Event-plane dependent away-side jet-like correlation shape in AuAu collisions at $\sqrt{s_{NN}} = 200$ GeV from STAR

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Outline

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- Methodology
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  - Flow background subtraction
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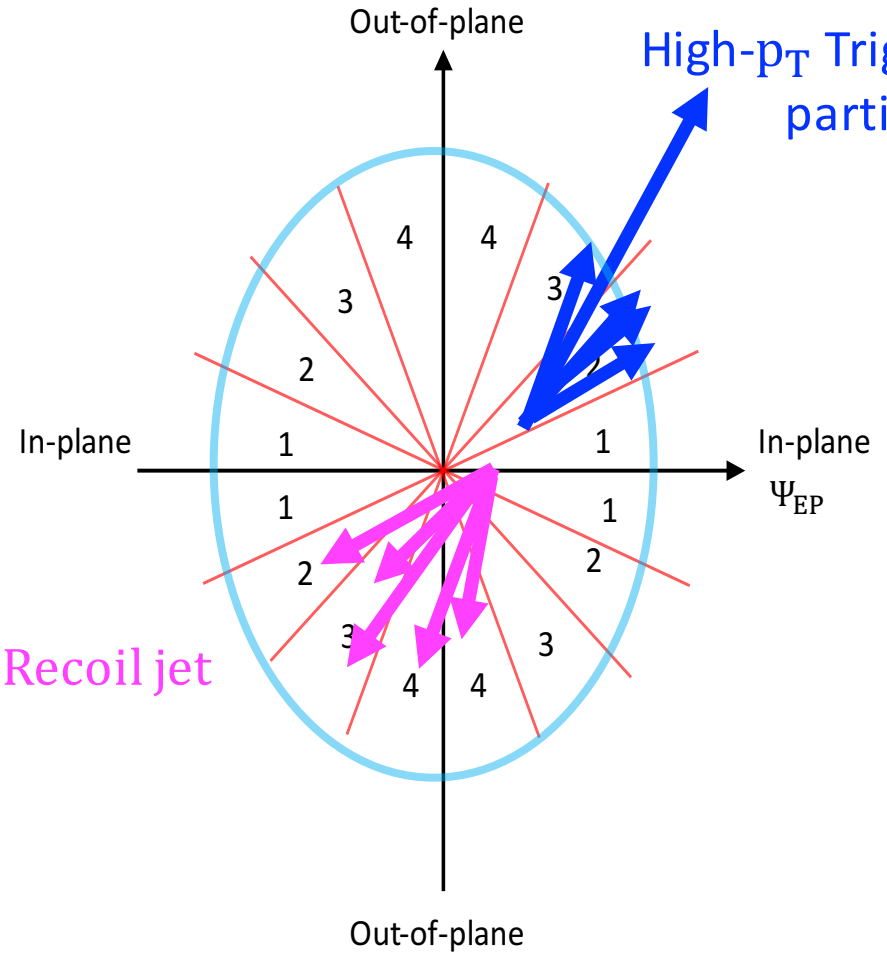
Motivation

- Jets are modified in relativistic heavy-ion collisions due to jet-medium interactions.
- In-medium path length that recoil (away-side) parton traverses is expected to depend on its emission angle w.r.t. the event-plane in non-central Au+Au collisons.

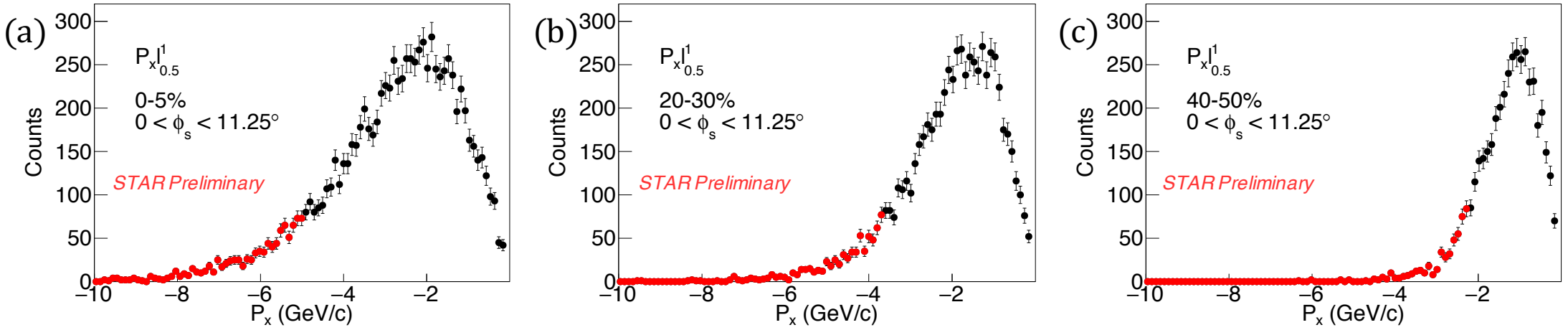


Jets selection

P_x: Recoil transverse momentum (projection of away-side p_T onto trigger axis).

