J/ψ v_2 measurement in isobar collisions

Qian Yang （杨 钱）
Shandong University

Analysis strategy

Event level:

Vpdmb-30 (600001, 600011, 600021 and 600031)

|Vr| <2 cm, -35<Vz< 25 cm, and $|V_z^{TPC} - V_z^{VPD}| < 3\ cm$

Bad run rejected, bad run index in backup slides

Electron identification:

$nHitsFit \geq 20$

$nHitsFit/nHitsPoss \geq 0.52$

$nHitsDedx \geq 15$

$dca < 0.75\ cm$

$|\eta| < 1.0$

$-1.5 \leq n\sigma_e \leq 2.0$

$p < 1.5\ GeV/c$

$|1 - 1/\beta| \leq 0.025$

$p \geq 1.5\ GeV/c$

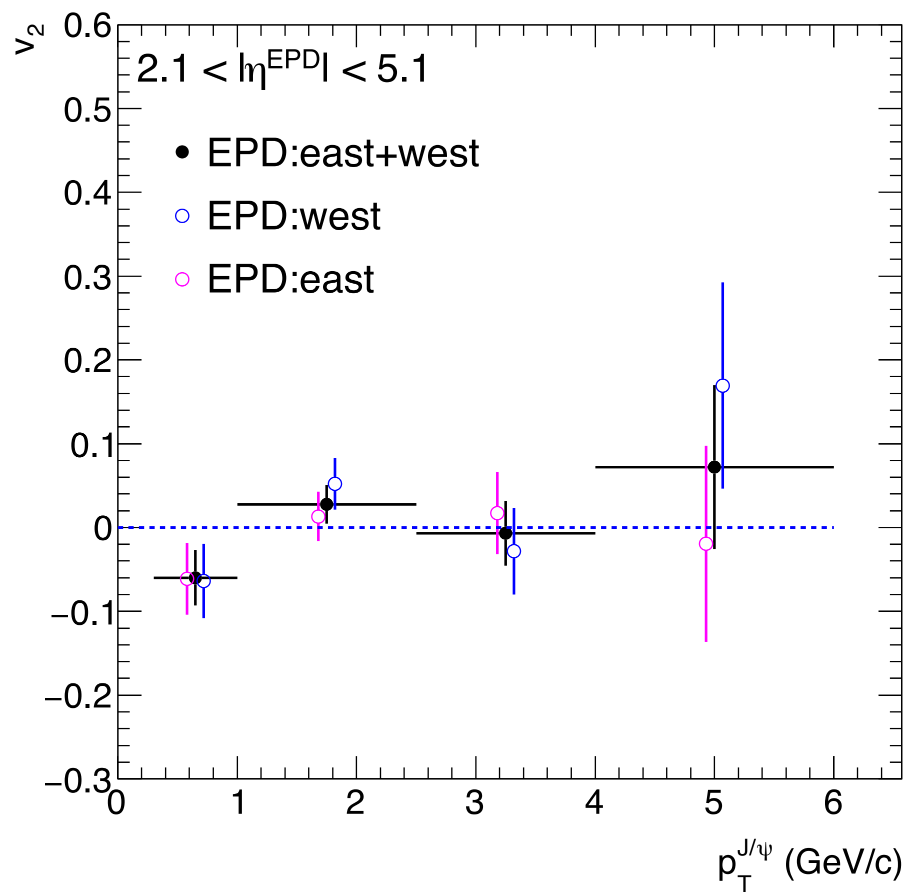
