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Investigation of the beginnings of star formation and the synthesis of chemical elements in the early Universe

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Metal-poor stars provide a unique testing ground to investigate the beginnings of star formation and the synthesis of chemical elements in the early Universe. In particular, the abundance patterns seen in these metal-poor stars provide constraints on the nature of first generation of super-massive stars in the universe. These stars are also characterized by unusual abundance patterns of carbon, nitrogen and oxygen, which could probably assign them as a Population II stars that formed from material chemically enriched by a first-generation supernova. A parametrical search for best fits suggest a scenario involving low-energy supernova explosions with a relatively narrow range of masses (10 − 25 solar masses) and little mixing. Although this supernova scenario might elucidate the formation of the light elements up to aluminium, the experimental upper limits currently observed for the abundances of heavier elements such as Cr, Mn, Co, Ni and Zn do not allow stronger constraints of the original supernova properties.

More puzzling, however, is the large abundance of Sr (Z=38) with [Sr/Fe] +1. Strontium is the only element heavier than the iron group currently observed in HE1327-2326. Supposedly, there are two nuclear-reaction scenarios that could produce Sr:

• The slow-neutron capture, the s-process, occurring in asymptotic giant branch (AGB) stars; how-ever, this process is inefficient in low metallicity.
• The main rapid-neutron capture, the r-process, could also produce strontium in a type-II super-nova; although the production of Sr is not included in some of the supernova models.

A measurement of the Ba abundance is fundamental to distinguish between the s-process, with an expected relative abundance of [Sr/Ba] −1, and the r-process, with a different ratio of [Sr/Ba] = −0.5 to −0.4. Here we present the first astronomical data for EC20291-3603, a metal-poor star observed with the SALT telescope.

Primary author: LOMBERG, Blaine (University of the Western Cape)

Presenter: LOMBERG, Blaine (University of the Western Cape)

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