$$P_x\ I_{\eta_1}^{\eta_2} = \sum_{\eta_1<\eta<\eta_2, |\phi-\phi_{trig}|>\frac{\pi}{2}} p_T \cos(\phi - \phi_{trig}) \frac{1}{\epsilon}$$

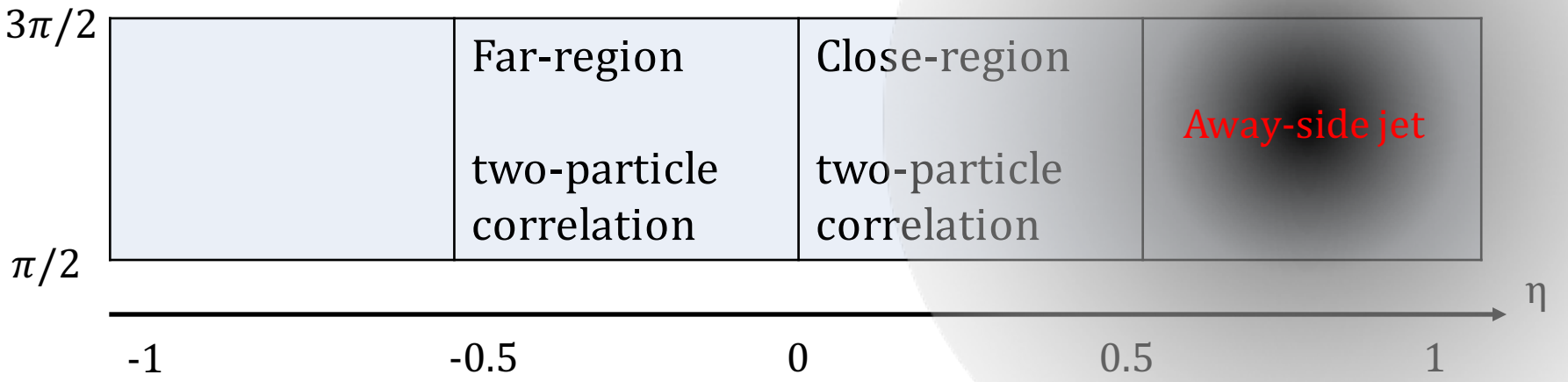
ϵ: single-particle acceptance efficiency.



For each centrality, cut on the left tail of the distribution (10% of events) to enhance the away-side jet population.

Flow background subtraction

- Two-particle correlation



Select events with a large P_x in a given η window from a high-p_T trigger particle to enhance away-side jet population.

Analyze two-particle correlation in close-region and far-region respectively.

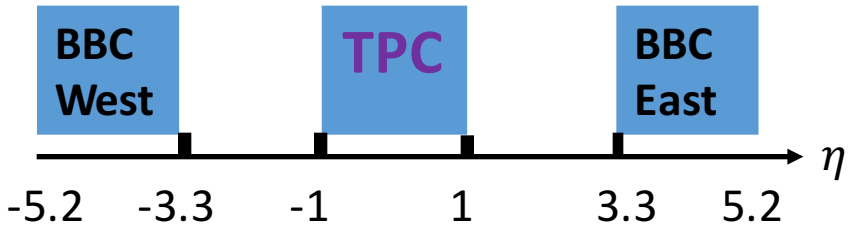
Flow contributions to close region and far region are equal.

