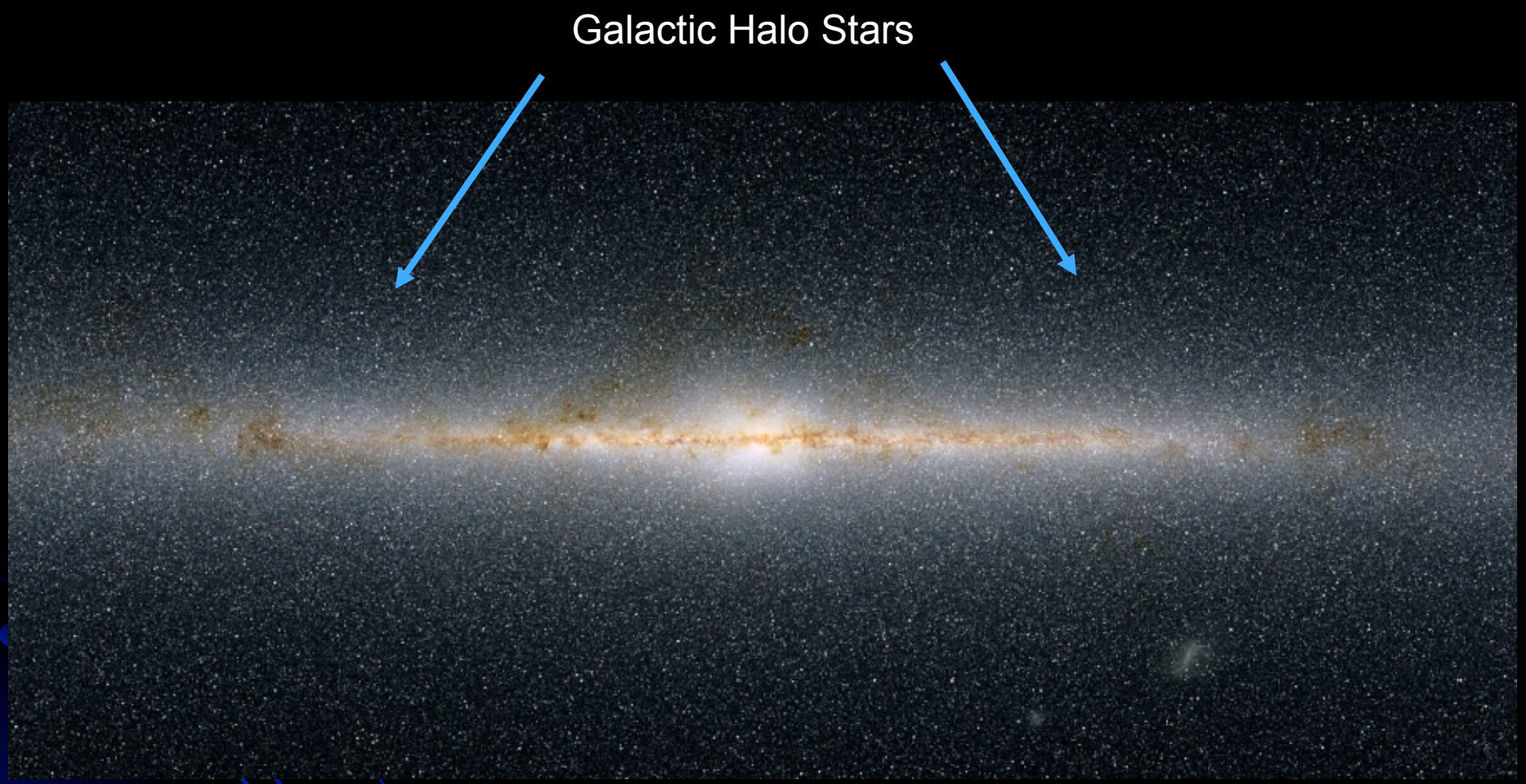
Abundance Clues and Constraints

- New observations (HST & Keck) of n-capture elements in low-metallicity Galactic halo stars providing clues and constraints on:
  1. Synthesis mechanisms for heavy elements early in the history of the Galaxy
  2. Identities of earliest stellar generations, the progenitors of the halo stars
  3. Suggestions on sites, particularly site or sites for the r-process
  4. Galactic chemical evolution
  5. Ages of the stars and the Galaxy → chronometers

