JINA-CEE Press Release

Using colors to identify the approximate ages of more than 130,000 stars in the Milky Way's halo, JINA-CEE astronomers from the University of Notre Dame have produced the clearest picture yet of how the galaxy formed more than 13.5 billion years ago.

Astrophysicist Daniela Carollo, research assistant professor in the Department of Physics at the University of Notre Dame and Timothy Beers, chair professor in astrophysics, along with research assistant professor Vinicius Placco and their colleagues, published their findings in Nature Physics, including a chronographic (age) map that supports a hierarchical model of galaxy formation. That model, developed by theoreticians over the past few decades, suggests that our Milky Way formed by merging and accretion of small mini-halos containing stars and gas, and that the oldest of the Milky Way's stars are at the center of the galaxy and younger stars and small galaxies merged with the Milky Way, drawn in by gravity over billions of years.

Using data from the Sloan Digital Sky Survey (in which JINA-CEE is a partner) the scientists identified more than 130,000 blue horizontal-branch stars, which burn helium in their cores, and exhibit different colors based on their ages. The colors, when the stars are at that stage, are directly related to the amount of time that a star has been alive, so the age can be estimated. They are the only type of star whose age can be estimated by color alone.

The mapped stars show a clear hierarchy, with the oldest stars near the center of the galaxy, and younger stars farther away.

Carollo explains that initial gas clouds containing primordial material, such as hydrogen and helium, formed early stars. Clouds with various masses and gas content behaved differently: the smaller clouds formed one or two generations of stars (older object) and then merged with other clouds and ended in the center of the Galaxy pulled by gravity, while larger mass clouds formed multiple generations of stars (younger object) before they merged.

The results will be important for the broader JINA-CEE collaborative network. JINA-CEE collaborators can now develop improved computer simulations of the formation and evolution of Milky Way like Galaxies. These models provide a basis for stellar astrophysicists and nuclear scientists to implement data from nuclear experiments at facilities like Notre Dame or NSCL/FRIB in order to unravel the formation of the chemical elements.

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