

Hierarchical mergers as tracers of globular cluster formation history

Sunday, 5 July 2026 14:45 (15 minutes)

The origin of globular clusters remains one of the most important open questions in astrophysics, with essential implications for our understanding of galaxy formation and the early Universe.

Globular clusters are unique sites of hierarchical black hole mergers, where the remnant of a previous merger undergoes a subsequent coalescence, a process only expected in the dense dynamical environments of stellar clusters. These mergers have distinct properties compared to binary black holes formed in isolated environments, making them promising candidates to be clearly identified in future observations.

Using population synthesis models of gravitational wave sources in globular clusters, I show that the hierarchical merger rate directly traces the cluster formation history. Adopting a model for the delay time, defined as the time between cluster formation and the eventual black hole merger, I demonstrate that the globular cluster formation history can be accurately inferred from hierarchical merger catalogues of third-generation detectors using a non-parametric Bayesian framework. This will constrain the cluster formation history to unprecedented accuracy, shedding light on the cluster formation efficiency across cosmic time, the role of globular clusters in cosmic reionization, and the physical conditions of high-redshift star formation. Third-generation detectors will therefore be unique probes of globular cluster formation and high-redshift star formation, complementing observatories such as JWST, Euclid, and the ELT.

Primary author: DOROZSMAL, Andris (National Astronomical Observatory of Japan)

Presenter: DOROZSMAL, Andris (National Astronomical Observatory of Japan)