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# Early Black Holes in Cosmological Simulations: Luminosity Functions and Clustering Behaviour

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We examine predictions for the quasar luminosity functions (QLF) and quasar clustering at high redshift (z > 4.75) using MassiveBlack, our new hydrodynamic cosmological simulation which includes a self-consistent model for black hole growth and feedback. We show that the model reproduces the Sloan QLF within observational constraints at z >= 5. We find that the high-z QLF is consistent with a redshift-independent occupation distribution of BHs among dark matter halos (which we provide) such that the evolution of the QLF follows that of the halo mass function. The sole exception is the bright-end at z=6 and 7, where BHs in high-mass halos tend to be unusually bright due to extended periods of Eddington growth caused by high density cold flows into the halo center. We further use these luminosity functions to make predictions for the number density of quasars in upcoming surveys, predicting there should be ~119+-28 (~87+-28) quasars detectable in the F125W band of the WIDE (DEEP) fields of the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey (CANDELS) from z=5-6, ~19+-7 (~18+-9) from z=6-7, and ~1.7+-1.5 (~1.5+-1.5) from z=7-8. We also investigate quasar clustering, finding that the correlation length is fully consistent with current constraints for Sloan quasars (r_0~17 h^{-1} Mpc at z=4 for quasars above m_i = 20.2), and grows slowly with redshift up to z=6 (r_0~22 h^{-1} Mpc). Finally, we note that the quasar clustering strength depends weakly on luminosity for low L_BH, but gets stronger at higher L_BH as the BHs are found in higher mass halos.

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