

**For systematic uncertainties estimation the cuts variations were pretty large (e.g. TPC number clusters 70 - 100, TPC  $\chi^2/\text{ndf}$  2 - 4,...). This way we might overestimate a bit systematic uncertainties**

Answer: Sorry the table was old. And it propagated to the text as well. We removed the tables and fixed the text. The default cut on TPC NCLs is 70 and we vary it down to 60 and up to 90 which changes the statistics by 2%. So the systematics rising from this variation is really not overestimated and under control.

You could see that for example by varying number of TPC space points: the maximum systematics measured in the results through all centralities and pT values is 1-2% for v422 of pions.

For  $\chi^2$  we checked for  $\chi^2 < 4$  and  $\chi^2 < 3$ . The text is fixed now. In this case as well, the systematics seems under control and not at all overestimated (of course with the correct value of the variation, i.e.  $\chi^2 < 3$ )

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**The comparison of non-linear and liner modes is to be done (agree with Sergei) and more critical view on the models would be a good addition**

Answer: Thanks, we have quantified the difference between the models and the results and also discussed the differences (if any) wrt the published v<sub>n</sub> results. These studies are included in the wiki: <https://twiki.cern.ch/twiki/bin/view/ALICE/HydroComparison>

As it was asked by other IRC, here is the reply (which is the same to others)

We tried to quantify the performance of these models in reproducing the measurements of total flow wrt non-linear flow modes by

- 1) taking the  $\chi^2/N_{\text{dof}}$  between each model and the measurement
- 2) fitting the relative ratios between the models and the data (both v<sub>n</sub> and v<sub>n,mk</sub>)

These exercises are included in the following twiki link:

<https://twiki.cern.ch/twiki/bin/view/ALICE/Nonlinearflowvsmodels>  
<https://twiki.cern.ch/twiki/bin/view/ALICE/PublishedTotalFlowMeasurements>

Our interpretation of the compatibility of different models with the measurements as included in the new version of the paper:

"These two models have been utilised before to reproduce the p<sub>T</sub>-differential v<sub>n</sub> measurements for identified particles [40]. In order to compare the performance of these two models in v<sub>n</sub> and v<sub>n,mk</sub> measurements, the relative ratios between each model and the measurements have been obtained. Tables 3 and 4 summarize these relative ratios for v<sub>n,mk</sub> and v<sub>n</sub>, respectively. The ranges in the tables present the minimum and maximum value of a constant fit to the relative ratios obtained from most-central to mid-peripheral collisions. These values should be taken with caution as the non-linear flow modes have smaller magnitude and any discrepancy between the models and the data becomes magnified in the ratios. Comparison between Tab. 3 and 4 shows that the AMPT calculations reproduces v<sub>4,22</sub> with 20% higher discrepancy on average compared to v<sub>4</sub>, while, TRENTo calculations performs better in v<sub>4,22</sub> compared to v<sub>4</sub> with 7%.

All in all, this study shows larger discrepancy between the model calculations and v<sub>n,mk</sub> measurements wrt. that of v<sub>n</sub>, indicating a larger sensitivity to the initial conditions and transport properties in non-linear flow modes. As a result, it is useful to tune the input parameters of hydrodynamic models using the non-linear flow measurements and constrain the values of transport properties and the initial conditions of the system."

In addition we also compared the character features (mass ordering and particle type grouping) in  $v_{422}$  and  $v_4$  and the results are compatible. We did the same exercise with the models which shows the same mass ordering in  $v_4$  and  $v_{422}$ .

Here is a link to these comparisons:

<https://twiki.cern.ch/twiki/bin/view/ALICE/V4vsV422>

As a result, we added a few lines to the paper mentioning that the mass ordering and particle type grouping in the non-linear modes is compatible with that seen in  $v_n$  measurements.

"The features seen in the measurement of non-linear flow modes can be further studied by comparing to that of total flow coefficients. Such comparisons have been performed for  $v_{4,22}$  ( $p_T$ ) (this study) and  $v_4(p_T)$  measurements [40] by taking the relative difference of pions wrt protons at a given  $p_T$  in both modes. This comparison shows that the observed mass ordering in low  $p_T$  region ( $0 < p_T < 2.5$  GeV/c) is of the same magnitude in  $v_{4,22}$  and  $v_4$ . In the intermediate  $p_T$  region ( $p_T > 2.5$  GeV/c) the observed particle type grouping also shows the same magnitude in both flow modes."

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**Figure vertical axis titles should not overlap with labels**

Answer: Thanks. We have fixed this issue in the new version.