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Sensitivity of Bayesian 21 cm power spectrum estimation to foreground model errors with hydra-pspec

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1 Extended Abstract

The highly redshifted 21 cm signal from neutral hydrogen is a promising probe of the period in the universe's history known as the Epoch of Reionization (EoR), where the first luminous sources ionized the surrounding intergalactic medium. Current interferometric experiments targeting this signal from the EoR are seeking a first detection in the form of the 21 cm power spectrum. Observation of this distant cosmological signal has proven difficult, however, due to the presence of artificial radio frequency interference (RFI) and bright astrophysical foregrounds (FGs) (1; 2; 3). Excising RFI from our observations results in missing gaps in the data which must be filled in with a model of the data to avoid spurious contamination of EoR dominated modes. Because of the large dynamic range between the EoR and FG signals, small modeling errors can lead to significant EoR power spectrum contamination. We are developing a Bayesian 21 cm power spectrum pipeline, hydra-pspec, which utilizes the combination of Gaussian constrained realizations and Gibbs sampling to address these difficulties (4). This combination of techniques allows us to draw samples from the joint posterior of the EoR modes and their power spectrum in the presence of data with gaps due to RFI and an uncertain foreground model. In this talk, I will review our Bayesian approach to 21 cm power spectrum estimation and demonstrate its robustness to FG model errors via analyses of simulated data. These tests show that, even in the most extreme scenarios tested, we can recover 21 cm power spectrum estimates consistent with a known input signal. This is true even when using FG models derived from modified FG catalogs containing spatial and spectral perturbations at the current level of uncertainty on our FG catalogs.

References

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