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New Highly r-Process-Enhanced Halo Stars

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Abstract. There are roughly 25 very metal-poor (VMP; [Fe/H] < -2.0), highly r-process-enhanced ('r-II'; [Eu/Fe] $> +1.0$) stars currently known, discovered over the past 20+ years. These stars provide nearly pure signatures of r-process events early in the Galactic history. We are conducting a high-resolution follow-up survey of RAVE and other bright targets to identify a total of > 100 r-II stars. Our pilot runs on the du Pont 2.5-m at Las Campanas Observatory and the ARC 3.5-m at Apache Point Observatory have already identified up to *fourteen* new r-II stars. We are continuing our high-resolution follow-up efforts to constrain the astrophysical site(s) and nature of the r-process.

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The rapid neutron capture ('r-') process is the mechanism responsible for synthesizing roughly half of the elements heavier than iron. While the physical mechanism of the r-process is relatively well understood, its astrophysical site still remains largely unknown (NS/NS mergers or Magneto-Rotational SNe are currently favored). The r-II stars provide observable signatures of single r-process events, and will ultimately permit confident identification of the site of the r-process.

Since r-II stars comprise 3-5% of all VMP stars, we expected a similar return rate in our pilot sample. From our 152 analyzed targets, 14 are new r-II stars, increasing the known r-II stars by ∼55%, and 80 are new r-I ($+0.3 <$ [Eu/Fe] $< +1.0$) stars. These are preliminary numbers, but our success rate appears very high. High-S/N spectroscopic follow-up of the newly discovered r-II stars is underway. We will obtain ∼2000 snapshot spectra of bright VMP stars, and at our current discovery rate, identify a total of 125-150 new r-II stars and 750-1000 new r-I stars.

In addition, the large number of high-resolution spectra gathered during our survey will enable a detailed comparison of the parameter determinations with the non-SEGUE Stellar Parameter Pipeline (n-SSPP; Beers *et al.* 2014).

References

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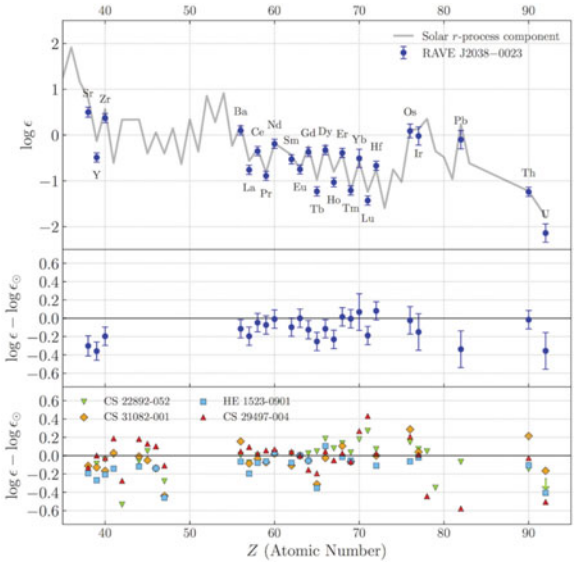

Figure 1. Top: Elemental abundance pattern of RAVE J2038-0023 (Placco *et al.* 2017) compared to the Solar System r-process pattern (Arlandini *et al.* 1999). Middle: Residuals between abundances of RAVE J2038-0023 and the Solar r-process pattern. Bottom: Residuals from the Solar pattern for all four 'uranium' r-II stars (Hill *et al.* 2002; Frebel *et al.* 2007; Hill *et al.* 2017) and CS 22892-052 (Sneden *et al.* 2008).

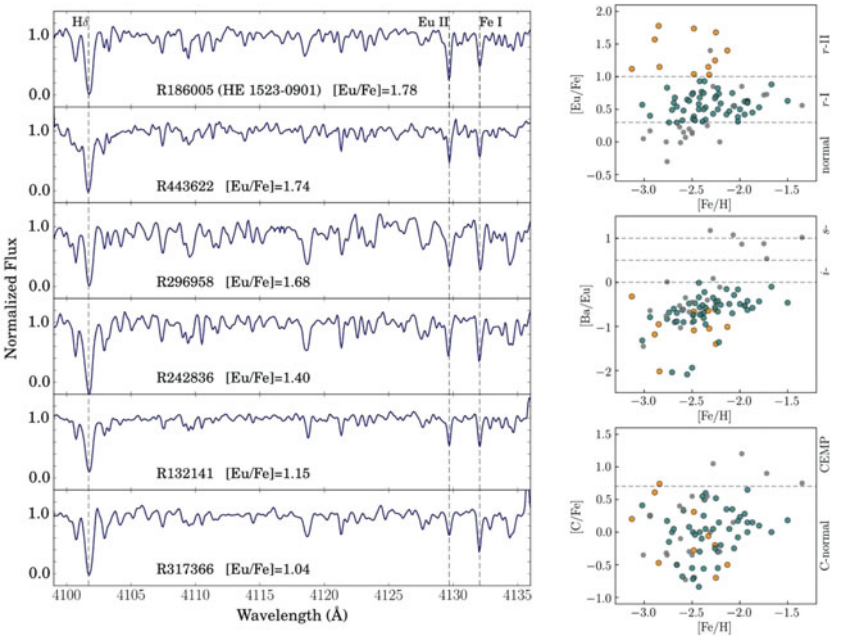

Figure 2. Left: Five new r-II stars and one rediscovered r-II star (top) thus far identified by high-resolution follow-up of RAVE (Steinmetz *et al.* 2006) catalog targets. Right: Elemental abundances of analyzed stars from the du Pont pilot sample.