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Multi-wavelength forward-modeling of the EoR and cosmic dawn

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In the near future, 21cm cosmology will give us unprecedented insight into the early universe, however the novel nature of this probe makes it difficult to validate our observations. One way to ensure our measurements are correct is to cross-correlate them with other wavelengths. This process will require a fast, flexible forward model which can self-consistently produce mock data of the 21cm signal as well as various signals at other wavelengths. To this end we have extended the popular semi-numerical simulation code 21cmFAST to include a stochastic source model which explicitly tracks halos and galaxies over cosmic time. Using this model, we can produce lightcones of large-scale fields which depend on galaxy properties, such as galaxy number density fields, CII line intensity maps, and the X-ray background. The statistics of these fields, and their cross correlation with the 21cm brightness temperature, can be included in our inference pipeline, tightening our constraints on the nature of the first galaxies, and allowing a vital sanity check on the first measurements from radio interferometers.

Research area

Epoch of Reionization

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