Dear PA's,

This is an important study, but I have strong issues with your analysis and your paper draft. I object to your omission of the nonflow subtraction method via near-side jetlike peak normalization STAR published in Ref.[19]. I thought you agreed that this will be one of the systematic uncertainties of nonflow subtraction. Since there're strong multiplicity biases in those small-system collisions, it is important to show the $\Delta\eta$ correlations similar to those in Fig.1 of Ref.[19], and I strongly encourage you to include those in the paper.

Your c_0-subtraction method, assuming nonflow in high multiplicity (HM) pAu/dAu/He3Au to be identical to that in MB pp, is really a simple/naive one because of multiplicity biases. The near-side jetlike normalization is a step forward to consider this effect.

Your c_1-subtraction and template fit methods are really identical except a multiplicative factor. From the template method Eqs.3,4, you have:

$$c_0 = Fc_0^{pp} + G$$

$$c_0 c_1 = Fc_0^{pp} c_1^{pp}$$

$$c_0 c_n = Fc_0^{pp} c_n^{pp} + Gc_n^{sub} \quad (\text{for } n = 2,3,4)$$

From these eqns, one can easily get:

$$c_n^{sub}\{\text{template}\} = \frac{c_0}{G}\left(c_n - f \times c_n^{pp}\right) = \frac{c_0}{G} c_n^{sub}\{c_1\text{-norm.}\}, \text{ or equivalently,}$$

$$c_n^{sub}\{\text{template}\} = \frac{c_n - f \times c_n^{pp}}{1-f} = \frac{1}{1-f} c_n^{sub}\{c_1\text{-norm.}\}$$

where $f = c_1 / c_1^{pp}$ is the scaling factor in the c_1-normalization method. The difference is really what baseline you take, c_0 from the HM events or $G = c_0 - Fc_0^{pp} = (1-f)c_0$ after subtracting the scaled MB pp baseline. Your Fig.2 indeed shows that $c_n^{sub}\{\text{template}\}$ is always larger than $c_n^{sub}\{c_1\text{-norm.}\}$ by some factor. So they should not really be called two different methods. I would simply choose one of them (probably the template one) and say the other one is equivalent except a multiplicative factor.

A small comment here: I wouldn't use c_0 in the Fourier expansion function, but something else like Y (yield) or A (amplitude). This is because c_0 and c_n as written mean really different things, and thus can be confusing. If you use c_0, then the Fourier function should be really written as $c_0 + \sum_{n=1}^{4} 2c_n \cos(n\Delta\phi)$, which I don't recommend as you will have to make many changes to the subsequent formulas.

The description on L69-85 about MB, HM, and centrality definition (by multiplicity) is important, as multiplicity biases are significant in these small-system collisions as I said above. This is because in these small systems, as you well know, by requiring high multiplicity you're biasing the underlying physics processes in these events towards, e.g., larger jet contributions. The paper uses top 10% centrality from MB dAu and He3Au data, and pAu data from HM trigger with a threshold cut. The multiplicity distributions are probably quite different. It is important to include a figure in the paper showing multiplicity distributions of MB pp/pAu/dAu/He3Au and HM pAu data.

You say:

L74: For p+Au collisions, in order to select a data sample with the similar mean number of tracks to that of the 0%− 10% central d+Au and make a straight-forward comparison of the $v_{2;3}$ value, we use HM trigger p+Au data set with a threshold cut applied to the raw multiplicity.

I don't think similar multiplicity between pAu and dAu is necessarily a straightforward comparison because again there are strong correlations between the multiplicity and the underlying physics processes in these small systems, so the same multiplicity in these two systems could mean quite different things in terms of the underlying events.

L79: The uncertainties for non-ow subtraction will be much smaller in this selected p+Au sample by comparing with 0%-10% MB p+Au due to a factor of two larger mean number of tracks.

I'm not sure the nonflow uncertainty will be necessarily much smaller, as those high multiplicity pAu events are biased towards larger jet contributions.

L106: The observed patterns in the correlation functions for p/d/^{3}He+Au collisions (shown in Fig. 1) suggests a sizable inuence from ow, as well as non-ow correlations that will be removed with subtraction methods. By contrast, the observed correlator for p+p indicates a dominating role for the non-ow correlations, suggesting that it can be leveraged to give quantitative estimates of the non-ow contributions to the correlators for p/d/^{3}He+Au collisions.

I agree that the distributions are different, but I don't see how you can directly jump to the conclusion that there's a sizable influence from flow as well as nonflow correlations. If you just simply get Fourier coefficients, then they're probably all similar (independent of multiplicity), except c1; see STAR's publication Physics Letters B 747 (2015) 265–271.

L118: We assume that the non-ow contributions to p/d/^{3}He+Au is a superposition of several proton-proton collisions.

You need to add 'MB' before "proton-proton collisions".

L127-133: the description is quite cumbersome. Why do you use Trig. and Assoc. at all? Since they are from the same phase space, I would simply say pair correlations normalized by single particles, and then vn is just the square-root of cn.

Best regards,
Fuqiang