Response to referee report for scipost_202201_00008v1

Title: *Probing the Inflaton Potential with SKA*
Authors: Tanmoy Modak, Tilman Plehn, Lennart Röver, Björn Malte Schäfer

Dear Editor,
We would like to thank the reviewer for her/his comments and suggestions. Our responses and alterations are presented below.

Question 1:

The authors used the existing constraints on the parameters obtained from Planck as a prior. However, we know there are some uncertainties even on choices for the values of the constraints. If the authors adopted the most milder bounds on them, how do the results change?

Reply 1:

The constraints on the third and fourth order slow-roll parameters, ξ_H^2 and ω_H^3 are driven by the improvement in the constraints from SKA alone. Using a CMB experiment with weaker constraints than the ones reported by Planck would not significantly impact on our constraints on these two. For the parameters $\tilde{A}_s$, ϵ_H and η_H the Planck likelihoods allow to cut off the approximately flat directions in their correlation. With a weaker prior than the Planck likelihood the marginalized constraints on the individual parameters would increase accordingly. However, the smaller of the principal axes will not change significantly.

Question 2:

About uncertainties coming from the H_0 tension, how did the authors resolve the problem in their choices for actual values of the free parameters?

Reply 2:

In fact, given the tension between reported best fit values of the Hubble-parameter, one would need to make a choice for the purpose of forecasting. We have chosen a low value, similar to the one derived from PLANCK in order to have consistency in the modelling of the CMB-spectra. The constraints on the Hubble-parameter for SKA alone is rather weak, so the the constraints are essentially resulting from the CMB alone. Changing the fiducial value of the Hubble function in the SKA forecast to a different value should not impact the slow-roll parameter forecasts significantly, as our internal tests suggest.

Question 3:

Even for the ionization fraction of electron χ there should exist corresponding spatial fluctuations. How did the authors treat χ-fluctuations in their analysis?

Reply 3:

In our analysis we followed [Muñoz, JCAP 05 (2017) 032] where spatial fluctuations of the ionizing fraction are treated as negligible in the redshift range considered. Effectively, this implies that the ionisation fraction is homogeneous and only depends on cosmic time. Effects related to patchy reionisation, which is a much better approximation to reality, are neglected - after all, given the long lines of sight involved, this is a good approximation.

Question 4:

It seems that the authors assumed the constant slowroll parameters (or constant spectral index, the running, and the running-of-running, ...) as a function of the wave number k. I think this is not realized in a concrete inflation model for relevant ranges of k observed by the SKA. I encourage the authors to discuss the validity for their methods in the text.

Reply 4:

In order to find the primordial power spectrum we followed the HSR parametrization as given in Planck 2018 and 2015 papers. The primordial spectrum is obtained by solving Eq. (10) and the parametrization does not depend on the slow-roll approximation. Here, we chose to parameterize H in Eq. (10) as a Taylor expansion with respect to $(\varphi - \varphi^*)$ as given in Eq. (8). The HSR parameters indeed depend on the comoving wavenumber k but are evaluated at the pivot scale chosen to correspond to the comoving horizon size $k_* = 0.05$ Mpc^{-1}. This formalism is based on Ref. [60] and implemented in the Boltzmann code CLASS as a default option which we have utilized in our analysis. Similarly for the $\tilde{A}_s$, n_s, α and β parametrization we assumed the primordial spectrum is well approximated by Eq. (13) up to order β in the observable window for simplicity. We added discussion on this in the page 5.

We would like to thank the referee again for reviewing our manuscript and believe that we have addressed their comments adequately.

Yours sincerely,
Tanmoy Modak, Tilman Plehn, Lennart Röver, Björn Malte Schäfer