Long Symmetric Cumulant paper : 4th IRC review

Dear IRC members

 We would like to thank all IRC members for useful comments. The summary of the changes made in the updated version of the manuscript are provided below briefly. New figure for v_n(n=2,3,4 and 5) and pT_min dependence of v_n(n=2,3 and 4) are added and some minor improvements based on Ilya and Sudir's comments.

New version:
https://twiki.cern.ch/twiki/pub/ALICE/PtDependentStandardCandles/longSC_IRC_R4_v7.0.pdf

Difference between new and reviewed version:
https://twiki.cern.ch/twiki/pub/ALICE/PtDependentStandardCandles/diff_IRC_R4_R3.pdf

Reviewed version :
https://twiki.cern.ch/twiki/pub/ALICE/PtDependentStandardCandles/longSC_IRC_R3_v6.4.pdf
Regards,

DongJo on behalf of PC

A. Ilya Selyuzhenkov's comments

Dear DongJo, All,

the presentation of the results in the paper has improved a lot, in particular I like the new data representation and the compact layout of the figures with model-to-data comparison. Also, it is good to see added in the appendix model comparison for individual flow harmonics.

Nevertheless, I do not see implemented one important comment which was discussed during our last PC+IRC meeting and which was related to the completeness of the data presentation used to obtain the normalized NSC(n,m) correlations.

I remember it was a common agreement during our last PC+IRC meeting that it is important to provide a complete set of data which went into the calculations of the SC and a NSC correlators. This includes v2-v5 vs centrality with the same analysis cuts which went into calculation of data points in Fig. 1(right) and the corresponding pT_min dependence of vn which were used to obtain NSC vs pT_min in Fig. 2 panels (b) and (d). This comment is not mentioned in the reply document and is not reflected in the updated paper draft. Did the opinion of the PC has changed on this issues?

Somewhat related to this, I see that you have mentioned in the reply document that you are waiting for hydro calculations for v5, but I believe that independent of this we should have a dedicated figure in Section 5 "Results" which reflects the <v_n^2><v_m^2> correction used in calculations of Fig. 1-2. I would think that this can be addressed

by adding a new figure after Fig. 2 showing sqrt{<v_n>^2} for n=2-5 in the left panel and sqrt{<v_n>^2} vs. pT_min for n=2-4 in the right panel. From our previous PC+IRC discussion, my understanding is that this information cannot be derived from the previously published data and thus should be included in this paper for completeness of the data presentation.

R : Since we have 6 centrality bins, it is bit hard to put all in two pads. We now split into the left pad for vn vs centrality and the right pad for vn vs pTmin. Each pad consists of 3 sub-pad for each harmonics with a except, most left bottom contains v4 and v5.

A small comment/suggestion for the new version of Fig. 2:
with a current choice of the Y-axis range a lot of points at high pT_min fall outside of the plotting range. I understand that this choice was driven by the small values of results in 0-5 and 5-10% centralities. Since in Fig. 2 we focus on the pT dependence, maybe the left panels (a) and (c) can be shown for self-normalized quantities, i.e. divided by the results for pT_min integrated values which are shown in Fig. 1(left)? This representation would reduce the strong change in magnitude coming from the centrality dependence, and will better show the shape of the pT dependence in different centrality bins.

R : We zoomed out the figures to show all the data points instead of doing any additional change. It looks good still.

Best regards,
Ilya

B. Sudhir Raniwala

Some of the following comments may be repeated from earlier versions --- in words or in spirit. Please accept my apologies for those.

Some of the following may be useful.

General:

1. The study of pT dependence was limited to lower harmonics. Is there a reason? Should the reason me mentioned?
R : Statistics are limited as we go to higher order harmonics and we think we don't need to mention it in the paper.

2. What is referred to as 'higher harmonics'? SC(4,3) is higher, but SC(4,2) is lower, but SC(5,2) is higher. Is there a convention that we may want to define, however arbitraty. In this manuscript, if n+m > 6, we call them 'higher'.
R : Done.

3. It may be good to mention explicitly which SC show greater sensitivity to which attribute (unless it is already there, and I missed it).

R : It was mentioned in line 385. "\item The NSC(3,2) observable is sensitive mainly to the initial conditions, while the other observables are sensitive to both the initial conditions and the temperature dependence of η/s.
"

4. I find the section on model comparisons much better now. The statement in lines 436-438 well describe the main conclusion.

The paragraphs beginning line 341 and the one beginning line 370 are too dense. It is good to see the results of model comparisons listed. It may enhance the message in the manuscript to make more definitive statements about these comparisons e.g.
Line 436 and 438 rightly describe the conclusion, but is it possible to make statement(s) like SC(i,j) shows greater sensitivity to XXX feature in the models.
NSC(p,q) shows greater sensitivity to YYY feature in the models.