Close-region 2p corr.=flow + near-side jet + away-side jet * fraction_close

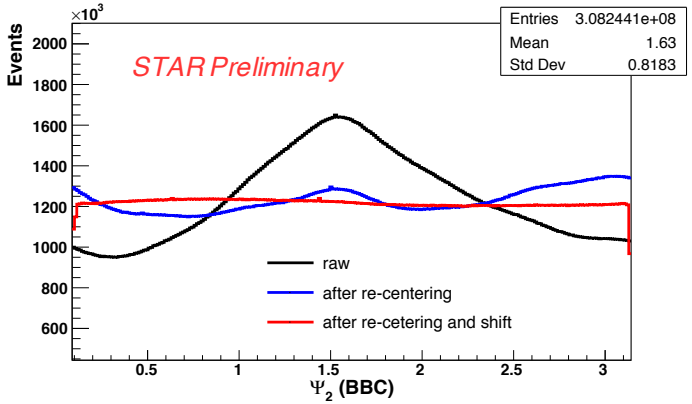
Far-region 2p corr. =flow + near-side jet + away-side jet * fraction_far

BBC event-plane Ψ_2 determination

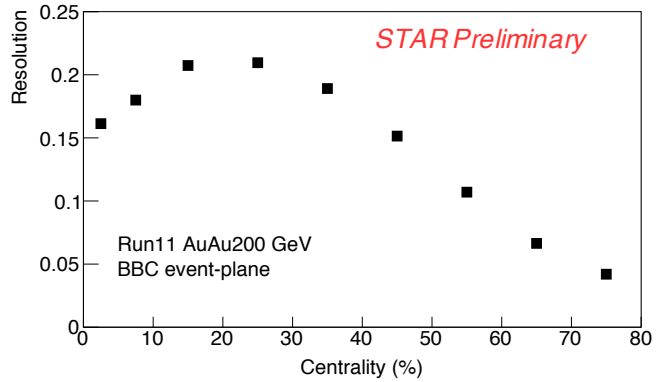
(a)



(b)



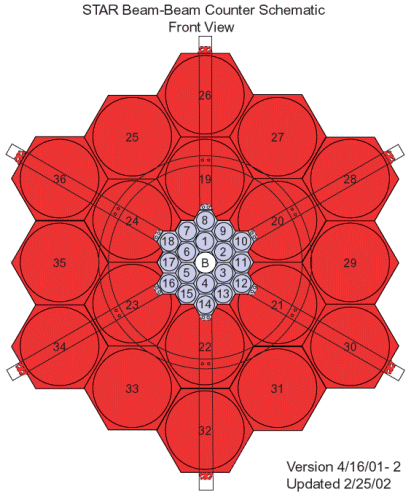
(c)



A large η gap between BBCs and mid-rapidity region.

The correlation between trigger particles and BBC Ψ_2 can be eliminated effectively.

(d)