Periodic Table

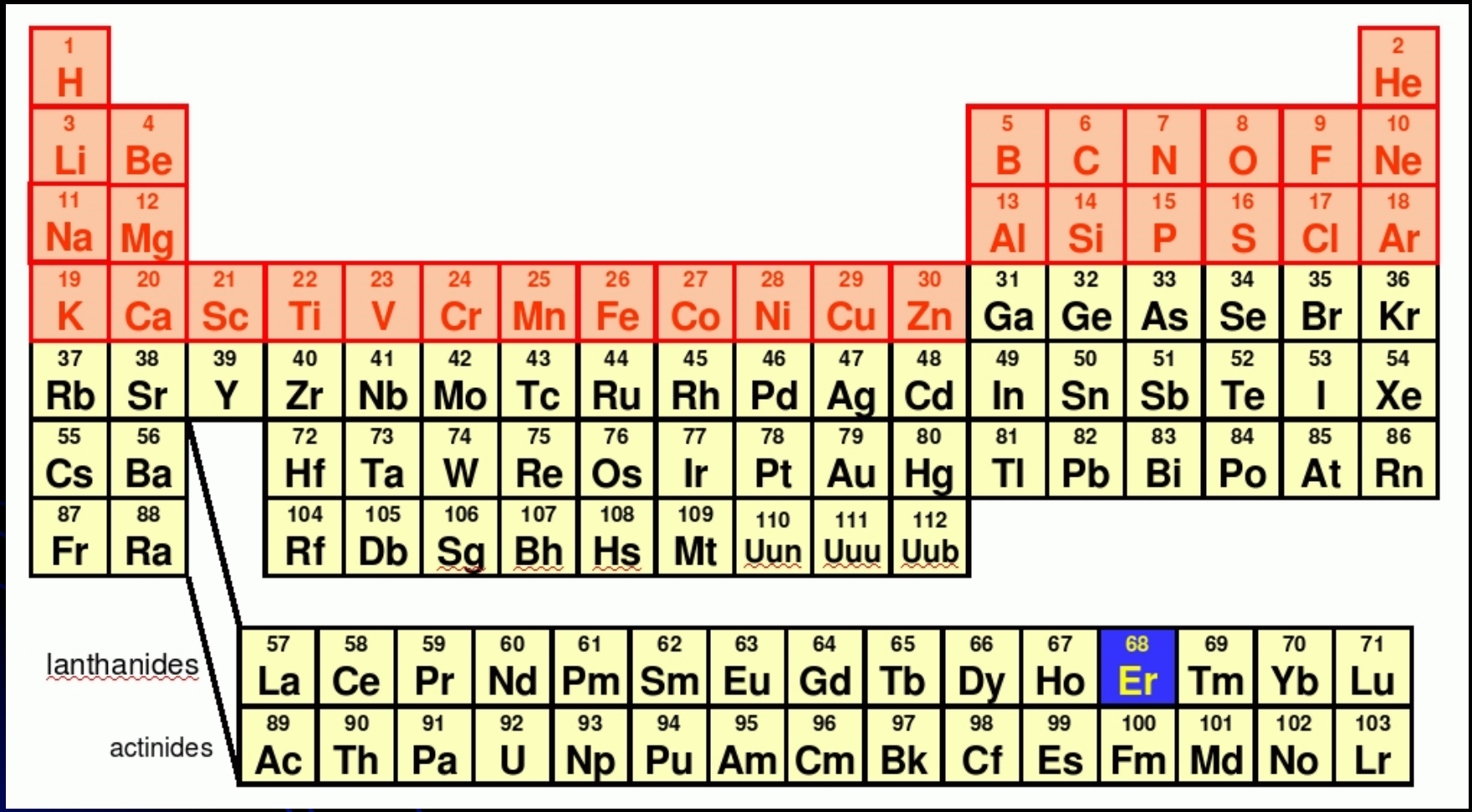
2MASS View of the Milky Way



- Metal-poor Halo Stars are ``fossils'' of the Early Universe
- These Stars are Relatives of the First Stars in the Universe

