

REPORT ON JCAP_053P_0121

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Title: Investigating the Effect of PBH, Dark Matter – Baryon and Dark Matter – Dark Energy Interaction on EDGES in 21cm Signal

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Referee report

I have gone through the manuscript JCAP_053P_0121 by Ashadul Halder and Madhurima Pandey. This paper attempts to use the anomalous absorption signal measured by the EDGES experiment to place constraints on several extensions of the standard cosmological model. In particular, on primordial black holes (PBHs), dark matter (DM) – baryon and DM – dark energy (DE) interactions. Taken separately, within the context of the EDGES measurements, all of the above extensions have been already investigated by various research groups. This is also acknowledged by the authors. The authors claim that it is somehow beneficial to study all of these extensions at the same time. To me this does not seem to be very reasonable. For this purpose one should certainly include other observables beyond the EDGES 21cm measurements to derive more meaningful constraints on this extended set of models.

Many of the calculations have been done in too approximate way. For example, simply copying the approach of several pioneering studies, the authors have opted to use a very rough on-the-spot approximation for the energy deposition. In reality one should take into account the energy distribution and propagation effects of the injected photons and electrons from the evaporating PBHs. To perform these calculations it is easiest to use the results provided by Tracy Slatyer at <https://faun.rc.fas.harvard.edu/epsilon/>

In the formalism presented in section 5 a crucial piece is missing, namely the description for the Lyman-alpha background. After all, the generation of Lyman-alpha photons by the first sources is what determines the shape

of the transition of the spin temperature ($T_S = T_R \rightarrow T_S = T_K$) and thus a detailed shape of the onset of the absorption feature as measured by EDGES.

It seems that only the amplitude and the location of the absorption feature have been used to derive model constraints. Indeed, in that case a particular model for the Lyman-alpha background is not that important. But if one starts to present detailed figures for T_{21} etc, one should also specify assumed model for Lyman-alpha background. In these figures it would then also be reasonable to show EDGES measurement points.

The redshift range in Figure 2 is absolutely irrelevant for the Earth-based 21cm measurements. Due to opacity of the ionosphere these redshifts can only be explored with future space missions.

In general, starting from an extremely clumsy and grammatically incorrect title, this paper struck me with a surprising lack of originality. I could not find good answers to the following questions:

- What is really new here?
- Any improvement over the earlier developments?
- How the obtained results compare to similar calculations done by the other authors?

Also, there is an overlap with a new arXiv submission 2102.00959 as noted by the automatic arXiv administrator. Since one of the authors is the same, arXiv allows much higher textual overlap than usual, before raising the alarm. I had also a quick look at this new paper and have to admit that the overlap is indeed very obvious. Quite possibly both of these papers should be combined into a single work. Even then the question of originality remains.

Due to the above reasons I do not think that this work is fit for JCAP and should be rejected.