Stars with the chemical clock on hold

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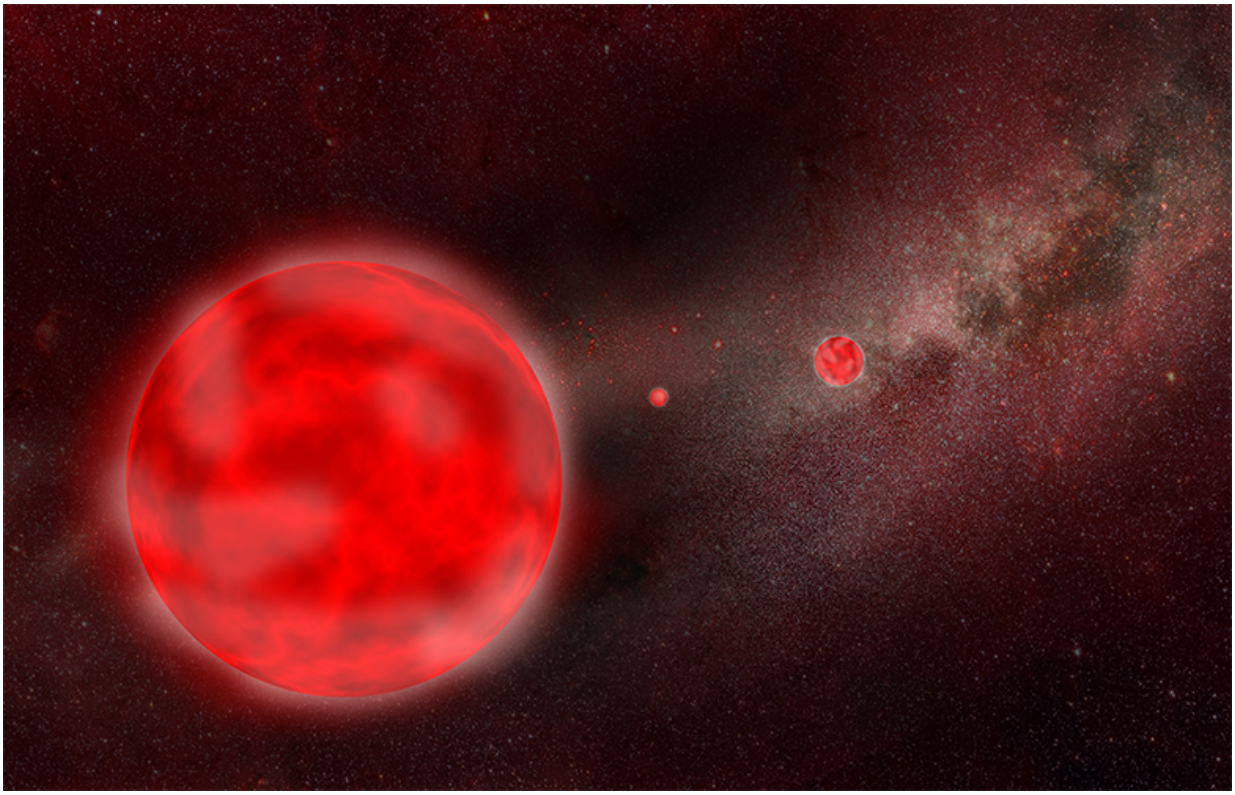


Artist impression of red giant stars in the Milky Way. Credit: AIP/ J. Fohlmeiste

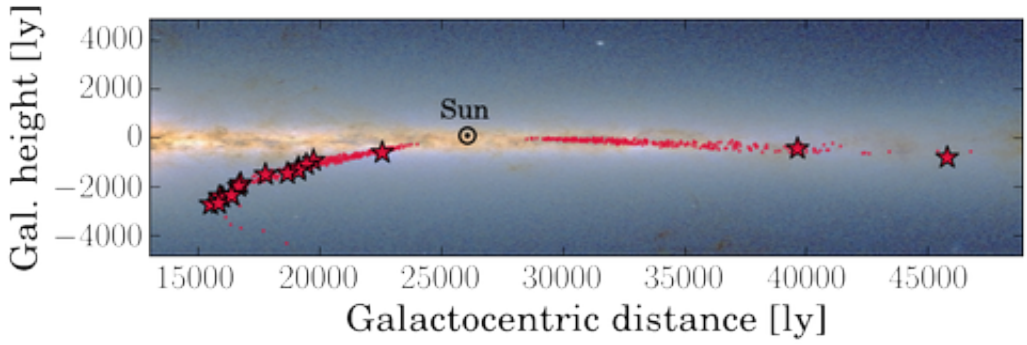
An international team of astrophysicists, led by Cristina Chiappini from the Leibniz Institute for Astrophysics Potsdam, has discovered a group of red giant stars for which the 'chemical clock' does not work: according to their chemical signature, these stars should be old. Instead, they appear to be young when their ages are inferred using

asteroseismology. Their existence cannot be explained by standard chemical evolution models of the Milky Way, suggesting that the chemical enrichment history of the Galactic disc is more complex than originally assumed.

The term 'Galactic Archaeology' was coined to describe the fact that the Milky Way's history is encoded not only in the quantities of various chemical elements seen in the spectra of stellar atmospheres (abundances), but also in stellar motions. One of the pillars of Galactic Archaeology is the use of stellar abundance ratios as an indirect estimator of age. While massive stars that explode as core-collapse supernovae mainly enrich the interstellar medium with oxygen and other 'alpha elements' on short timescales, Type Ia supernovae produce the bulk of iron and die after a longer time. The time delay between interstellar medium enrichment in alpha elements and iron can then be used as a chemical clock. Indeed, the chemical clock has been shown to work for many stars.

However, the authors of the new study demonstrate that alpha/iron enhancement is no guarantee that a star is in fact old. It has only recently become possible to determine precise ages for these stars, thanks to asteroseismology. This method measures pulsation frequencies, providing additional information about the age of stars. The group of stars studied appears to be relatively young, despite being enriched with alpha elements with respect to the Sun. Interestingly, these stars were found to be more abundant towards the inner Galactic disc regions where the interplay between the bar and spiral arms may lead to a more complex chemical enrichment scenario.

"Although there were similar stars in previous surveys, they were not identified as such and only very few of them. This may explain why these stars have received little attention so far," mused Friedrich Anders, Chiappini's co-author.



Location of the red giants studied by CoRoGEE in the Milky Way. The red stars show the ones for which the chemical clock does not work. Credit: F. Anders

"Future observations will provide more clues as to the origin of these stars and the complex chemical evolution of the Milky Way," concluded Cristina Chiappini.

The new CoRoT-APOGEE (CoRoGEE) sample is the result of collaboration between APOGEE (a high-resolution infrared survey) – part of the Sloan Digital Sky Survey III (SDSSIII) – and the CoRoT red giant working group. This collaboration enabled hundreds of red giant stars to be followed up spectroscopically, providing seismic information in the CoRoT fields. At present, only CoRoGEE can explore the inner-disc regions and determine the age of its field stars.

More information: Young [α /Fe]-enhanced stars discovered by CoRoT and APOGEE: What is their origin?, Chiappini et al. 2015, *A&A*, 576, L12. www.aanda.org/10.1051/0004-6361/201525865

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