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Statistical constraints on primordial globular cluster formation

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Globular clusters (GC) are the oldest known astronomical objects in the universe. Discovered about two hundred years ago, the initial conditions that give rise to GCs are still mysterious. Significant progress has been made in the last decade: a clear correlation has been found between the total number (or mass) of GCs in a galaxy and the mass of its host dark matter halo, which provides an important constraint on models; meanwhile, detailed hydrodynamical models of GC populations in a cosmological context have shown that substantial fraction may have formed in the turbulent ISM of massive, gas-rich galaxies at $1 < z < 4$. However, a subdominant population of primordial GCs may also have formed as 'nuclear clusters' in low-mass dark matter halos, before the epoch of reionization. If primordial clusters exist, their cosmic abundance may be a useful probe of the earliest epoch of galaxy formation, and hence of cosmology (as suggested by \cite{Peebles1984}). Therefore, answering the formation of GCs in the extreme context of a high redshift universe is important. In this work, we apply parameterized models of primordial GC formation to Extended Press-Schechter merger trees and attempt to constrain their allowed parameter space through statistical comparison to the observed relation between cluster number and halo mass. We found that the primordial GC formation process can answer for the abundance of GCs in dark matter halos at mass $\leq 10^{10} M_{\odot}$. On the higher mass halos, we need a process of GC disruption to keep less than 50% of GCs in these host halos, assuming the observational data from \cite{Harris2013}.

Primary author: LE, Minh Ngoc (National Tsing Hua University, Taiwan)

Co-author: COOPER, Andrew

Presenter: LE, Minh Ngoc (National Tsing Hua University, Taiwan)

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