back

New Atomic Data to Improve Elemental Abundance Values

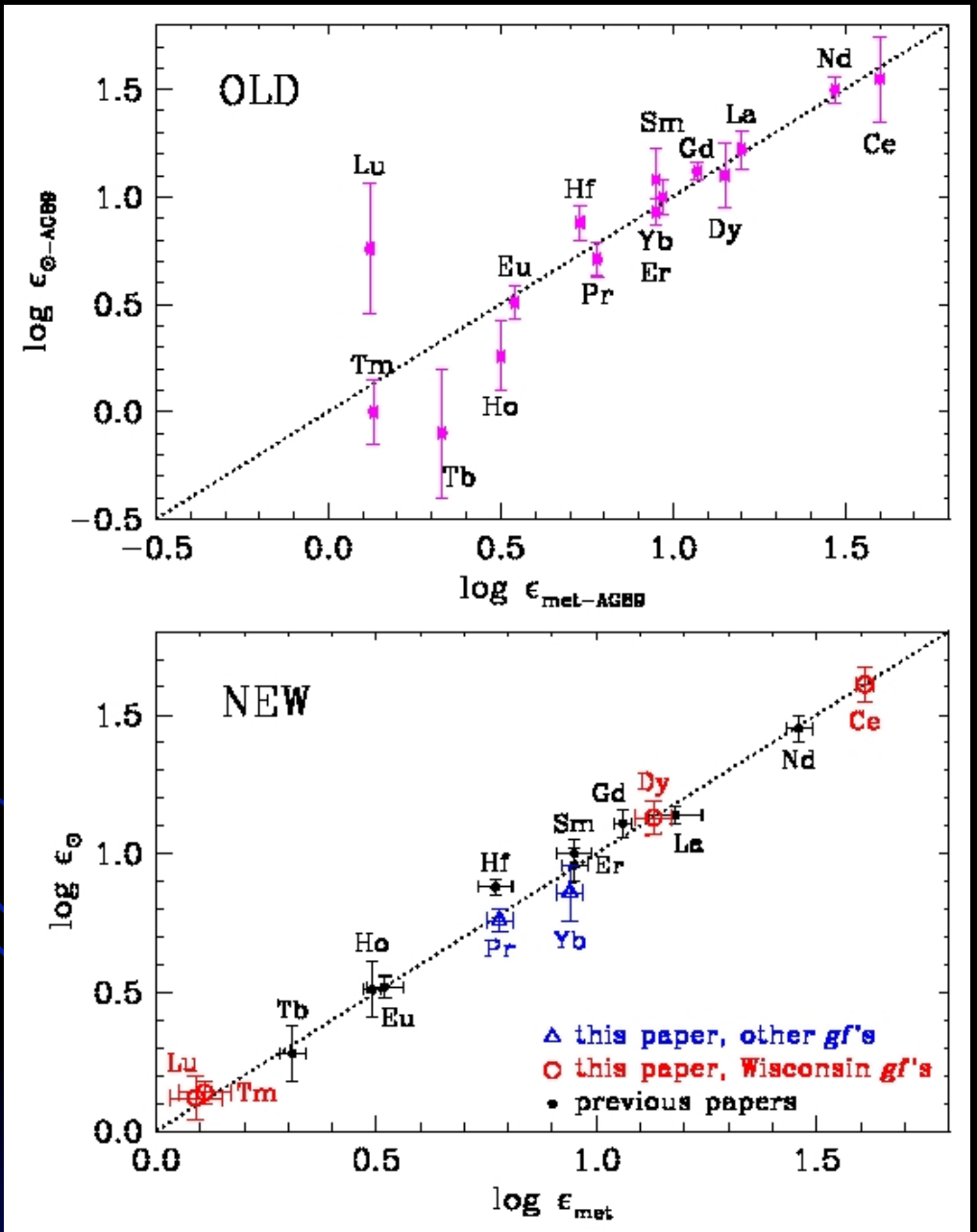


Concentrating on the Rare-Earth Elements

Focus On Rare Earth Elements

Comparisons of SS meteoritic & photospheric values of the REE

Working our way through the periodic Table!



New experimental atomic physics data:

Nd done (Den Hartog et al. 2003)

Ho done (Lawler et al. 2004)

Pt done (Den Hartog et al. 2005)

Sm done (Lawler et al. 2006)

Gd done (Den Hartog et al 2006)

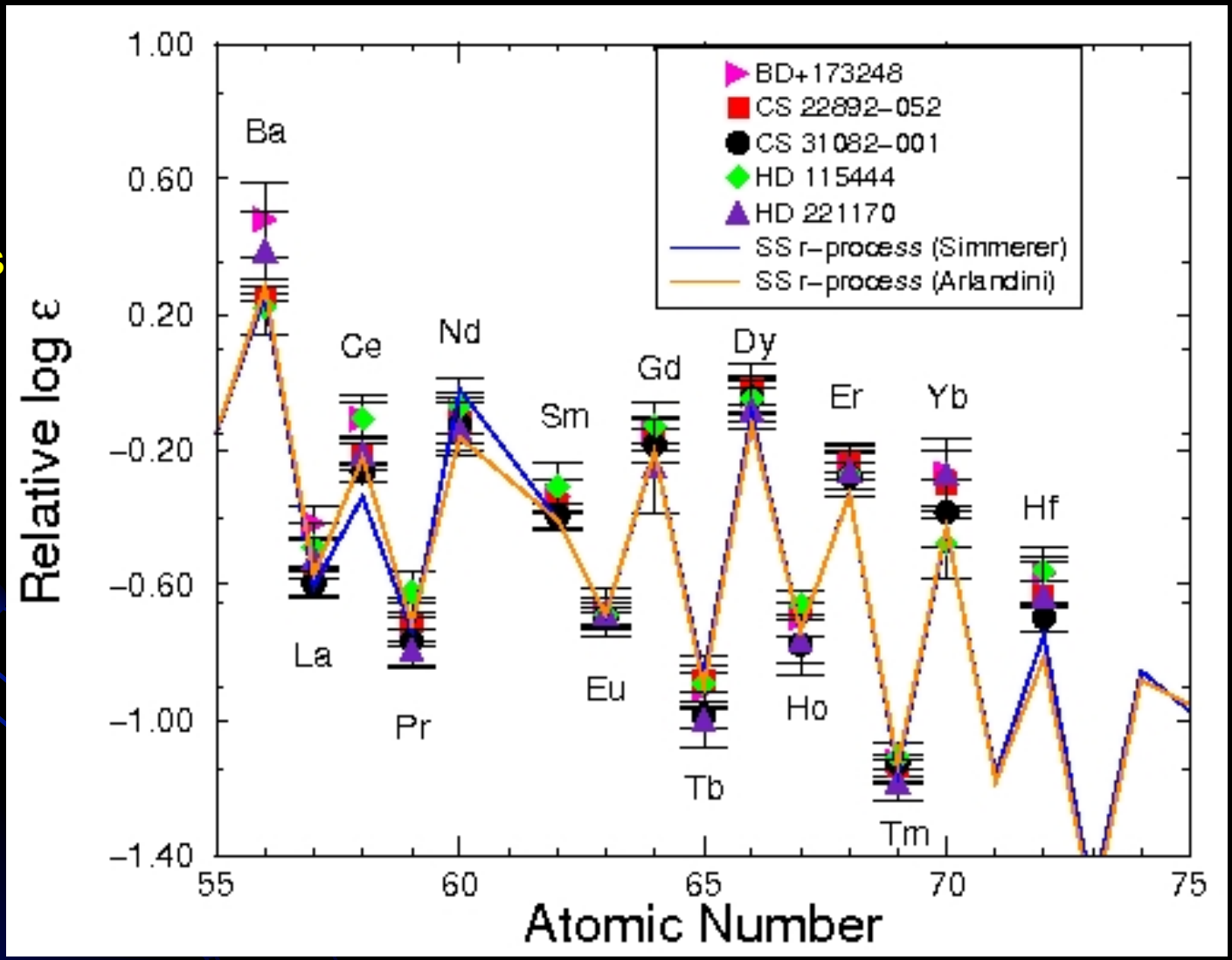
Hf done (Lawler et. al. 2007)

Er done (Lawler et al. 2008)

Ce, Pr done (Lawler et al. 2009, Sneden et al. 2009)

Rare Earth Abundances in Five r-Rich Stars

Comparisons of new REE abundances with SS r-only predictions



Very little scatter

All normalized to Eu

Sneden et al. (2009)

