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Efficient simulation of galaxy lightcones and associated radiation fields

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I will present a substantial upgrade to the public simulation code, 21cmFASTv4, allowing efficient and flexible forward models of galaxy and IGM observables. In an end-to-end approach, we sample cosmological parameters, creating a 3D realization of the initial conditions. Dark matter halos are identified in Lagrangian space and then moved, together with the matter field, to Eularian space using 2LPT. Galaxies are assigned to DM halos by sampling parametric conditional probability densities motivated by well-established empirical relations such as the stellar to halo relation, star forming main sequence, fundamental metallicity relation etc. Cosmic radiation fields (Lyman-alpha, Lyman-continuum, and X-ray) sourced by these galaxies are calculated using approximate radiative transfer, and the IGM is evolved accordingly. Under fiducial settings, 21cmFASTv4 computes all of these steps in ~2 core hours for a single realization, thus facilitating high-dimensional, multi-tracer, field-level Bayesian inference of cosmology and astrophysics.

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