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The hierarchical assembly of galaxies and black holes in the first billion years: predictions for the era of gravitational wave astronomy

Tuesday, 6 July 2021 07:40 (20 minutes)

The LISA detectability of GWs from supermassive black hole mergers will crucially depend on the physical properties of their host galaxies.
In this talk I will present a semi-analytic galaxy formation model, Delphi, that fully tracks the accretion- and merger-driven hierarchical assembly of the dark matter halo, gas, stellar, and black hole masses of high-redshift ($z > 5$) galaxies. We explore a number of physical scenarios that include (i) two types of black hole seeds (stellar and those from direct collapse); (ii) the impact of reionization; and (iii) the impact of instantaneous versus delayed galaxy mergers on the baryonic growth. Using a minimal set of mass- and redshift-independent free parameters associated with star formation and black hole growth, and their associated feedback, we show that our model successfully, and crucially, reproduces all available data sets for early galaxies and quasars. We then use this model to predict the LISA detectability of merger events at high-redshifts. We show that mergers of stellar BHs dominate the merger rates for all scenarios and our model predicts an expected upper limit of about 20 mergers using instantaneous merging and no reionization feedback over the 4-yr mission duration. I will end by showing the impact of reionization feedback and delayed mergers on the expected event rates and the most optimal LISA surveys required to reach these numbers.

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Session Classification: Planning Gravitational Wave Detections form LISA

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