CS 22892-052 Abundances

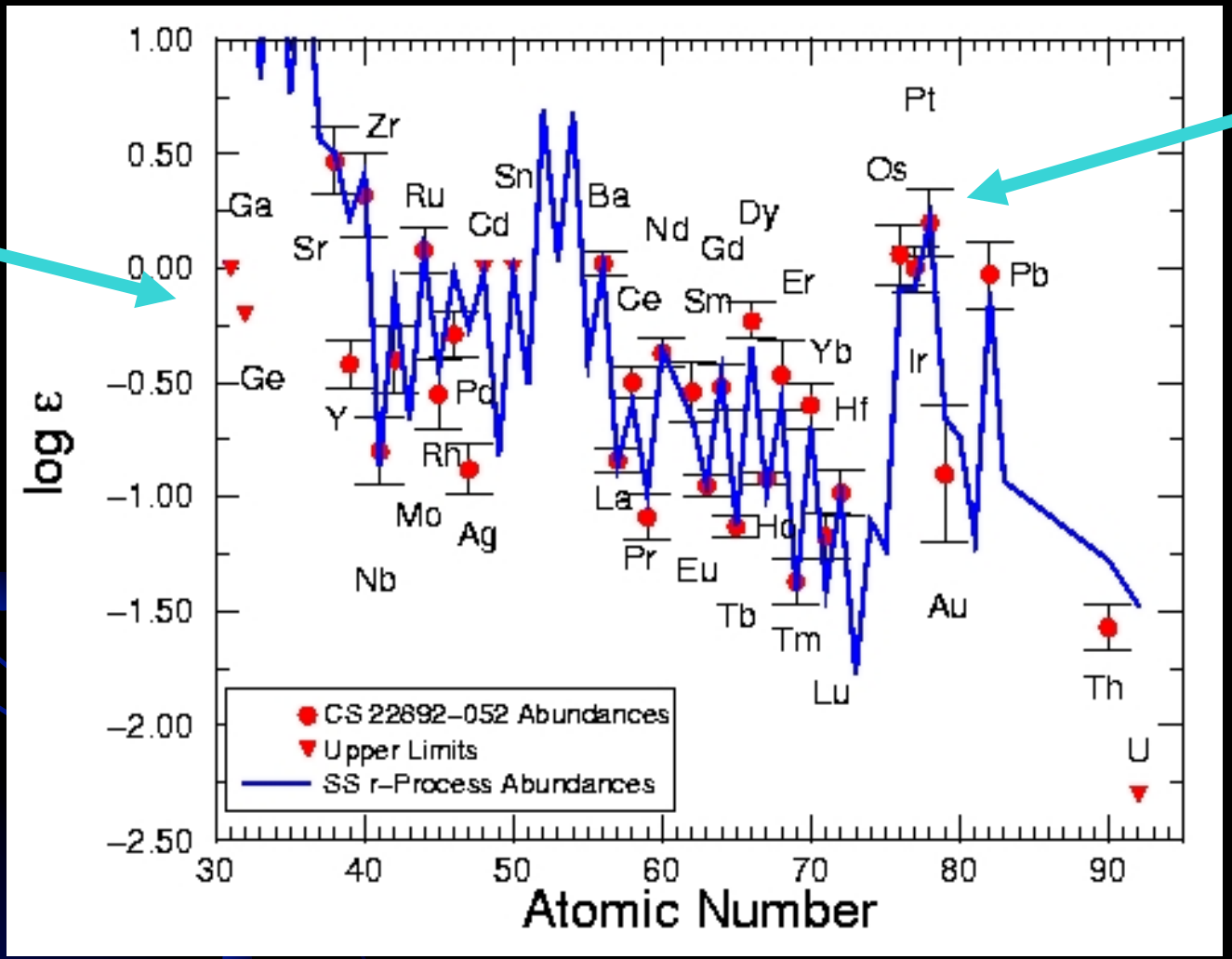
(with new atomic and stellar data)

31 N-Capture Elements Detected ➡ The Old King

Germanium

Platinum

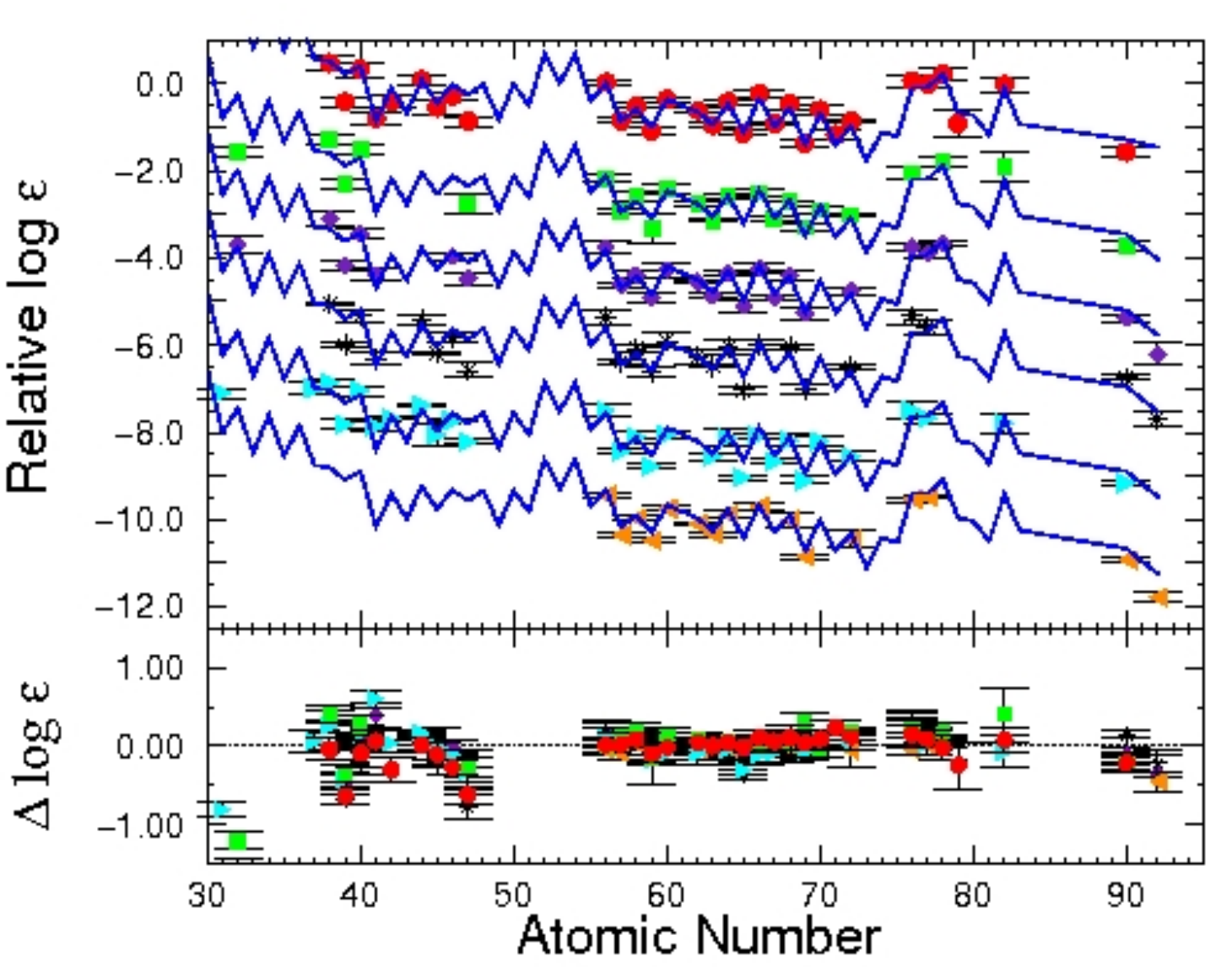
(64 HST Orbits)



