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The original composition of the gas forming first-population stars in globular clusters

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Globular clusters (GCs) are among the most fascinating objects in the Universe, but their formation and evolution remain a key challenge in astrophysics. These dense and compact agglomerates of stars are believed to have formed from the dense cores of super-giant molecular clouds during the earliest stages of galaxy formation. However, the environment in which GCs originated is still quite unexplored, as only a small amount of intra-cluster medium (ICM) has been observed in present-day GCs. Furthermore, such ICM would not accurately reflect the chemical composition of the proto-cluster gas, as it is contaminated by the material expelled by GC stars during their post-main-sequence evolution.

To address this challenge, we have developed a new method for identifying GC stars formed from pristine material, known as first-population (1P) stars, and determining the chemical composition of the environment from which proto-GCs originated. Our approach relies on the 'Chromosome Map'(ChM), which is a pseudo-two-color diagram that enables the detection of star-to-star variations in chemical composition with an unprecedented precision of ~ 0.01 dex in [Fe/H]. By analyzing ChMs across a large sample of 55 Galactic GCs, we have determined the chemical composition of the gas from which Milky Way clusters formed approximately ~ 11-13 Gyr ago.

In this talk, I will describe how 1P stars can be used to investigate the chemical composition of GC natal clouds, focusing on our latest observational results. Additionally, I will discuss the impact of these new findings on the formation scenarios of multiple stellar populations in GCs.

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