Scientist dated some of the oldest stars with unprecedented precision

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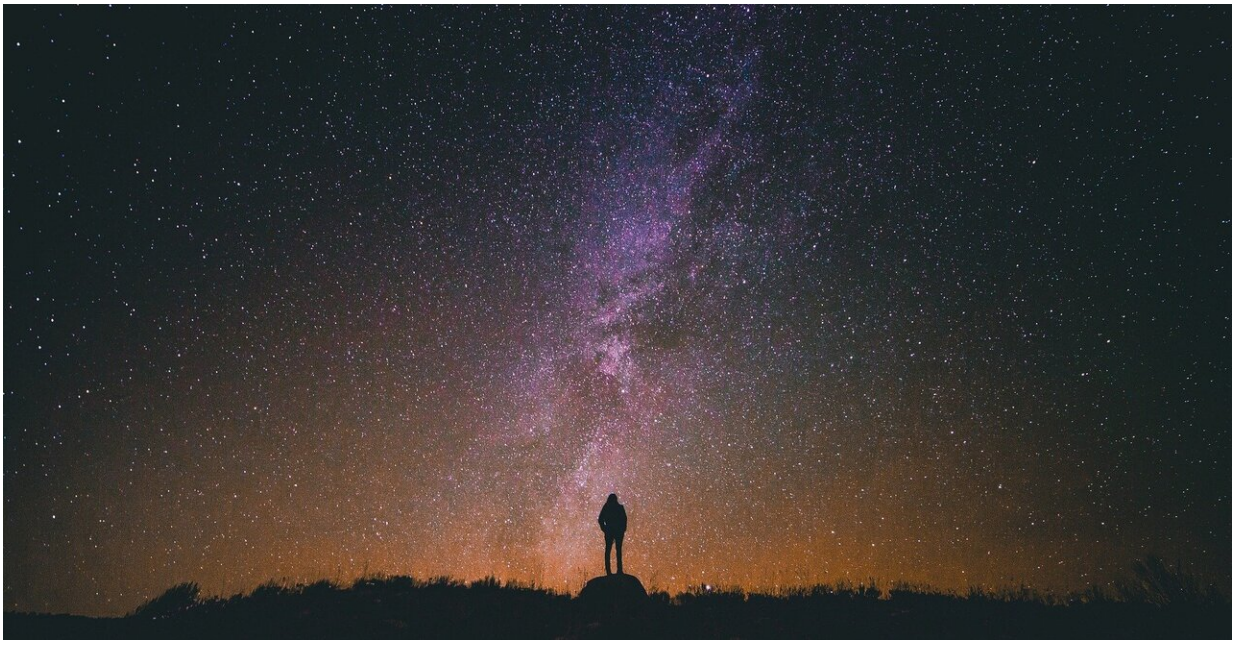

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Scientists have succeeded in dating some of the oldest stars in the galaxy with unprecedented precision by combining data from the stars' oscillations with information about their chemical composition.

The team, led by researchers at the University of Birmingham, surveyed around 100 red giant stars, and were able to determine that some of these were originally part of a satellite galaxy called Gaia-Enceladus, which

collided with the Milky Way early in its history.

The results, published in *Nature Astronomy*, revealed that the group of stars surveyed all have similar ages, or are slightly younger than the majority of the stars known to have started their lives within the Milky Way. This corroborates existing theories suggesting the Milky Way had already started forming a significant fraction of its stars when the merger with the Gaia-Enceladus (also known as the Gaia Sausage) occurred.

By the time of the collision, the Milky Way was already efficiently forming stars, most of which now reside within its thick disc, one of two disc-like structures that make up the galaxy.

Josefina Montalbán, lead author on the paper, said: "The chemical composition, location and motion of the stars we can observe today in the Milky Way contain precious information about their origin. As we increase our knowledge of how and when these stars were formed, we can start to better understand how the merger of Gaia-Enceladus with the Milky Way affected the evolution of our galaxy."

In the calculations, the team incorporated asteroseismology data from the Kepler satellite in combination with data from the Gaia and APOGEE instruments. All three are set up to gather data to map and characterize stars in the Milky Way.

Asteroseismology is a relatively new technique, which measures the relative frequencies and amplitudes of the natural modes of oscillation of the stars. This enables scientists to assemble information about the star's size and internal structure, which enables accurate estimations of the star's age to be made.

In this research, the team used information on the individual oscillation modes of each star rather than averaged properties of their pulsations.

They were also able to use asteroseimology in combination with spectroscopy, which enabled them to measure the chemical compositions of the stars.

Co-author Professor Andrea Miglio at the University of Bologna said, "We have shown the huge potential of asteroseismology in combination with spectroscopy to deliver precise, accurate relative ages for individual, very old, stars. Taken together, these measurements contribute to sharpen our view on the early years of our galaxy and promise a bright future for Galactic archeoastronomy."

More information: Chronologically dating the early assembly of the Milky Way, *Nature Astronomy* (2021). DOI: 10.1038/s41550-021-01347-7

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