57 elements observed. More than any star except the Sun.

$$\text{Log } \varepsilon(A) = \text{Log}_{10}(N_A/N_H) + 12$$

Observational Summary



CS 22892-052

HD 115444

BD +17 3248

CS 31082-001

HD 221170

HE 1523-0901

Sneden, JC & Gallino (2008)

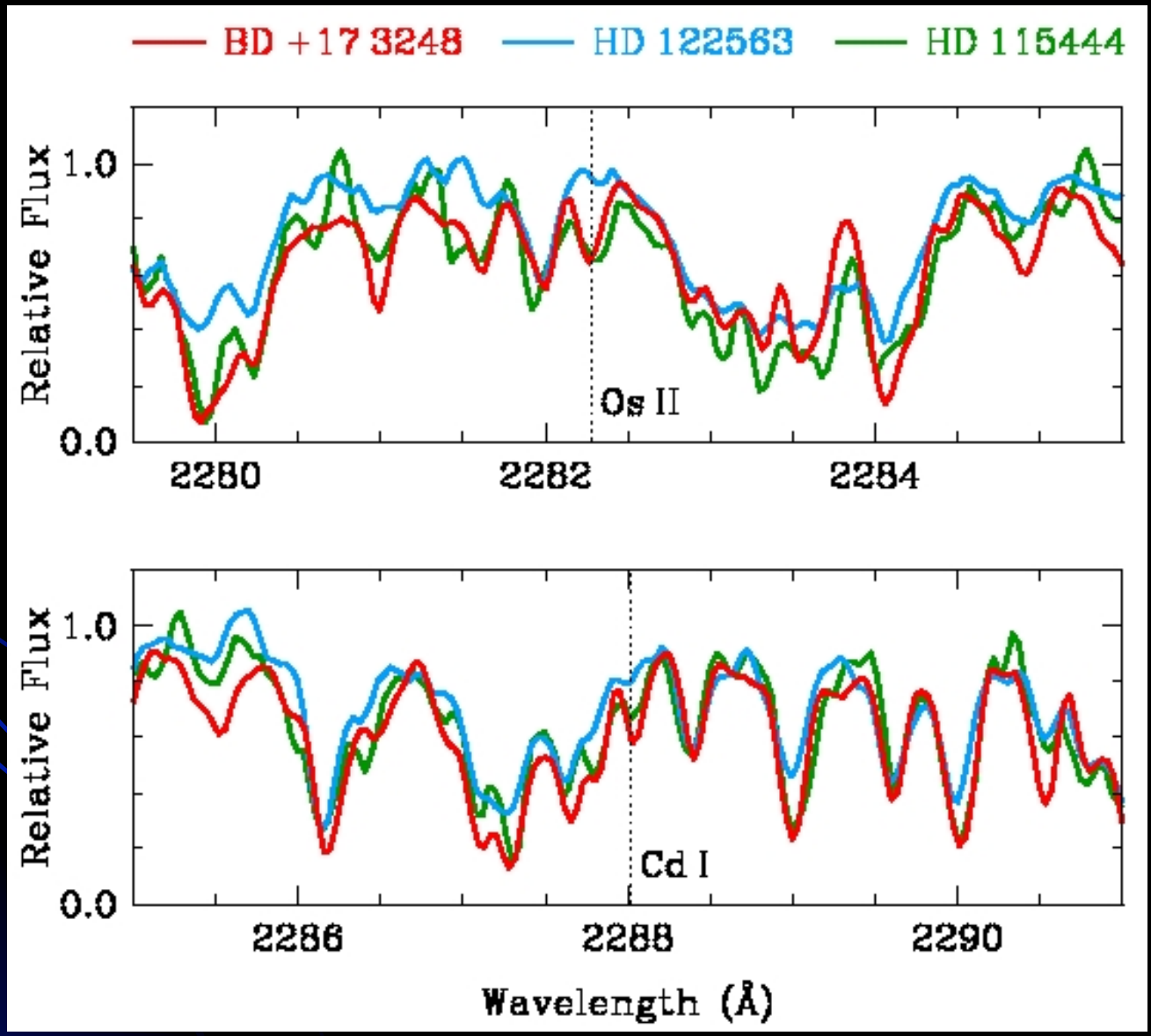
6 r-process rich stars

Same abundance pattern at the upper end and ? at the lower end.

