Reproducing sub-millimetre galaxy number counts with cosmological hydrodynamic simulations

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Abstract

Matching the number counts of high-z sub-millimetre-selected galaxies (SMGs) has been a long standing problem for galaxy formation models. In this talk, I will present predictions for the Simba cosmological hydrodynamic simulations. We use 3D dust radiative transfer to model the sub-mm emission from galaxies, and compare predictions to the latest single-dish observational constraints on the abundance of 850μm-selected sources. We find unprecedented agreement with the integrated 850μm luminosity function, along with good agreement in the redshift distribution of bright SMGs. The excellent agreement is driven primarily by Simba’s good match to infrared measures of the star formation rate (SFR) function between z=2–4 at high SFRs. Also important is the self-consistent on-the-fly dust model in Simba, which predicts, on average, higher dust masses compared to using a fixed dust-to-metals ratio. We construct a lightcone to investigate the effect of far-field blending, and find minimal contribution to the shape and normalisation of the luminosity function. Our results demonstrate that exotic solutions to the discrepancy between sub-mm counts in simulations and observations, such as a top-heavy IMF, are unnecessary, and that sub-millimetre-bright phases are a natural consequence of massive galaxy evolution.