Poster Presentation:

First patch:

The 21 cm signal is sensitive to the density and temperature of neutral hydrogen in the early universe and the presence of the first stars and galaxies Therefore, any deviation from the predictions of the standard cosmological model of this signal will affect the shape of the signal. In this study, we explore the potential of this signal to reveal non-standard physics.

Second Patch:

We adopt the Markov Chain Monte Carlo (MCMC) method combined with the Levenberg Marquardt (I will later tell the reason) algorithm to estimate the best fit physical parameters of the theoretical 21cm curves. We use the Accelerated Reionization Era Simulations (ARES) to generate models for the global 21 cm signal. We used data released by the EDGES group as the basis for our fitting process, but our script is open to future datasets. Our method is flexible to the choice of parameters from ARES.

The knowledge of these best fit parameters will help us to constrain future proposed models and set theoretical limits for the precision of upcoming experiments to observe non-standard effects.

Third Patch:

Since ARES is computational heavy, we developed an emulator based on ARES curves using radial basis function interpolation This emulator can generate global 21 cm curves approximately a thousand times faster than ARES With the emulator's help, we were able to run the MCMC for up to ten million steps.

We confirmed the convergence of this chain by analyzing its power spectrum, which exhibited a flat behavior on low frequencies.

Since we expect that the MCMC algorithm should converge in 1000 to 10000 steps, we need to find a way to help mcm converge faster. In order to achieve faster convergence of MCMC chains, we are exploring various methods, one of which involves using a posterior distribution that accounts for correlations between different parameters.

To generate this posterior distribution, we first use a Levenberg-Marquardt fitter to obtain a set of best fit parameters and the covariance matrix of parameters based on the local derivatives of the likelihood at the best fit point. We then draw samples from this covariance matrix to generate the posterior distribution. Currently, we are using this method to improve the convergence of our MCMC chains.