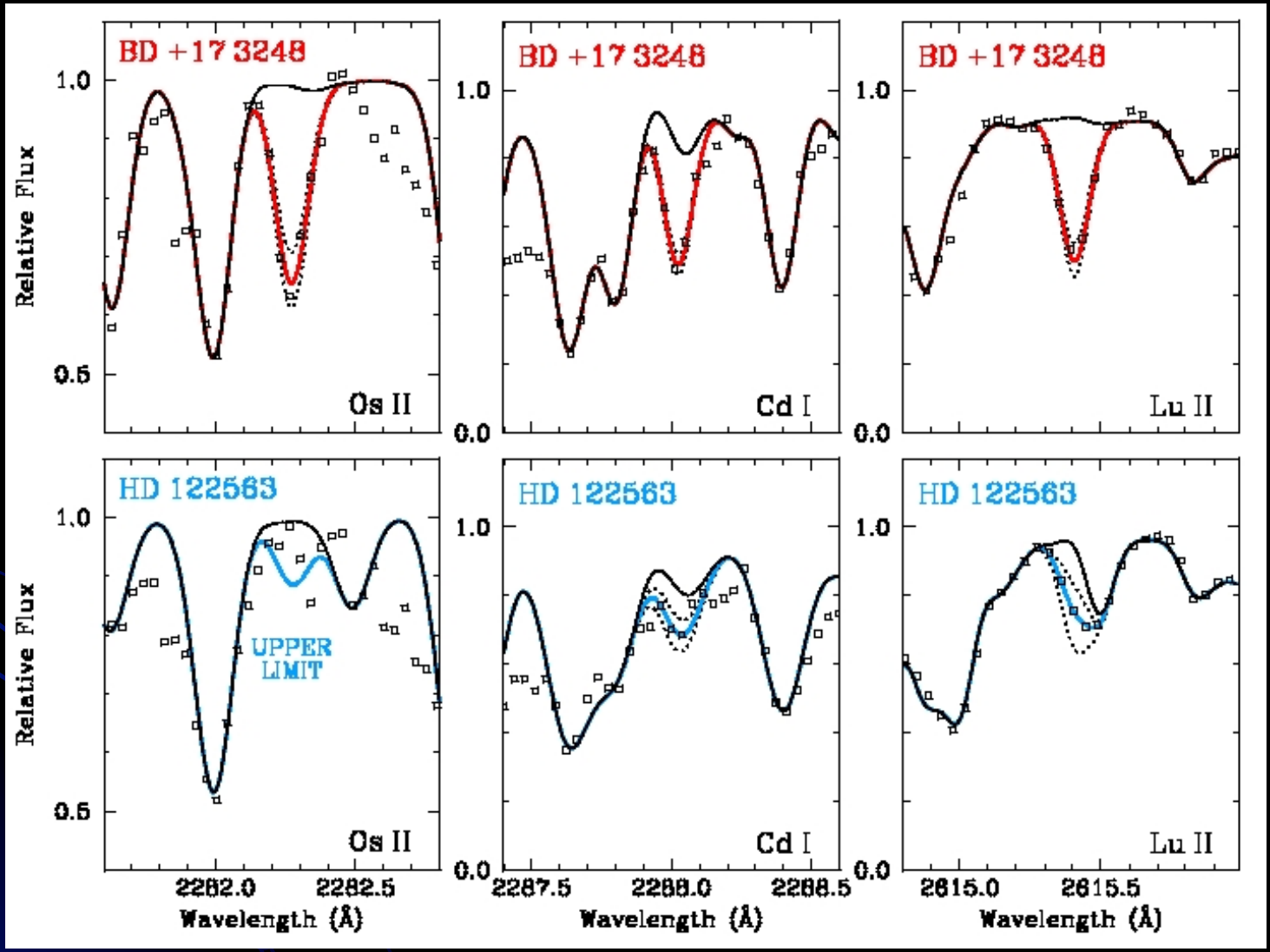
New Abundance Detections in BD +17 3248

UV: HST STIS

Roederer et al. (2010)



New Abundance Detections of Cd I, Lu II and Os II in BD +17 3248



Roederer et al. (2010)

