U12a Fast semi-analytical method for generating mock line intensity maps

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Large-scale structure provides information that allows us to constrain the cosmological model. For accurate constraints to be obtained, large volumes need to be mapped to reduce cosmic variance. In contrast to galaxy surveys which detect individual galaxies, line intensity mapping measures the emission of spectral lines from many sources collectively, thus providing a much faster way to map the universe. Its ability to detect contributions from faint galaxies undetected in galaxy surveys also means that deeper redshifts can be probed. In order to analyse the intensity mapping observations, it is necessary to generate many independent realisations of mock intensity maps to evaluate statistical uncertainties and systematic errors.

We develop a new method for generating mock data using a dark matter halo catalogue generator, PINOCCHIO, based on Lagrangian Perturbation Theory, allowing it to be faster than conventional N-body simulations. We adopt an approach derived from the empirical model EMERGE to assign SFRs to these halos according to their growth rate, which is found to be correlated with the amount of baryonic material that is available, and halo mass, which is linked to the efficiency of converting this material to stars. We then use the obtained SFRs to assign emission lines to halos. This enables the rapid generation of many mock intensity maps, with cubic volumes as large as 1Gpc on a side at redshift ~ 2. We also evaluate the effect of varying the model on the resulting power spectrum.These mock catalogues can be used for estimating uncertainties in future constraints as well as training machine learning models for data analysis.