On description of the correlation between multiplicities in windows separated in azimuth and rapidity

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Outline

- ♢ Connection of the forward-backward (FB) correlation coefficient b with two-particle correlation function C_2
- ♢ Triggered and untriggered di-hadron correlations
- ♢ Model with strings as independent identical emitters
- ♢ Taking into account the string fusion and the FSI (final state interactions)
- ♢ Connection between the ridge and the flows

Connection of the FB correlation coefficient with two-particle correlation function - 1

By definition the two-particle correlation function C_2 is defined through the inclusive ρ_1 and double inclusive ρ_2 distributions:

$$C_2(\eta_F,\phi_F;\eta_B,\phi_B) = \frac{\rho_2(\eta_F,\phi_F;\eta_B,\phi_B)}{\rho_1(\eta_F,\phi_F)\rho_1(\eta_B,\phi_B)} - 1 \qquad (1)$$

$$\rho_1(\eta,\phi) = \frac{d^2N}{d\eta\, d\phi}\ , \qquad \rho_2(\eta_F,\phi_F;\eta_B,\phi_B) = \frac{d^4N}{d\eta_F\, d\phi_F\, d\eta_B\, d\phi_B} \qquad (2)$$

To measure the ρ_1 one has by definition to take a small window $\delta\eta\,\delta\phi$ around η, ϕ, then

$$\rho_1(\eta,\phi) \equiv \frac{\langle n \rangle}{\delta\eta\,\delta\phi}\ , \qquad (3)$$

here $\langle n \rangle$ is the mean multiplicity in the acceptance $\delta\eta\,\delta\phi$.
One has to reduce the acceptance until the ratio (3) becomes constant.

Connection of the FB correlation coefficient with two-particle correlation function - 2

To measure the ρ_2 one has by definition to take TWO small windows: $\delta\eta_F\,\delta\phi_F$ around η_F, ϕ_F and $\delta\eta_B\,\delta\phi_B$ around η_B, ϕ_B, then

$$\rho_2(\eta_F,\phi_F;\eta_B,\phi_B) \equiv \frac{\langle n_F n_B \rangle}{\delta\eta_F\,\delta\phi_F\,\delta\eta_B\,\delta\phi_B} \;. \qquad (4)$$

One has to reduce the acceptances of the observation windows until the ratio (4) becomes constant.
So by (3) and (4) the definition (1) means the following experimental procedure of the determination of the correlation function C_2:

$$C_2(\eta_F,\phi_F;\eta_B,\phi_B) \equiv \frac{\langle n_F n_B \rangle - \langle n_F \rangle \langle n_B \rangle}{\langle n_F \rangle \langle n_B \rangle} \;, \qquad (5)$$

where n_F and n_B are the event multiplicities in TWO small windows: $\delta\eta_F\,\delta\phi_F$ around η_F, ϕ_F and $\delta\eta_B\,\delta\phi_B$ around η_B, ϕ_B.

Connection of the FB correlation coefficient with two-particle correlation function - 3

Traditionally one uses the following definition of the FB correlation coefficient:

$$b_{abs} \equiv \frac{\langle n_F n_B \rangle - \langle n_F \rangle \langle n_B \rangle}{\langle {n_F}^2 \rangle - \langle n_F \rangle^2} \qquad \text{or} \qquad b_{rel} \equiv \frac{\langle n_F \rangle}{\langle n_B \rangle} b_{abs} \tag{6}$$

For small FB windows by (5) we have

$$b_{abs} = \frac{\langle n_F \rangle \langle n_B \rangle}{D_{n_F}} C_2(\eta_F, \phi_F; \eta_B, \phi_B) \;, \qquad b_{rel} = \frac{\langle n_F \rangle^2}{D_{n_F}} C_2(\eta_F, \phi_F; \eta_B, \phi_B) \tag{7}$$

Note that for small forward window: $D_{n_F} \to \langle n_F \rangle$.
So by (7) we see that the traditional definition of the FB correlation coefficient in the case of TWO small observation windows coincides with the standard definition of two-particle correlation function C_2 upto some common factor $\langle n_B \rangle$ or $\langle n_F \rangle$, which depends on the width of windows.

