Dear Frank Geurts,

Many thanks for your important comments. Please, find below our answers.

Best Regards,
Cesar A. Bernardes.

I read with great interest the proceedings and the beautiful results on speed of sound from CMS collaboration. I have two major comments, after considering those the proceedings may be accepted for publication. (1) The analysis is expected to be very sensitive to the way the centrality selection is done experimentally and theoretically may be also to the initial energy deposition. Hence an appropriate sentence me added in the proceedings for readers to get the correct picture - see for example recent paper - https://arxiv.org/pdf/2312.04623.pdf

Yes, indeed the two points should be mentioned. But we see caveats. First, regarding the dependence on the initial energy deposition, we think that it is very important to take into account the correlation between this variable and Nch, which was not considered by the Trajectum authors in this paper you mentioned. In this case, it is possible that the large power parameter value that seems to have an important influence in the slope may be ruled out.
Concerning the centrality dependence, we also checked this in our data. In fact, this really happens as described in the reference above. But we think that it is important to make clear that it is important to avoid auto correlations, i.e., using a large eta-gap between the region where centrality is defined and the <pT> and Nch are measured. We do expect to have compatible results if you do the measurement, for example, using charged particles multiplicity or calorimeter energy but for a large eta-gap as we used, i.e., 3 <|eta|<5 for centrality (and in the barrel |eta|<1 for the <pT> and Nch). Otherwise, will see autocorrelation effects as described in Fig. 4 of the reference above. Note that in the reference above is not used a considerably large eta gap, and we think that this is very important for the stability of the results.

Then, we propose to add the following sentence in the "Results" section of the proceedings: changing from "... within the allowed parameter space constrained by a global Bayesian analysis [10, 11]" → "... within the allowed parameter space constrained by a global Bayesian analysis [10, 11]. In recent studies [ref above], it was shown that the slope of the steep rise of <pT> vs Nch can depend, in addition to the EoS, on the simulation parameters used to describe the initial transverse energy density and also the centrality selection definition. Regarding the former, it is important to note that correlations between these parameters and Nch were not taken into account in Ref. [ref above], which can exclude the existence of such large parameters and consequently do not result in considerable influence in the slope. For the latter, based on studies using the CMS data, in order to have stable results, it is recommended to use a large eta-gap between the definition of centrality and the measured <pT> and Nch, as performed in the present analysis."

(2) The extraction of Teff is based on <pT>/3 - does it not assume ideal equation of state, where cs^2 = 0.333, however we know from the current study that it is not 0.333 - this aspect may be clarified.

Right, but this relation was also shown to hold as a good approximation in hydrodynamic simulations. Please, see Fig. 2 (upper panels) of Ref. Nature Phys. 16, 615 (2020). We do not think is needed to change the text of the proceedings, since we have the following sentence in the introduction section: "It has been shown by hydrodynamic simulations in Refs. [7,9] that <pT>/3 is a good estimator of an effective temperature Teff …", where Ref. 9 is Nature Phys. 16, 615 (2020).

- *Abstract:*

The measurement is based on an analysis of the observed charged multiplicity dependence of the average particle transverse momentum in ultra-central events (impact parameter of nearly zero), a variable which probes the system temperature as a function of entropy density at a fixed volume. ==> The measurement is based on an analysis of the observed charged multiplicity dependence of the average particle transverse momentum in ultra-central events (impact parameter of nearly zero). This variable probes the system temperature as a function of entropy density at a fixed volume.

Done

- *Sec: Introduction*

In ultrarelativistic nuclear collisions are observed many evidences of the production of a state of matter composed of quarks and gluons. ==> In ultrarelativistic nuclear collisions, many evidences of the production of a state of matter composed of quarks and gluons are observed.

Done

In general, these collisions are described in several stages, with the QGP state as a specific phase modeled by relativistic hydrodynamics [5]. ==> These collisions are generally described in several stages, with the QGP state as a specific phase modelled by relativistic hydrodynamics [5].

Done

- *Sec: Measurement method*

colorimeter ==> calorimeter

Done

represent the mean transverse momentum and charged multiplicity ==> represents the mean transverse momentum and charged multiplicity

Done

By normalizing both ⟨pT⟩ and Nch by their values in the reference event class, most of the systematic uncertainties can be minimized. ==> Normalizing both ⟨pT⟩ and Nch by their values in the reference event class can minimise most of the systematic uncertainties.

Done

- *Results*

At higher multiplicities, corresponding to ultra-central PbPb events, a steep rise is observed. ==> A steep rise is observed at higher multiplicities, corresponding to ultra-central PbPb events.

Done

If space allows, the proceedings could benefit from reference to other published studies which extracts speed of sound and I see the values are similar order - for example -https://doi.org/10.1103/PhysRevC.68.064903 and https://doi.org/10.1088/0954-3899/31/11/015 That's all.

We added the following sentence in the last paragraph of the Results section of the proceedings:
"Is important to note that first attempts to extract the speed of sound in ultrarelativistic collisions at lower center of mass energies were performed by analyzing rapidity distributions [ref1, ref2], extracting values for cs^2 of similar order as in the present work."