$0.3 \leq p/E \leq 1.5$

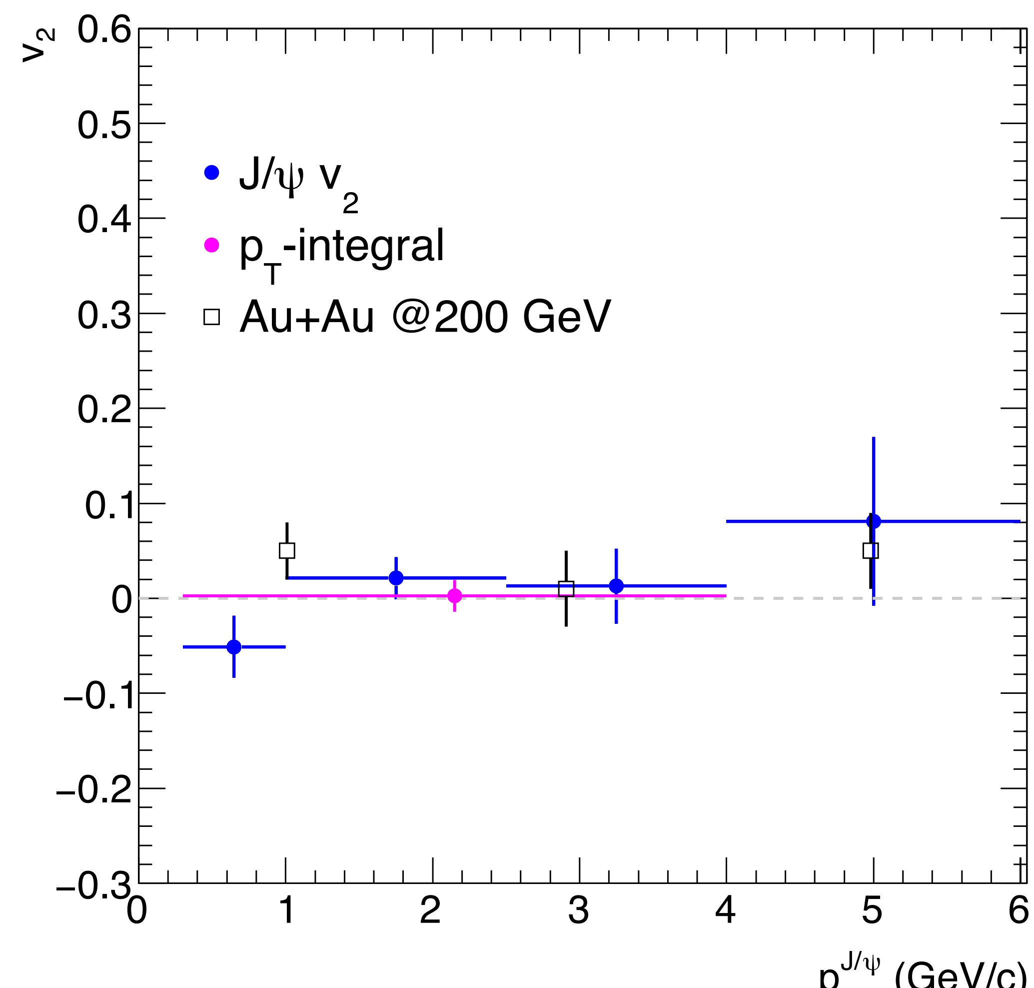
J/psi pT	0.3 - 1 GeV/c	1 - 2.5 GeV/c	2.5-4 GeV/c	4-6 GeV/c
Minimum electron pT	0.4 GeV/c	0.6 GeV/c	0.6 GeV/c	0.8 GeV/c

J/ψ elliptic flow

Previous

$$v_2^{obs} = \frac{<Q_{2,POI}Q^*_{2,EPDW}>}{\sqrt{\frac{<Q_{2,EPDW}Q^*_{2,EPDE}><Q_{2,EPDW}Q^*_{2,TPC}>}{<Q_{2,EPDE}Q^*_{2,TPC}>}}} = \frac{v_{2,POI}v_{2,EPD+}R_{EPD+}}{\sqrt{\frac{v_{2,EPD+}v_{2,EPD-}v_{2,EPD+}v_{2,TPD}R^2_{EPD+}R_{EPD-}R_{TPC}}{v_{2,EPD-}v_{2,TPC}R_{EPD-}R_{TPC}}}} = \frac{v_{2,POI}v_{2,EPD+}R_{EPD+}}{\sqrt{v^2_{2,EPD+}R^2_{EPD+}}}$$