Connection of the FB correlation coefficient with two-particle correlation function - 4

Note that one can go in C_2 to the variables:

$$\Delta\eta = \eta_F - \eta_B \ , \qquad \eta_C = (\eta_F + \eta_B)/2 \tag{8}$$

$$\Delta\phi = \phi_F - \phi_B \ , \qquad \phi_C = (\phi_F + \phi_B)/2 \tag{9}$$

and EXPERIMENTALLY check up the dependence of the two-particle correlation function C_2 on η_C for the different configurations and separations between FB observation windows.
Summing up, we see that by the standard definition (1) the experimental determination of the two-particle correlation function $C_2(\eta_F, \phi_F; \eta_B, \phi_B)$ requires (5) the measurements of the event multiplicities n_F and n_B in TWO SMALL windows: $\delta\eta_F\,\delta\phi_F$ around η_F, ϕ_F, and $\delta\eta_B\,\delta\phi_B$ around η_B, ϕ_B, which is performed in our approach.

Triggered and untriggered di-hadron correlations - 1

Untriggered di-hadron correlation function

$$C(\Delta\eta, \Delta\phi) \equiv S/B - 1 \tag{10}$$

takes into account all possible pair combinations of particles produced in given event in some ONE LARGE pseudorapidity window $\Delta\eta \in (-Y, Y)$, where

$$S = \frac{d^2 N}{d\Delta\eta \, d\Delta\phi} \tag{11}$$

and the B is the same but in the case of uncorrelated particle production. Experimentalists obtain the B by the event mixing procedure.
Note that (10) has only indirect connection with the standard definition (1) of the two-particle correlation function $C_2(\eta_F, \phi_F; \eta_B, \phi_B)$.
It's easy to show, that

$$C_2(\eta_F, \phi_F; \eta_B, \phi_B) = C(\Delta\eta, \Delta\phi) \tag{12}$$

only in the case when the pseudorapidity translation invariance (the independence C_2 on η_C) takes place.

Triggered and untriggered di-hadron correlations - 2

Note also that even in the presence of the translation invariance the details of the event mixing procedure can lead to the loss in $C(\Delta\eta, \Delta\phi)$ the common "pedestal", which takes place in $C_2(\Delta\eta, \Delta\phi)$
(see arXiv:1305.0857 for details).
Important that the experimental procedure (5):

$$C_2(\eta_F, \phi_F; \eta_B, \phi_B) \equiv \frac{\langle n_F n_B \rangle - \langle n_F \rangle \langle n_B \rangle}{\langle n_F \rangle \langle n_B \rangle} = \left\langle \frac{n_F}{\langle n_F \rangle} \frac{n_B}{\langle n_B \rangle} \right\rangle - 1 \; , \qquad (13)$$

based on the event-by-event multiplicity observations in TWO small windows $\delta\eta_F\, \delta\phi_F$ around η_F, ϕ_F, and $\delta\eta_B\, \delta\phi_B$ around η_B, ϕ_B, which is performed in our approach in correspondence with the standard definition (1) of the two-particle correlation function C_2 enables in any case to determine the correlation function C_2 without using of the event mixing procedure.

Triggered and untriggered di-hadron correlations - 3

Triggered di-hadron correlation:

$$C(\Delta\eta, \Delta\phi) \equiv S/B - 1 \tag{14}$$

where

$$S = \frac{d^2N}{d\Delta\eta \, d\Delta\phi} \tag{15}$$

and the B is the same but in the case of uncorrelated particle production. It takes into account all possible pair combinations of particles produced in given event in some ONE LARGE pseudorapidity window $\Delta\eta \in (-Y, Y)$, with some additional conditions on the momenta of these particles. Usually they take the momentum of one (trigger) particle belonging to some higher momentum interval than the momentum of its pair.