$$Q_{2x} = \sum_i w_i \cos(2\phi_i),\ Q_{2y} = \sum_i w_i \sin(2\phi_i),$$

Here w_i calculated from ADC signals, where

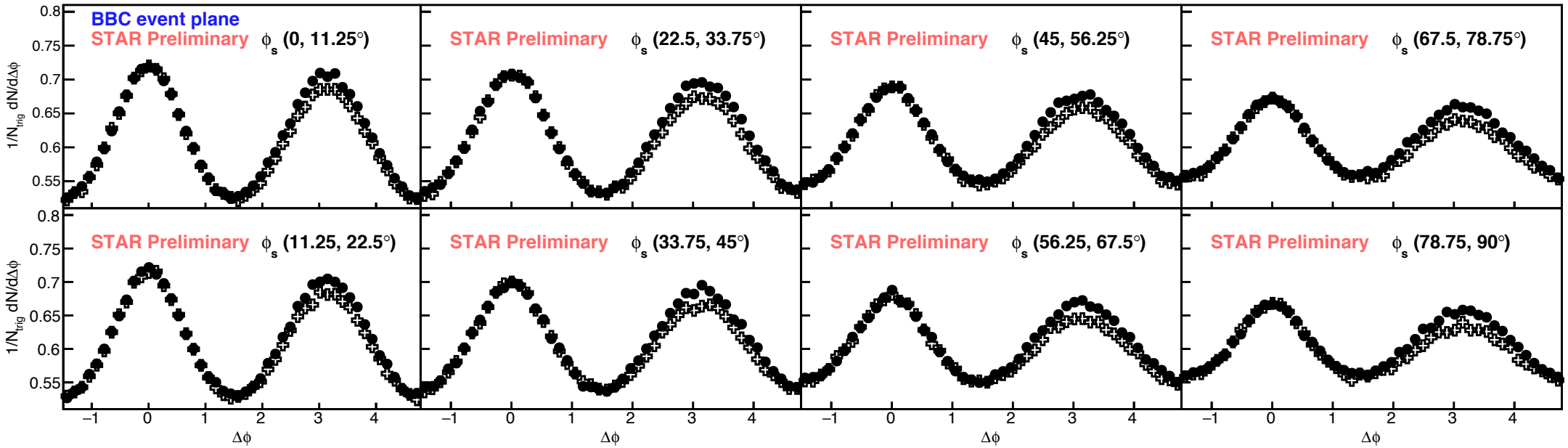
$$w_i = \frac{A_i}{\sum A_i}.$$

$$\Psi_2 = (\tan^{-1}\frac{Q_{2y}}{Q_{2x}})/2.$$

Raw results

Run11 AuAu 20-60%, $3 < p_T^{trig} < 10$ GeV/c, $1 < p_T^{assoc} < 2$ GeV/c

● Close-region
○ Far-region

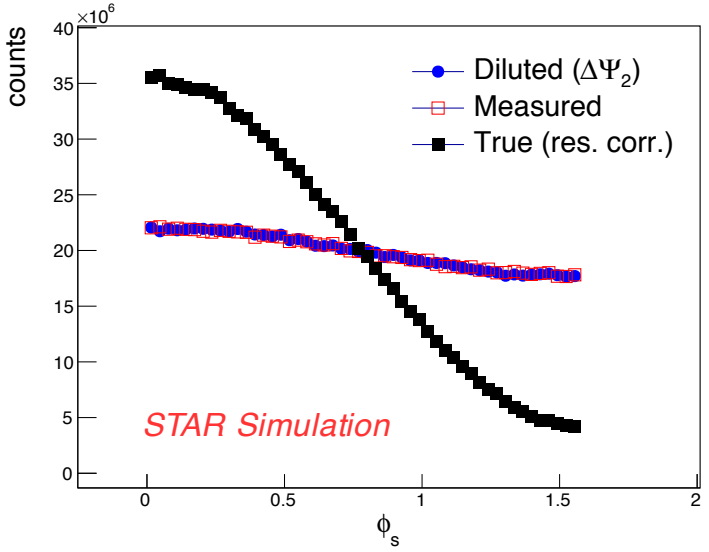


Different panels give the two-particle jet-like correlation with trigger particles in different ϕ_s regions. We couldn't see a clear difference in correlation shape due to the poor resolution of Ψ_2^{BBC}.

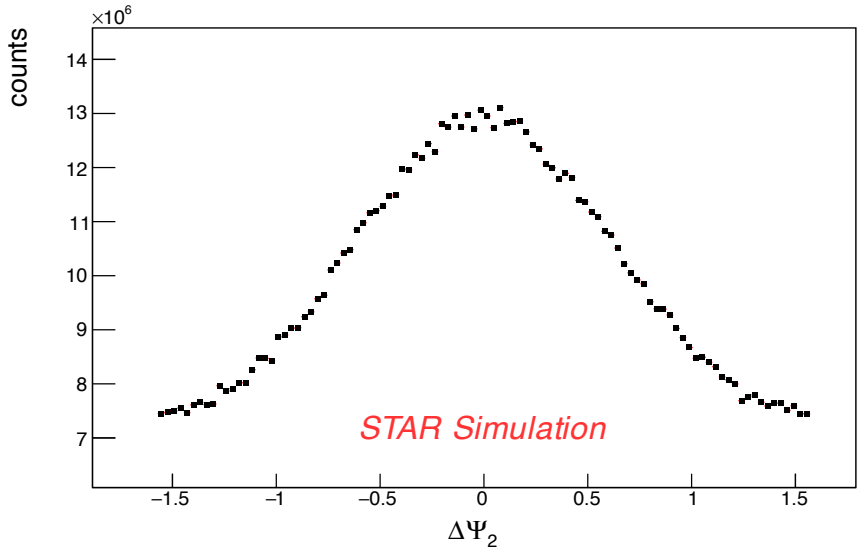
Can we obtain the true correlation in different ϕ_s regions? Resolution correction? Unfolding?

Resolution correction (Unfolding)

(a)



(b)



$$\frac{dN}{d\phi_s} \propto \left(1 + \frac{2v_2}{\mathcal{R}}\cos(2\phi_s)\right),$$

ϕ_s: The separate angle between trigger particles and EP.

