The Joint Institute for Nuclear Astrophysics

A new nucleosynthesis process in the early Galaxy

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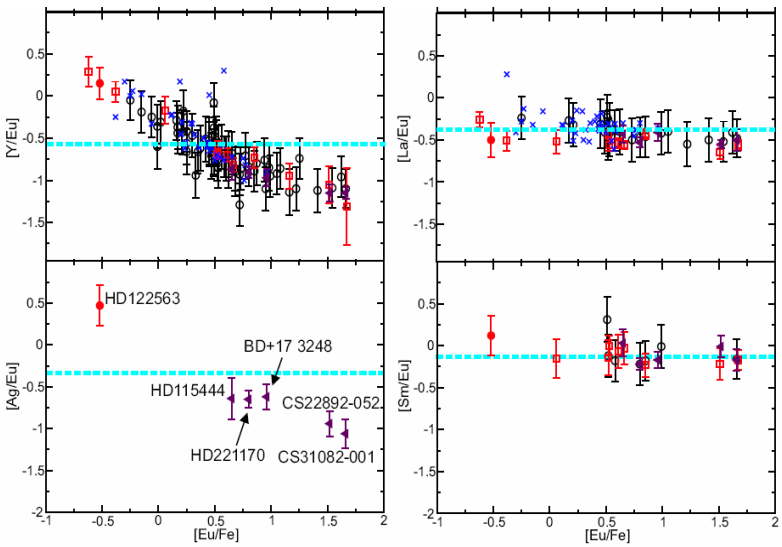
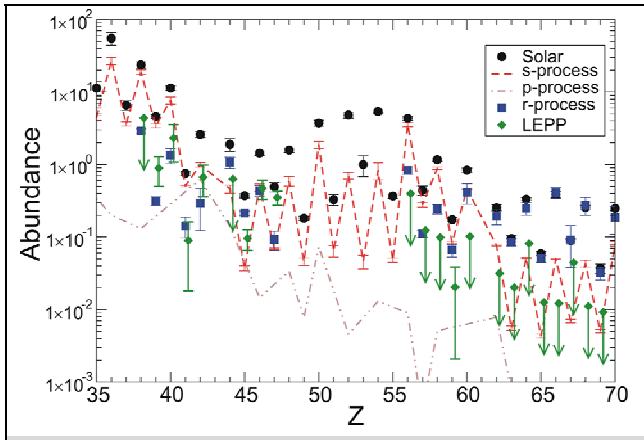


Abundance ratio of metal poor-stars as a function of Eu-richness. While the abundances of stars with [Eu/Fe]>0.5 are r-process dominated, stars with [Eu/Fe]<-0.5 are LEPP-enriched. We use the convention $[A/B] = \log_{10}[(Y_A/Y_B) / (Y_A/Y_B)_{solar}]$.

Observations of elemental abundances in unevolved metal-poor halo stars can provide important clues about nucleosynthesis events in the early Galaxy. These stars are old and preserve in their photospheres the abundance composition at the location and time of their formation. In particular a sub-class of those stars (rII) are thought to show the abundances of a pure rapid neutron- capture process (r-process).

Recent advances in the astronomical observations of those stars have revealed rather surprising results. While for heavy elements Z≥56 and Z<83 the abundance pattern is remarkable stable (even when compared to the solar system r-process contribution), elements Z≤47 show a non-uniform abundance pattern.

Based on the elemental abundance as a function of Eu-richness in a large sample of metal-poor stars, JINA scientists have shown that the mixing of a consistent and robust light element primary process (LEPP) with the also robust and consistent r-process pattern found in r-II metal-poor stars can explain the observations well. Interestingly, the new LEPP abundance pattern was found to be also consistent with a missing component in the solar abundances when using a recent s-process model. It is therefore possible that the LEPP is the missing piece in the puzzle of the origin of the elements. Explorations of the possible astrophysical site using new nuclear physics data to predict signatures from different models and to disentangle the multiple processes are underway.



Contribution to the solar system pattern from the different nucleosynthesis processes. Since most of the Eu and Ba are made in the r- and s- processes respectively, the abundance of those elements are used as signatures of those processes.

Publications:
Ap. J. 671 (2007) 1685

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