Triggered and untriggered di-hadron correlations - 4

Clear that this modification can be implemented in our approach based on the event-by-event n_F and n_B multiplicity observations in TWO small windows $\delta\eta_F\,\delta\phi_F$ and $\delta\eta_B\,\delta\phi_B$ by taking into account only the particles belonging to corresponding momentum intervals δp_F and δp_B.

Note that with small momentum intervals δp_F and δp_B we simply go to the distributions:

$$\rho_1(\eta,\phi,p) = \frac{d^3N}{d\eta\,d\phi\,dp} = \frac{\langle n\rangle}{\delta\eta\,\delta\phi\,\delta p} \tag{16}$$

and

$$\rho_2(\eta_F,\phi_F,p_F;\eta_B,\phi_B,p_B) = \frac{d^6N}{d\eta_F\,d\phi_F\,dp_B\;d\eta_B\,d\phi_B\,dp_B} = \frac{\langle n_F n_B\rangle}{\dots} \tag{17}$$

Model with strings as independent identical emitters - 1

$$\rho_1^N(\eta) = N\lambda_1(\eta) \ , \tag{18}$$

$$\rho_2^N(\eta_F,\eta_B;\Delta\varphi) = N\lambda_2(\eta_F,\eta_B;\Delta\varphi) + N(N-1)\lambda_1(\eta_F)\lambda_1(\eta_B) \ . \tag{19}$$

Then after averaging over N the one- and two-particle densities of charge particles are given by

$$\rho_1(\eta) = \langle N\rangle\lambda_1(\eta) \ , \tag{20}$$

$$\rho_2(\eta_F,\eta_B;\Delta\varphi) = \langle N\rangle[\lambda_2(\eta_F,\eta_B;\Delta\varphi) - \lambda_1(\eta_F)\lambda_1(\eta_B)] + \langle N^2\rangle\lambda_1(\eta_F)\lambda_1(\eta_B) \tag{21}$$

and

$$\rho_2(\eta_F,\eta_B;\Delta\varphi) - \rho_1(\eta_F)\rho_1(\eta_B) = \tag{22}$$

$$= \langle N\rangle[(\lambda_2(\eta_F,\eta_B;\Delta\varphi) - \lambda_1(\eta_F)\lambda_1(\eta_B)] + D_N\lambda_1(\eta_F)\lambda_1(\eta_B) \ ,$$

where D_N is the event-by-event variance $D_N = \langle N^2\rangle - \langle N\rangle^2$ of the number of emitters.

Model with strings as independent identical emitters - 2

Then we find

$$C_2(\eta_F, \eta_B; \Delta\varphi) = \frac{\Lambda(\eta_F,\eta_B;\Delta\varphi)+\omega_N}{\langle N\rangle} ,$$

where ω_N is the event-by-event scaled variance $\omega_N = D_N/\langle N\rangle$ of the number of emitters and

$$\Lambda(\eta_F, \eta_B; \varphi_F - \varphi_B) = \frac{\lambda_2(\eta_F, \eta_B; \varphi_F - \varphi_B)}{\lambda_1(\eta_F)\lambda_1(\eta_B)} - 1 \qquad (23)$$

is the two-particle correlation function for charged particles produced from a decay of a single string.

Model with strings as independent identical emitters - 3

In the central rapidity region, where each string contributes to the particle production in the whole rapidity region, one has the translation invariance in rapidity

$$\lambda_1(\eta) = \mu_0 = const \ , \qquad \Lambda(\eta_F, \eta_B; \Delta\varphi) = \Lambda(\eta_F - \eta_B; \Delta\varphi) \ , \tag{24}$$

then

$$\rho_1(\eta) = \langle N \rangle \mu_0 = const \ , \tag{25}$$

$$C_2(\Delta\eta, \Delta\phi) = \frac{\Lambda(\Delta\eta, \Delta\phi) + \omega_N}{\langle N \rangle} \ . \tag{26}$$

Recall that $\Delta\eta$ and $\Delta\varphi$ are the distances between the centers of forward and backward windows in rapidity and azimuth.