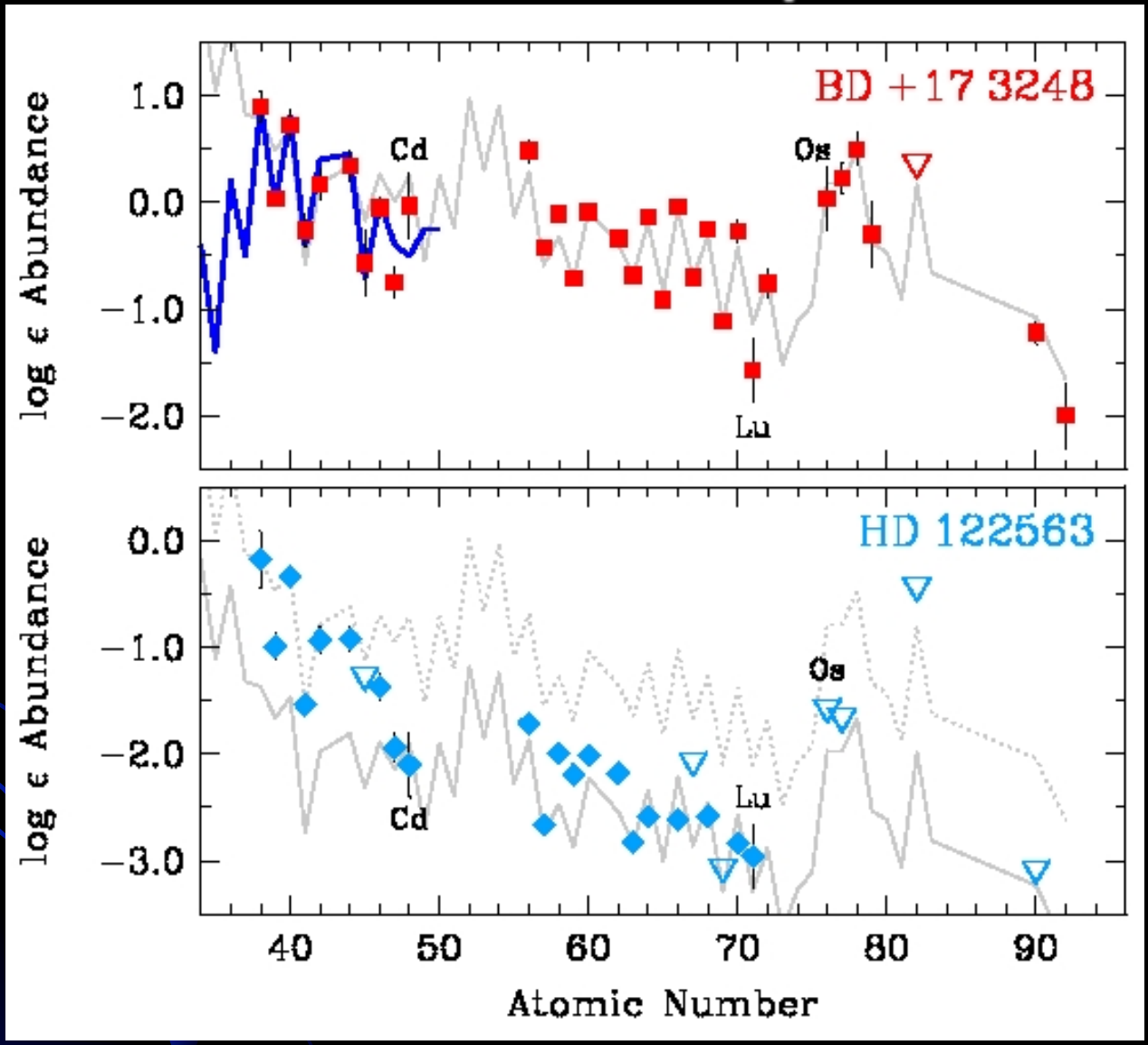
First detections of these n-cap species in metal-poor stars

Cadmium: Good in Stars, Bad in People!

- Heavy Metal: It is not as pervasive as lead. But a study is underway to establish safe levels of cadmium.
- McDonald's recently recalled 12 million Shrek-themed glasses because of concern about the level of cadmium contained in the enamel.