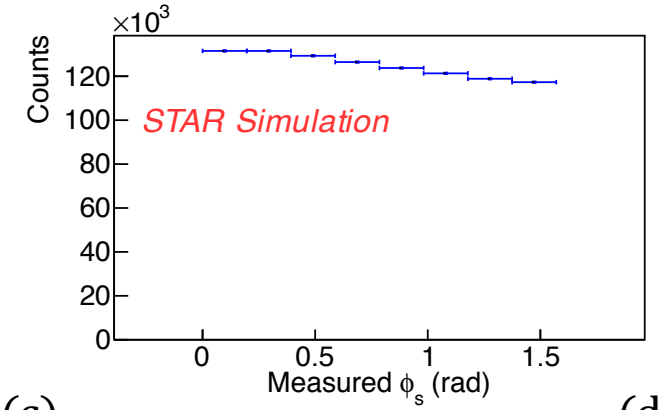
$$f(\chi, \Delta\Psi_2) = \frac{1}{\pi}\left[e^{-\frac{\chi^2}{2}} + \sqrt{\frac{\pi}{2}}\chi(\cos 2\Delta\Psi_2)e^{-\frac{\chi^2 \sin^2 2\Delta\Psi_2}{2}}\left(1 + \mathrm{erf}\left(\frac{\chi\cos 2\Delta\Psi_2}{\sqrt{2}}\right)\right)\right],$$

and $\chi = \mathcal{R}/\sqrt{\frac{\pi}{8}}$.

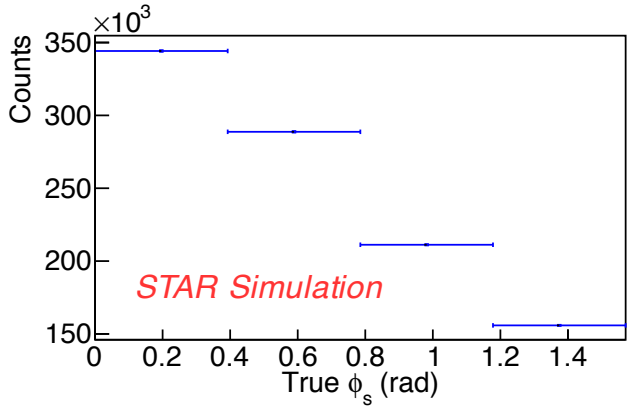
S. Voloshin, Y. Zhang, Z. Phys. C 70 (1996)665

Resolution correction (Tunfold)

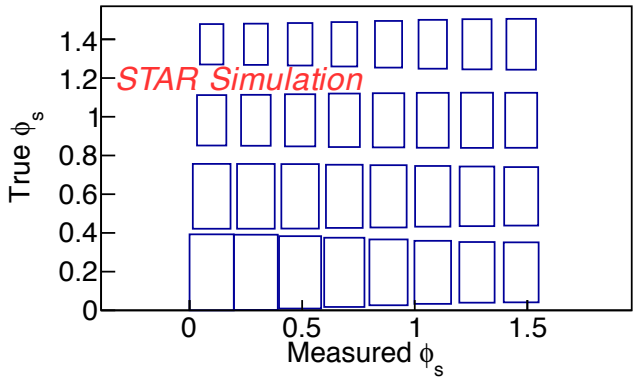
(a)



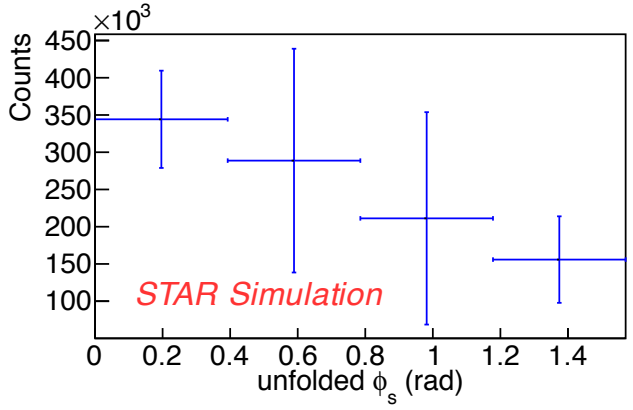
(b)



(c)



(d)



- (a) and (b) are filled by the data generated by MC.
- 2D histogram (c) is regarded as the "probability matrix". boxes for each row of y can be understood as the probability to migrate to the bin of x.
- We again use (a) but as the input. We can obtain the output (d)
- The number of bins after unfolding is half of the input.

https://root.cern.ch/doc/master/classTUnfold.html

Summary

- We adopted a data-driven method for subtracting flow background. (No assumptions on flow background shape and amplitude)
- We have reported a measurement of two-particle jet-like correlation shape relative to a high-p_T trigger particle ($3 < p_T^{trig} < 10$ GeV/c) in 200 GeV AuAu collisions.
- The 2nd-order event-plane in our analysis is reconstructed with BBC. (Significantly eliminate the correlation between EP and trigger particles)
- We have studied the two-particle jet-like correlation shape for trigger particles in different ϕ_s regions.
- We are going to correct for the EP resolution via an unfolding procedure.