So we see that this common "pedestal" in $C_2(\Delta\eta, \Delta\phi)$ is physically important. By (26) we see that from the height of the "pedestal" ($\omega_N/\langle N \rangle$) one can obtain the important physical information on the magnitude of the fluctuation of the number of emitters N at different energies and centrality fixation.

Taking into account the string fusion and the FSI - 1

local fusion (overlaps)

M.A. Braun, C. Pajares Eur.Phys.J. **C16**, 349, (2000)

$$\langle n \rangle_k = \mu_0 \sqrt{k}\; S_k/\sigma_0 \;, \qquad \langle p_t^2 \rangle_k = p_0^2 \sqrt{k} \;, \qquad k = 1, 2, 3, ... \qquad (27)$$

global fusion (clusters)

M.A. Braun, F. del Moral, C. Pajares, Phys.Rev. **C65**, 024907, (2002)

$$\langle p_t^2 \rangle_{cl} = p_0^2 \sqrt{k_{cl}} \;, \qquad \langle n \rangle_{cl} = \mu_0 \sqrt{k_{cl}} S_{cl}/\sigma_0 \;, \qquad k_{cl} = k\sigma_0/S_{cl} \quad (28)$$

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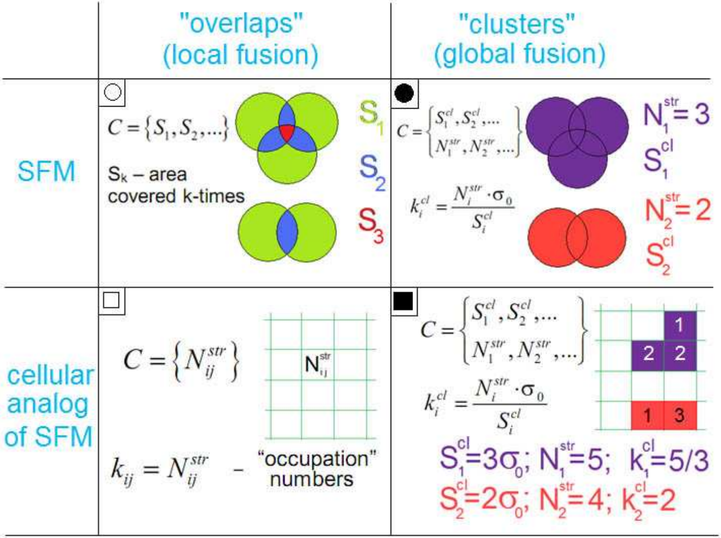
the cellurar version of SFM

Vechernin V.V., Kolevatov R.S., hep-ph/0304295; hep-ph/0305136

Braun M.A., Kolevatov R.S., Pajares C., Vechernin V.V. Eur.Phys.J. C32 (2004) 535.

Taking into account the string fusion and the FSI - 2



Taking into account the string fusion and the FSI - 3

As discussed, in the central rapidity region di-hadron correlation function:

$$C(\Delta\eta, \Delta\varphi) = C_2(\Delta\eta, \Delta\varphi) \equiv \frac{\rho_2(\Delta\eta, \Delta\varphi)}{\rho_1^2} - 1 \quad (29)$$

Consider very simple model, in which we will not take into account the two-particle correlation between particles originating from the decay of a same string ($\Lambda(\Delta\eta, \Delta\phi) = 0$).

