The earliest stars in the Universe

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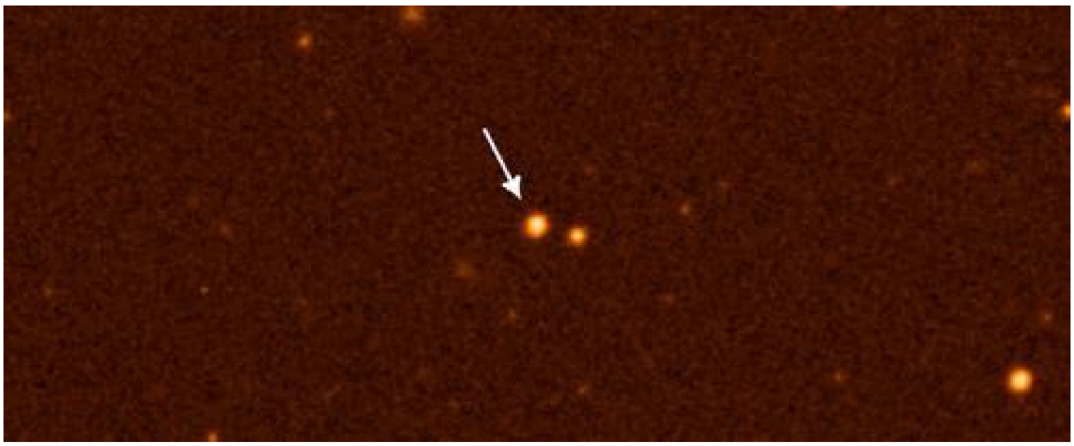

A faint star in the southern Milky Way has been found to consist virtually only of hydrogen and helium, with only 1/200,000 of the heavier elements seen in the sun. Credit: ESO VLT

(PhysOrg.com) -- Matter in the universe after the big bang consisted almost entirely of hydrogen and helium atoms. Only later, after undergoing fusion reactions in the nuclear furnaces of stars, did these light elements transform into all the other (so-called "heavy") elements that are found in the cosmos today. But astronomers know that the process of making stars, at least today, includes important roles for these heavy elements, for example helping the pre-stellar cloud collapse until the first nuclear reactions can ignite. How, then, did the first stars form, and what did subsequent generations of stars look like?

According to the current theory, the first generation of stars had to be very massive, about one hundred times the mass of our sun, in order to trigger the first nuclear fusion reactions. When these stars died as supernovae, they seeded the surrounding gas with chemically enriched material that enabled the birth of a first generation of lower mass and longer lived-stars. Today some of these stars are still shining. Astronomers observe them as stars comparatively deficient in heavy elements, since unlike stars born recently, they had only one (or a few) generations of supernovae to enrich their natal clouds. By studying these surviving low-mass, heavy-element deficient stars, scientists are able to test theories and measure the conditions in the early universe.

CfA astronomer Anna Frebel and seven colleagues have completed a comprehensive study of twenty key elements in sixteen heavy-element deficient stars in the outer regions of the Milky Way, some of them with almost ten thousand times fewer heavy atoms (compared to hydrogen) than in the sun. They found good agreement with theory, but discovered that apparently there are several chemically distinct kinds of such deficient stars, for example depending on the amounts of iron, lithium, or other species. Their results not only help to confirm the models, but serve as a test of new software tools that will facilitate a more efficient search for aged remnants of the earliest stars of the universe.

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