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A Bayesian Approach To The Halo-Galaxy-SMBH Connection Through Cosmic Time

Wednesday, 17 May 2023 10:00 (15 minutes)

We present an empirical galaxy evolution model, investigating the co-evolution of dark matter halos, galaxies, and supermassive black holes using from z= 0 - 10. Our approach connects the evolution of dark matter structure with simple empirical prescriptions for baryonic processes, allowing us to reproduce key observations in the relationship between galaxies and their black holes.
To construct our model, we assumed a physically-motivated direct relationship between galaxy and supermassive black hole properties and their host halo mass. We then used this relationship to derive expressions for the galaxy stellar mass function, galaxy UV luminosity function, active black hole mass function, and quasar bolometric luminosity function. We calibrated our baryonic prescriptions using a fully Bayesian approach, ensuring that our model was consistent with observed population statistics.
Our results show that the model is qualitatively consistent with observations, reproducing the galaxy stellar mass - UV luminosity relation, black hole mass - stellar mass relation, black hole mass - AGN luminosity relation, and their evolution with redshift. We present upper limits on the expected number of sources for z=5 up to z=15 for upcoming surveys by JWST and Euclid. Our study demonstrates that empirical models can complement more computationally expensive approaches, providing a fast, easy, and flexible way to make predictions for observational surveys.

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