Then for a given string configuration $i = 1, ..., K$ (a given event) , we can assume

$$\rho_2^i(\varphi_1, \varphi_2) = \rho_1^i(\varphi_1)\rho_1^i(\varphi_2) \ , \quad (30)$$

where $\rho_1^i(\varphi)$ is an inclusive distribution of charged particles produced by the given string configuration i with taking into account the string fusion and the FSI:

$$\rho_1^i(\varphi) \equiv \rho_0^i[1+2\sum_{n=1}^{\infty}(a_n^i \cos n\varphi + b_n^i \sin n\varphi)] = \rho_0^i[1+2\sum_{n=1}^{\infty} v_n^i \cos n(\varphi - \psi_n^i)] \ . \quad (31)$$

Taking into account the string fusion and the FSI - 4

Here

$$\rho_0^i = \frac{1}{2\pi} \int \rho_1^i(\varphi) d\varphi \ , \tag{32}$$

$$a_n^i = \frac{1}{2\pi\rho_0^i} \int \rho_1^i(\varphi) \cos n\varphi \, d\varphi \ , \tag{33}$$

$$b_n^i = \frac{1}{2\pi\rho_0^i} \int \rho_1^i(\varphi) \sin n\varphi \, d\varphi \ , \tag{34}$$

$$v_n^i = \sqrt{a_n^{i2} + b_n^{i2}} \ , \qquad \mathrm{tg}\, n\psi_n^i = b_n^i / a_n^i \ . \tag{35}$$

Then the flows are given by

$$v_n = \frac{1}{K} \sum_{i=1}^{K} v_n^i = \frac{1}{K} \sum_{i=1}^{K} \sqrt{a_n^{i2} + b_n^{i2}} \ . \tag{36}$$

Connection between the ridge and the flows - 1

In this approximation we have for the di-hadron correlation function:

$$C(\Delta\varphi) = C_2(\varphi_1 - \varphi_2) \equiv \frac{\rho_2(\varphi_1 - \varphi_2)}{\rho_1^2} - 1 \ , \tag{37}$$

where

$$\rho_1 = \frac{1}{K}\sum_{i=1}^{K} \rho_1^i(\varphi + \widetilde{\varphi}^i) \ , \tag{38}$$

$$\rho_2(\varphi_1 - \varphi_2) = \frac{1}{K}\sum_{i=1}^{K} \rho_1^i(\varphi_1 + \widetilde{\varphi}^i)\rho_1^i(\varphi_2 + \widetilde{\varphi}^i) \tag{39}$$

and $\rho_1^i(\varphi)$ is given by (31). Here $\widetilde{\varphi}^i$ is an additional common RANDOM phase, which arises due to the event-by-event fluctuation of the reaction plane.

Connection between the ridge and the flows - 2

Averaging over events with this additional common random phase $\widetilde{\varphi}^i$ gives (we add an additional averaging over this phase also for each string configuration, which corresponds to the rotation of a given string configuration):

$$\rho_1 = \frac{1}{K}\sum_{i=1}^{K}\frac{1}{2\pi}\int_0^{2\pi}\rho^i(\varphi+\widetilde{\varphi}^i)\;d\widetilde{\varphi}^i = \frac{1}{K}\sum_{i=1}^{K}\rho_0^i \equiv \langle\rho_0^i\rangle\;. \qquad (40)$$

Recall that

$$\rho_0^i = \frac{1}{2\pi}\int\rho_1^i(\varphi)d\varphi\;. \qquad (41)$$

The ρ_1 is the mean multiplicity density.

$$\rho_2(\varphi_1-\varphi_2) = \langle(\rho_0^i)^2\rangle + 2\sum_{n=1}^{\infty}\langle(\rho_0^i v_n^i)^2\rangle\cos(n\Delta\varphi)\;. \qquad (42)$$

Connection between the ridge and the flows - 3

Then

$$C(\Delta\varphi) = \frac{2}{\langle\rho_0^i\rangle^2}\sum_{n=1}^{\infty}\langle(\rho_0^i v_n^i)^2\rangle\cos(n\Delta\varphi) + C = 2\sum_{n=1}^{\infty}\langle(\frac{\rho_0^i}{\langle\rho_0^i\rangle}v_n^i)^2\rangle\cos(n\Delta\varphi) + C \tag{43}$$

where

$$C = \frac{\langle(\rho_0^i)^2\rangle - \langle\rho_0^i\rangle^2}{\langle\rho_0^i\rangle^2} \ . \tag{44}$$

