Semi-analytic forecast: uncovering galaxy formation with joint constraints from wide and deep surveys

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Abstract

We present physical properties for bulk populations of galaxies predicted by the well-established Santa Cruz semi-analytic model (SAM) with the recently implemented multiphase gas partitioning and molecular hydrogen-based star formation recipes. Recently, we have shown that the galaxy properties and UV LFs predicted by our models match extremely well with existing observational constraints over a wide range of redshifts (up to $z \sim 10$). Our SAM is able to simultaneously model objects spanning a wide range of masses, including the rare, massive ones that are expected to be captured by Euclid, and the faint, low-mass ones that are exclusively detectable by *JWST*. Taking advantage of the SAM's high computational efficiency, we are able to systematically vary the subgrid physical parameters to explore the sensitivities of high-z galaxy properties to the uncertainties in the underlying physical processes. We discuss how anticipated surveys with the two missions can jointly provide constraints for key processes that shape the formation of these galaxies. Furthermore, we work out the implications of our predictions for the cosmic reionization history and confront this with a suite of currently available observational constraints from CMB and IGM observations.