Observations of Neutron-Capture Elements in the Early Galaxy

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The abundance distributions of neutron-capture elements in metal-poor halo Population II stars offer unique ways to gain insight into very early Galactic nucleosynthesis. We review highlights recent high resolution spectroscopic studies of the lowest metallicity stars by several groups world-wide, emphasizing the results of our own collaborative studies.

There are two main features of neutron-capture (n-capture) element abundances in very low-metallicity ([Fe/H] < -2.0) stars. First, large star-to-star scatter, reaching over two orders of magnitude, is observed in the overall bulk levels of the n-capture elements compared to the Fe-peak elements. This is the most direct evidence of the effects of individual nucleosynthesis events occurring in a poorly mixed halo of the early Galaxy. Second, the abundance ratios among the n-capture elements are very different than their solar-system values, clearly pointing to the dominance of so-called rapid n-capture nucleosynthesis that accompanied the deaths of the short-lived high mass stars that were the first element donors of the Galaxy. The onset of contributions from slow n-capture events came later, as indicated by the generally higher metallicity levels of stars that have n-capture element abundance ratios that are more nearly like those of the Sun.

We concentrate much of our discussion on two stars: CS 22892-052, and BD+17^{o}3248, because these stars have very high contrasts between their n-capture element strengths and those of Fe-peak elemeents. In additon to many elemental abundances determined for these stars, we discuss derivation of Eu isotopic abundance fractions in them.

The long-lived radioactive element Th is now being routinely detected in low metallicity stars. In at least one star, U also has been discovered. The current state of the Th and U observational evidence is reviewed and estimates are given of the Galactic chronometric age from comparisons of Th and U contents to those of lighter stable n-capture elements.

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