Usually experimentalists can't measure the constant C (see, V.V. arxiv:1305.0857). Recall that

$$(\rho_0^i v_n^i)^2 = (\rho_0^i)^2[(a_n^i)^2 + (b_n^i)^2] = \tag{45}$$

$$= \left[\frac{1}{2\pi}\int \rho^i(\varphi)\cos n\varphi\, d\varphi\right]^2 + \left[\frac{1}{2\pi}\int \rho^i(\varphi)\sin n\varphi\, d\varphi\right]^2 \ ,$$

Connection between the ridge and the flows - 4

Further rude evaluation of (43) is possible only if we will consider that ρ_0^i weakly depends on i:

$$\rho_0^i \approx \langle \rho_0^i \rangle = \frac{1}{K} \sum_{i=1}^{K} \rho_0^i = const \ . \tag{46}$$

Then

$$C(\Delta\varphi) = 2 \sum_{n=1}^{\infty} \langle (v_n^i)^2 \rangle \cos(n\Delta\varphi) \ , \tag{47}$$

at that $C = 0$.

We see that even in this simple model (without initial internal correlations) the final state interactions (FSI) lead through the direct flow ($n = 1$) to the formation of the ridge phenomenon in resulting correlation function.

Connection between the ridge and the flows - 5

Note that even in the last very rude approximation (47) the $C(\Delta\varphi)$ is expressed not through the flows:

$$v_n = \langle v_n^i \rangle = \frac{1}{K} \sum_{i=1}^{K} v_n^i = \frac{1}{K} \sum_{i=1}^{K} \sqrt{a_n^{i2} + b_n^{i2}} \ , \tag{48}$$

but rather through the "mean squared flows"(v_n^{ms}):

$$v_n^{ms} \equiv \sqrt{\langle (v_n^i)^2 \rangle} = \sqrt{\frac{1}{K} \sum_{i=1}^{K} (v_n^i)^2} = \sqrt{\frac{1}{K} \sum_{i=1}^{K} (a_n^{i2} + b_n^{i2})} \ . \tag{49}$$

Using this notation we have in the rude approximation

$$C(\Delta\varphi) = 2 \sum_{n=1}^{\infty} (v_n^{ms})^2 \cos(n\Delta\varphi) \ . \tag{50}$$

Backup slides

Backup slides

Connection between two-particle and di-hadron correlations1

The di-hadron correlation function

$$C(\Delta y, \Delta\phi) \equiv S/B - 1 \tag{51}$$

takes into account all possible pair combinations of particles produced in given event in some ONE LARGE pseudorapidity window $\Delta y \in (-Y, Y)$, where

$$S = \frac{d^2 N}{d\Delta y \, d\Delta\phi} \tag{52}$$

and the B is the same but in the case of uncorrelated particle production. Experimentalists obtain the B by the event mixing procedure.
We can express the enumerator of (51) through the two-particle correlation function:

$$S(\Delta y, \Delta\varphi) = \int_{-Y/2}^{Y/2} dy_1 dy_2 \, \rho_2(y_1, y_2; \, \Delta\varphi) \, \delta(y_1 - y_2 - \Delta y) \tag{53}$$

Connection between two-particle and di-hadron correlations2

In the central rapidity region, when the translation invariance takes place within the whole rapidity interval $(-Y/2, Y/2)$, we have

$$\rho_2(y_1, y_2;\, \Delta\varphi) = \rho_2(y_1 - y_2;\, \Delta\varphi)$$

and one can fulfill the integration in (53):

$$S(\Delta y, \Delta\varphi) = \rho_2(\Delta y; \Delta\varphi)\, t_Y(\Delta y) \tag{54}$$

where the $t_Y(\Delta y)$ is a "triangular"weight function

$$t_{\delta y}(y) = [\theta(-y)(\delta y + y) + \theta(y)(\delta y - y)]\, \theta(\delta y - |y|)\ . \tag{55}$$

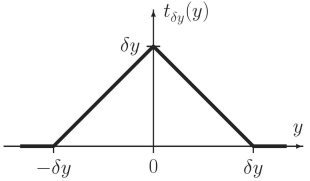


Рис.: The "triangular"weight function arising due to phase space .