Time Magazine – July 12, 2010

Abundance Comparisons



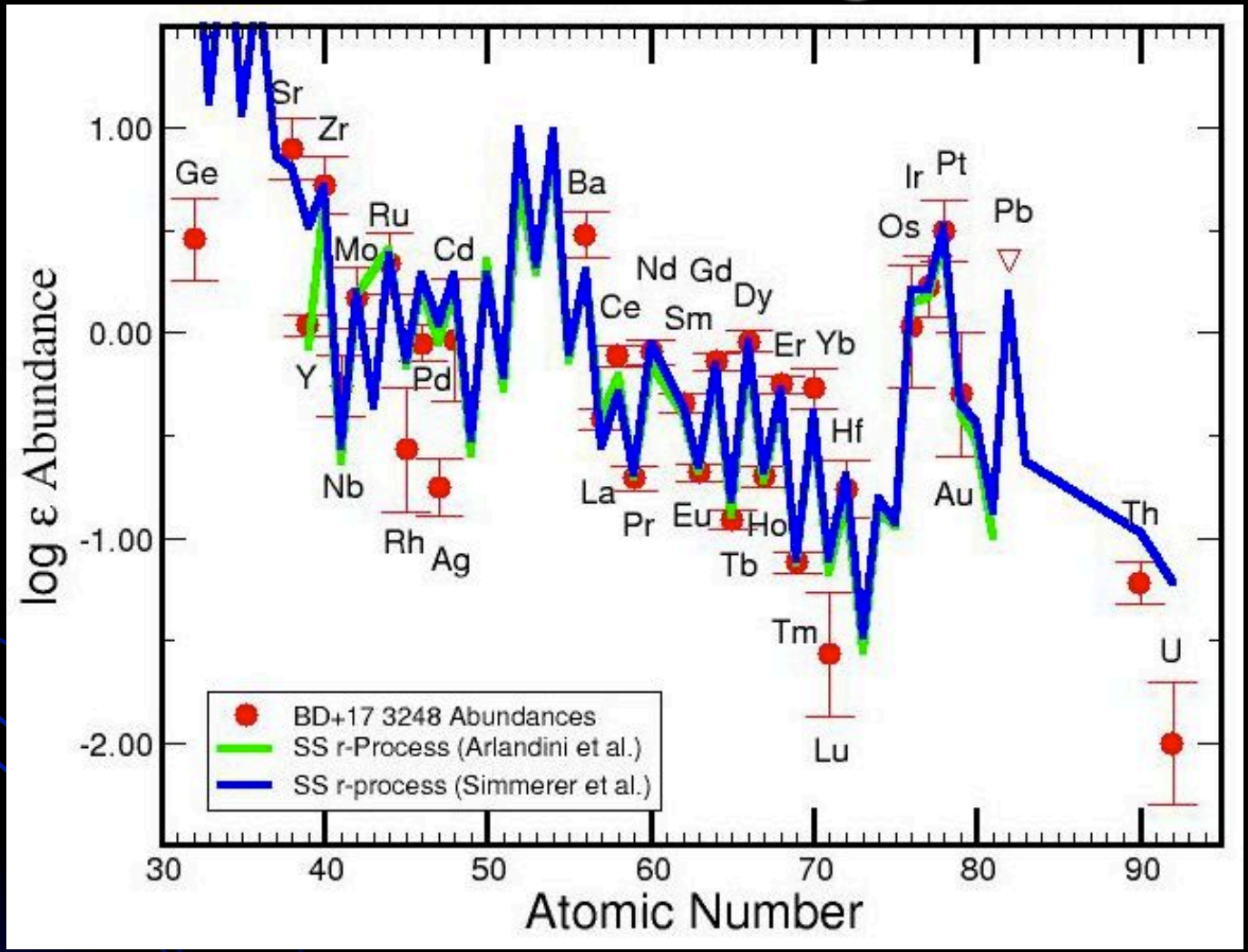
r-process rich

r-process poor

Note general fall off

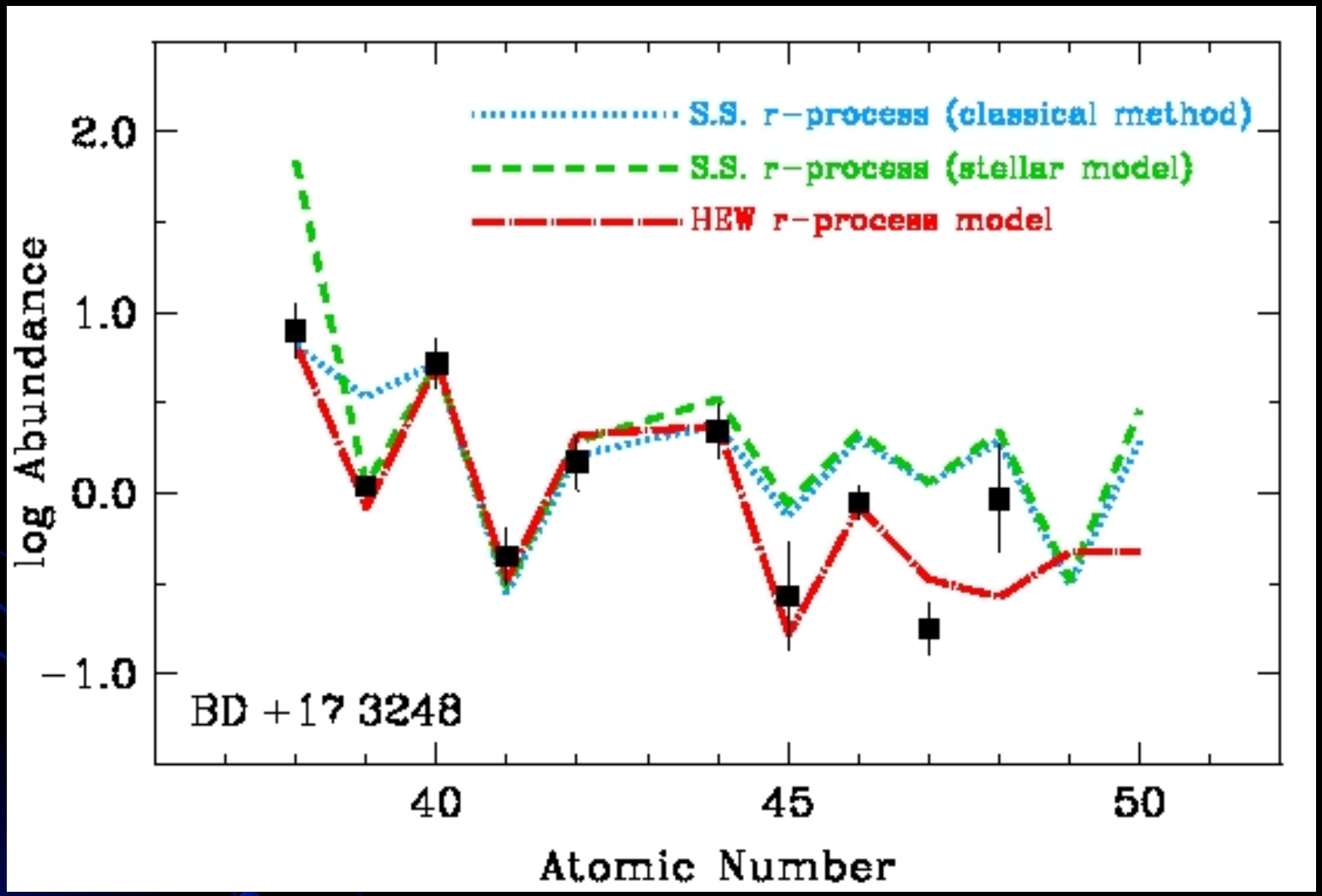
Roederer et al. (2010)

Abundances in BD+17 3248: Meet the New King!



32 n-capture elements detected in BD +17 3248 ➡ Most in any metal-poor halo star to date!

Origin of the Lighter n-Capture Elements: Work in Progress



See Roederer et al. (2010a) and NIC Poster

Conclusions

- Three new n-capture species (Cd I, Lu II and Os II) detected in r-process rich star BD+17 3248 with HST
- Combined with other observations from Keck: new abundances for Mo I, Ru I, Rh I - brings to 32 n-capture element detections

→ most in any metal-poor star so far

- Lighter n-capture element abundances do not fit the scaled SS r-process curve

→ places constraints on sources and/or sites for these elements

- New improved abundances providing clues about early Galactic nucleosynthesis and stellar populations