I also notice that there is no mention of EKRT model comparisons in this list.

R : As it is not described as you are suggesting, however, in addition to line 385, next bullet (line389) is emphatically addressing a quantitive disagreement of NSC(3,2) between the data and the models, implicating possible improvement of initial conditions(IC) in models. Furthermore NSC(4,3) is mentioned as an additional constrain to IC and eta/s because of the discrepancy found between the data and the models in line 387. As for EKRT, like line 385 and 387, if a model is not explicitly mentioned, it comes for all the models used as said in line 379.
We place the general conclusions from all model comparisons first and the lessons from the specific model later in the updated version.

5. Please share the link to the corresponding Analysis Note.

R : The analysis note and presentations can be found in https://twiki.cern.ch/twiki/bin/viewauth/ALICE/PtDependentStandardCandles.
Analysis Note
  ○ Method discription https://aliceinfo.cern.ch/Notes/node/407⬀
  ○ Pt dependent SC https://aliceinfo.cern.ch/Notes/node/495⬀
  ○ SC from QC YZ_SC_AN.pdf

Specifics (editorial and others):

L27: programs --> program
R : Done
L32-33: The sentence "The large ....energies" implicitly conveys that the flow at RHIC and LHC is large, without distinguishing that it is larger at LHC. Also, the statement may be misunderstood that elliptic flow was discovered at RHIC.

Suggestion: 'The elliptic flow at RHIC and LHC energies is observed to be large and demonstrate an increase with the collision energy.'

R : We think the current version is ok.

L45:Anisotropic flow is quantified….." —> It is quantified with nth order flow harmonics but NOT with symmetry plane angles. Symmetry plane angles are USED, but only vn quantify.

R : We think the current version is ok.

L73: (see Regs.[30,31]) —> [30,31]

R : We think the current version is ok.

L74: '……lower order harmonics, v2 and v3, to a good approximation, are linearly proportional….'

R : Done

L82-83: Please correct me if I am wrong. I thought the viscous distribution function WAS the correction to the equilibrium distribution. How is the latter different?
R : Yes, you are right. The previous change was not done correctly. Now i changed ",to the" to ",a"

L87-88: 'The first results for new observables, the Symmetry Cumulants (SC), which quantify the relationship……'
R : We think the current version is ok.

L94: SC observables —> SC (remove observables, since SC already denotes Symmetry Cumulants).
R : We think the current version is ok. It is coherent over the paper.

L99: explained —> detailed
R : We think the current version is ok.

L105: effects —> effect
R : We think the current version is ok.

L120: "...same set of observables..." → '..set of observables...'.
R : Done

L197: Do we understand why SC(5,3) has such large systematic error ?
R : We put the sentence back and it was removed because we thought it would not be interesting to the reader for the last version. "This is because v_{n} decreases with increasing n and becomes more sensitive to azimuthal modulation due to detector imperfections."

L220: But in NSC, we divide by the 'strength of the individual flow harmonics, so why should this be true? What am I missing here?
R : You are right, it meant for the next sentence. We now changed the order of the sentences.

L223-228: What is the significance of "....increase non-linearly...."? Why is this statement relevant here? It may be a good idea to say what is learnt from these observations.
R : It describes what we observe. We think this is ok.

L240-243: I miss the point of comparing the result with a completely different variable. In one case it is correlations between different harmonics, and in the other it is fluctuation of a harmonic.
R : It is very important to point it out that the flow fluctuation shown in the individual flow harmonics has different sensitivity to eta/s than our SC, similarly to pt integrated observables.

L270-273:First part of the sentence says thermalisation is achieved. Second part says it may not happen. While I understand what you want to say, the statement may require rephrasing.
R : We think the current version is ok.

L 280-290: Statement talks about flow of identified hadrons. It will help to mention what is the reference to Appendix A for.
R : Yes, we moved it to the last part of the paragraph to be more clear and no need to add extra reference than the appendix.
L302: This observation......Which observation, and why? We know that anisotropies originate mainly from fluctuations.
R : It refers to the previous sentence, the disagreement between the data and the models.

Appendix:

Precision is used at various places in the text.
Precision is not used in comparing data sets. Precision is used for a particular measurement. If a measurement has small error, then we say that the measurement is 'precise'.
If the measurement agrees with some known/standard value, then we say it is accurate.

Line 684-685:.

 Suggestion:' The model calculations could reproduce the observed centrality dependence to within 5% for v2 and within 10% for v3 and v4'.
R : improved.
L 694: precision? Suggestion: ' ...describe the data better, to within 10-20%'.
R : improved.
L696: 'precision'.....to be rephrased.
R : improved.
L707:'precision'.....to be rephrased, in light of above.
R : improved.