Connection between two-particle and di-hadron correlations3

In the denominator of (51) we should replace the $\rho_2(y_1, y_2; \Delta\varphi)$ by the product $\rho_1(y_1)\rho_1(y_2)$, which due to the translation invariance in rapidity reduces simply to ρ_0^2. Then

$$B(\Delta y, \Delta\varphi) = \rho_0^2 \; t_Y(\Delta y) \; . \tag{56}$$

Substituting into (51) we get

$$C(\Delta y, \Delta\varphi) = \frac{\rho_2(\Delta y; \Delta\varphi)}{\rho_0^2} - 1 = C_2(\Delta y, \Delta\varphi) \; , \tag{57}$$

We see that if the translation invariance in rapidity takes place within the whole interval $(-Y/2, Y/2)$, then the definition (51) for the di-hadron correlation function C leads to the standard two-particle correlation function C_2 (1) (see meanwhile the remark below).

Comments on the event mixing - 1

In the framework of the model with strings as independent identical emitters we have for the enumerator and the denominator of (51):

$$S(\Delta y,\Delta\varphi)=\rho_2(\Delta y;\Delta\varphi)\,t_Y(\Delta y)==\langle\rho_2^N(\Delta y;\Delta\varphi)\rangle\,t_Y(\Delta y)= \tag{58}$$

$$=[\langle N\rangle\Lambda(\Delta y,\Delta\varphi)+\langle N^2\rangle]\mu_0^2\,t_Y(\Delta y)\ ,$$

$$B(\Delta y,\Delta\varphi)=\int_{-Y/2}^{Y/2}dy_1dy_2\,\rho_1(y_1)\rho_1(y_2)\,\delta(y_1-y_2-\Delta y)=$$

$$=\int_{-Y/2}^{Y/2}dy_1dy_2\,\langle\rho_1^N(y_1)\rangle\langle\rho_1^N(y_2)\rangle\,\delta(y_1-y_2-\Delta y)=$$

$$=\rho_0^2\ t_Y(\Delta y)=\langle N\rangle^2\mu_0^2\ t_Y(\Delta y)\ , \tag{59}$$

we have noted that $\lambda_1(y)=\mu_0$. Then by $C=S/B-1$ we get

$$C(\Delta y,\Delta\varphi)=\frac{\omega_N+\Lambda(\Delta y,\Delta\varphi)}{\langle N\rangle}=C_2(\Delta y,\Delta\varphi)\ , \tag{60}$$

Comments on the event mixing - 2

But if instead of (59) one has

$$B(\Delta y, \Delta\varphi) = \int_{-Y/2}^{Y/2} dy_1 dy_2 \, \langle \rho_1^N(y_1)\rho_1^N(y_2)\rangle \, \delta(y_1 - y_2 - \Delta y) = \langle N^2 \rangle \mu_0^2 \, t_Y(\Delta y)$$

as it sometimes takes place in a di-hadron data analysis (or if some other artificial normalization conditions for the $B(\Delta y, \Delta\varphi)$ are being used), then instead of (60) by $C = S/B - 1$ we get

$$C(\Delta y, \Delta\varphi) = \frac{\langle N \rangle}{\langle N^2 \rangle} \Lambda(\Delta y, \Delta\varphi) \,, \tag{61}$$

which does not correspond to the standard two-particle correlation function $C_2(\Delta y, \Delta\varphi)$, defined by (1). Compare (61) with (60) we see that in this case the resulting $C(\Delta y, \Delta\varphi)$ does not have an additional contribution reflecting the event-by-event fluctuation in the number of emitters. It depends only on the pair correlation function of a single string $\Lambda(\Delta y, \Delta\varphi)$ and, therefore, is equal to zero in the absence of the pair correlation from one string.