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A Physical model for formation and evolution of QSOs and of their Spheroidal Hosts

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We present a physically motivated model for the early co-evolution of massive spheroids and active nuclei at their centers. Within dark matter halos, forming at the rate predicted by the canonical hierarchical clustering scenario, the gas evolution is controlled by gravity, radiative cooling, and heating by feedback from SN and from the growing active nucleus. SN heating is increasingly effective with decreasing binding energy in slowing down the star formation and in driving gas outflows. The more massive proto-galaxies virializing at early times are thus the sites of the faster star-formation. The correspondingly higher radiation drag fastens the angular momentum loss by the gas, resulting in a larger accretion rate onto the central black-hole. In turn, the kinetic energy carried by outflows driven by active nuclei can unbind the residual gas, thus halting both the star formation and the black-hole growth, in a time again shorter for larger halos. For the most massive galaxies the gas unbinding time is short enough for the bulk of the star-formation to be completed before type Ia SN can substantially increase the Fe abundance of the interstellar medium, thus accounting for the alpha-enhancement seen in the largest E galaxies. The feedback from SN and from the active nucleus also determines the relationship between the black-hole mass and the mass, or the velocity dispersion, of the host galaxy, as well as the black-hole mass function. In both cases the model predictions are in excellent agreement with the observational data. Coupling the model with GRASIL, a code computing in a self-consistent way the chemical and spectrophotometric evolution of galaxies over a very wide wavelength interval, we obtained predictions in excellent agreement with observations for a number of observables which proved to be extremely challenging for all current semi-analytical models, including the sub-mm counts and the corresponding redshift distributions, and the epoch-dependent K-band luminosity function of spheroidal galaxies.

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