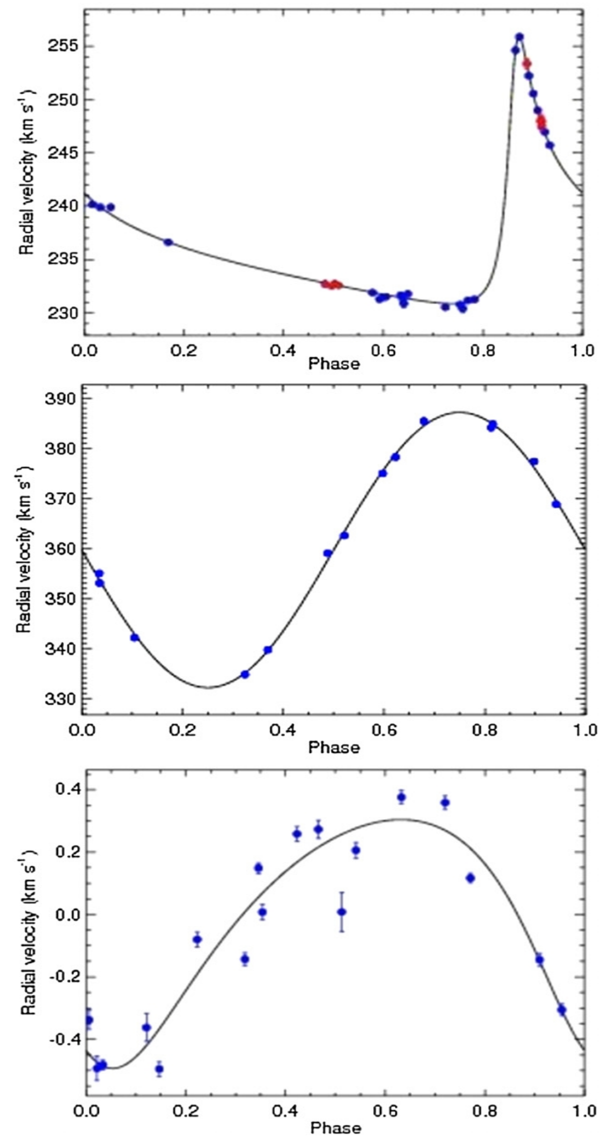
Joint Institute for Nuclear Astrophysics

The Binary Frequency of r-Process-Element Enhanced Stars and its Implications

A few rare halo giants in the range [Fe/H] −2.9 ± 0.3 exhibit *r*-process element abundances that vary as a group by factors up to [*r* / Fe] ~ 80, relative to those of the iron peak and below. Yet, the astrophysical production site of these *r*-process elements remains unclear. Knowledge of whether or not these peculiar stars require pollution by a binary companion can be used to eliminate entire classes of models for the astrophysical origin of the *r*-process . The Hansen et al. study discusses results from four years of monitoring the radial velocities of 17 *r*-process-enhanced metal-poor giants, in order to detect and characterize binaries in this sample.

Within this sample, these authors report the detection of three (possibly four) spectroscopic binaries with orbital periods and eccentricities that are indistinguishable from those of Population I binaries with giant primaries, and which exhibit no signs that the secondary components have passed through the asymptotic giant branch stage of evolution or exploded as supernovae. The other 14 stars in the sample appear to be single stars — **including the prototypical *r*-process-element-enhanced star CS 22892-052,** which is also enhanced in carbon, but not in *s*-process elements.

The conclusion is that the *r*-process (and potentially carbon) enhancement of these stars **was not a local event due to mass transfer or winds from a binary companion, but was imprinted on the natal molecular clouds of these (single and binary) stars by an external source.** These stars are thus spectacular chemical tracers of the inhomogeneous nature of the early Galactic halo system.



Observed and computed spectroscopic orbits for HE0442-1234 (top), HE1044-2509 (middle), and HE1523-0901 (bottom), the three clear binaries in this sample. The blue dots indicate the newly measured radial velocities, while the red dots indicate earlier data.

See the published work: Hansen et al. (2011)
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