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Star cluster properties from intermediate-mass black hole mergers

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Next-generation (XG) ground-based gravitational wave observatories are expected to be sensitive to mergers of intermediate-mass black holes (IMBHs) with a total source-frame mass in the hundreds out to a high redshift. Runaway tidal encounters lead to the formation of IMBHs in the cores of dense stellar clusters. I will discuss how single IMBH–IMBH merger events, occurring after the coalescence of clusters that sank into the center of their host galaxies, can be used to infer the properties of their progenitor star clusters. Implementing an astrophysically motivated analytic model and performing binary parameter estimation for our massive events in a network of three XG detectors, we find that inferring the structural properties of clusters through this channel is challenging due to model degeneracy. Nonetheless, the redshifts of cluster formation are better measured, and the cluster formation history may be inferred from an observed population of IMBH-IMBH mergers.

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