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Binarity in CEMP-no stars

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Abstract. We monitor a sample of CEMP-no stars using the CFHT and SALT telescopes to gain additional knowledge about the possible binarity of these stars. This information is valuable for each individual star, and additionally it could be used to further constrain their binary fraction. We find two new CEMP-no binaries and four additional CEMP-no stars that show some indication of radial velocity variations, resulting in a CEMP-no binary fraction of $\sim 20\%$.

Keywords. stars: chemically peculiar – stars: binaries – techniques: radial velocities

1. Introduction

It is well-known that with lower metallicity the fraction of stars that are enhanced in carbon increases (e.g. Lee *et al.* 2013). A sub-sample of the carbon-enhanced metal-poor stars, the CEMP-s stars, is thought to form through binary transfer. These stars have enhanced carbon relative to iron and additionally show an enhancement in s-process elements (usually produced in AGB stars). Radial velocity monitoring of these stars has confirmed their binarity in almost all cases (Starkenburg *et al.* 2014, Hansen *et al.* 2016a), supporting this formation mechanism. The CEMP-no stars are not enhanced in s-process elements and are clearly chemically distinct from the CEMP-s stars. They are not often found in binary systems (Starkenburg *et al.* 2014, Hansen *et al.* 2016b), and are thought to represent the original composition of the ISM out of which they formed. This makes them very useful stars to study processes in the early Milky Way.

2. Results

We have monitored a sample of CEMP-no stars for variations in radial velocity with the Canada-France-Hawaii Telescope (CFHT) and the Southern African Large Telescope (SALT). We present the radial velocity variations of the stars in our sample in Figure 1, where we show what our radial velocity measurements add to the current literature in this preliminary data analysis. We highlight two stars, which with the addition of our new data show large radial velocity variations and are most likely in a binary system. Additionally, we find four stars that show radial velocity variations > 5 km s^{-1}, which might also be binaries but we need more data to confirm. In Figure 2 we plot the sample of monitored CEMP-no stars (from Hansen *et al.* 2016b and this work) on the [Fe/H] vs. A(C) and [Fe/H] vs. [Ba/Fe] planes, with respect to a large compilation of CEMP stars from Yoon *et al.* (2016). We highlight the binaries and potential binaries, and conclude that they do not lie in a specific place in these diagrams. The s-process enrichment in CEMP-no binaries is low, even for CEMP-no stars, indicating that they are most probably in non-interacting binary systems.

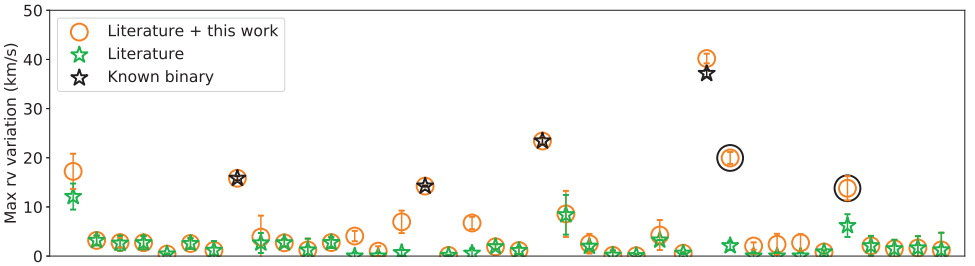

Figure 1. Radial velocity variation in individual CEMP-no stars. We show the complete sample of CEMP-no stars that have multiple radial velocity measurements, which consists of the samples from Starkenburg *et al.* (2014), Hansen *et al.* (2016b) and this work Arentsen *et al.* (in prep.). The two circled stars indicate our newly discovered CEMP-no binaries.

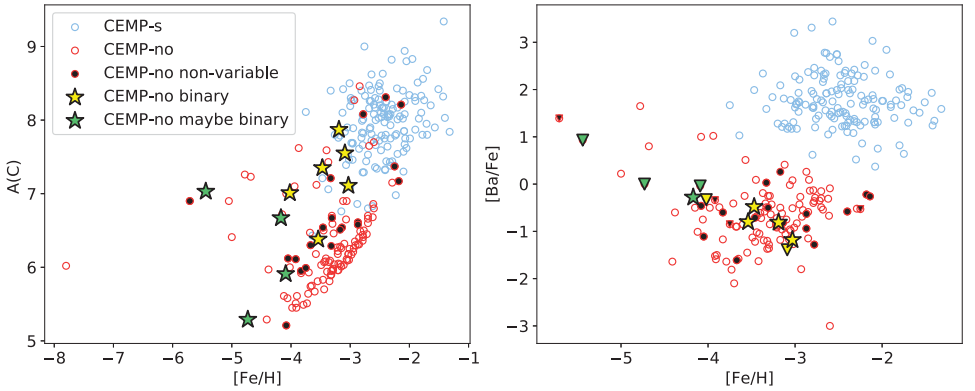

Figure 2. [Fe/H] versus A(C) (left) and [Ba/Fe] (right) for the full sample of CEMP stars as compiled in Yoon *et al.* (2016). The complete CEMP-no radial velocity sample with its (potential) binaries is indicated. Four of the binaries are described in Hansen *et al.* (2016b) and two of them are new, as are the potential binaries. Upper limits are indicated by triangles.

3. Summary

We find two new CEMP-no binaries in our radial velocity monitoring sample, which increases the sample of known CEMP-no binary stars by 50%. The fraction of CEMP-no stars that are in binaries stays around 20% (as in Hansen *et al.* 2016b). To better constrain the binarity properties of the CEMP-no population as a whole, a larger sample and more systematic measurements are needed.

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