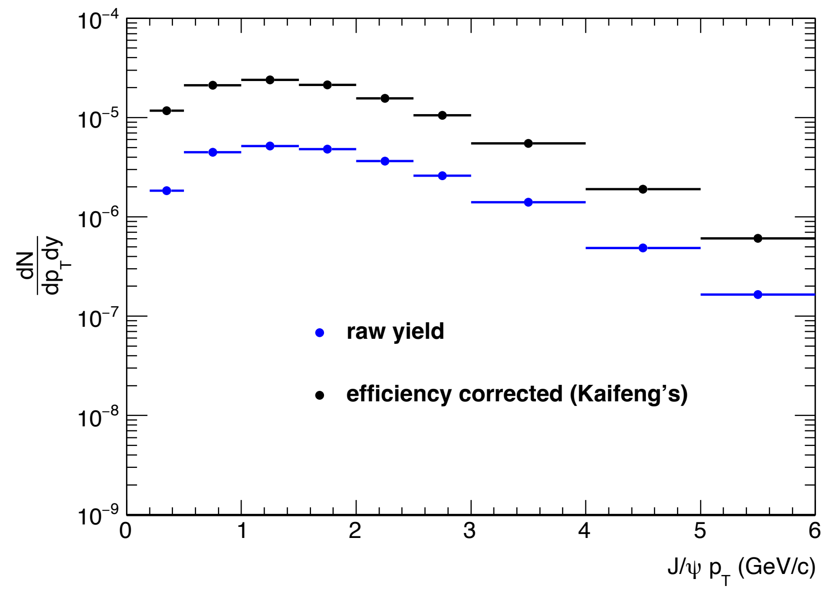




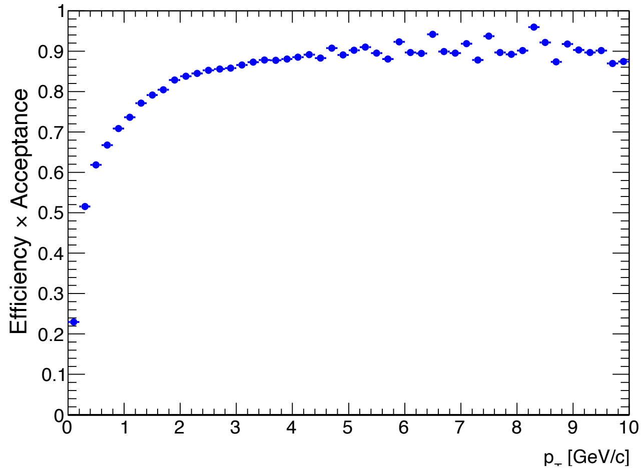
- Limited non-flow contribution but with a slightly worse event-plane resolution compared to TPC event-plane method
- What is the J/psi detector efficiency impact on the v2 results?

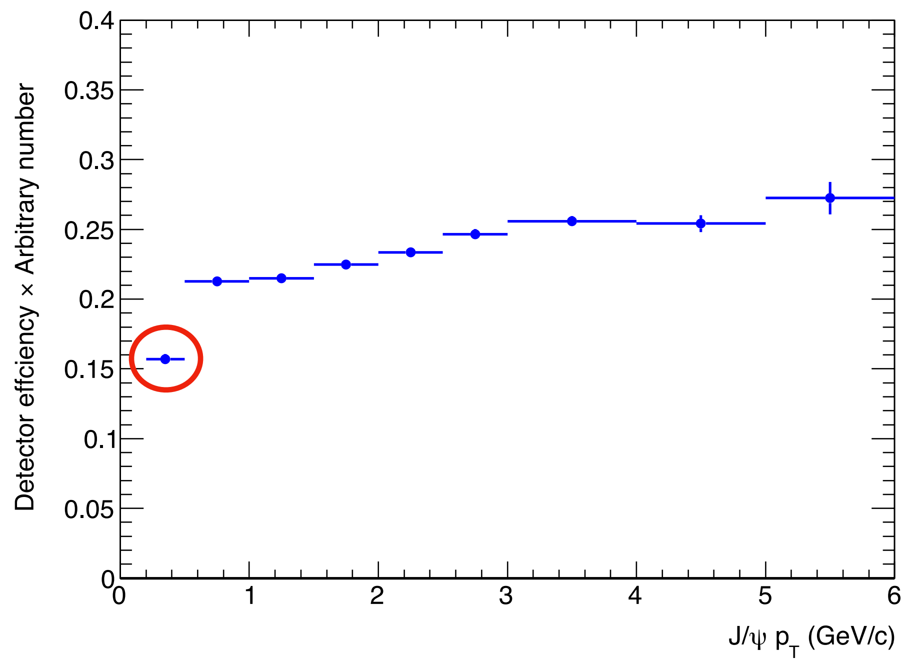
J/ψ detector efficiency

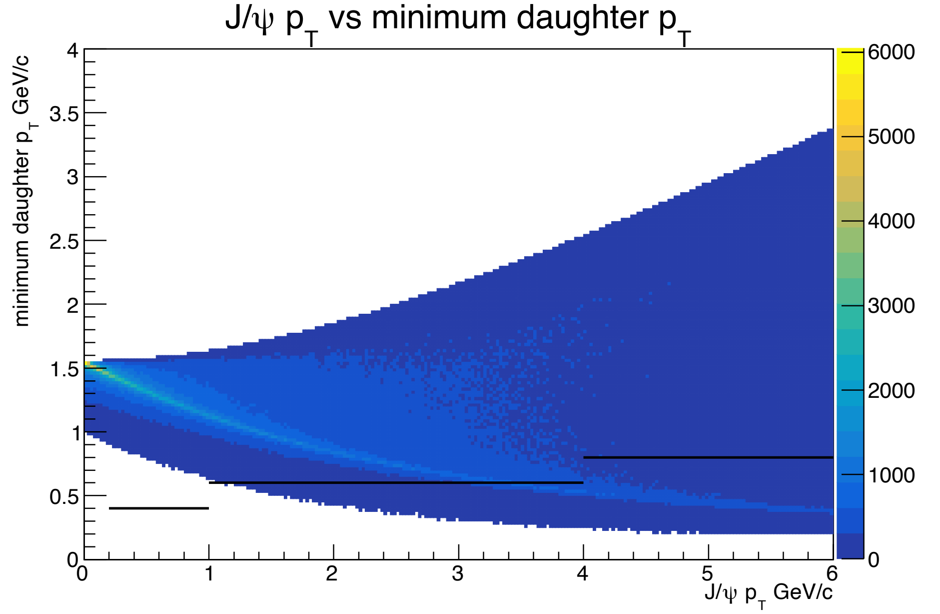
- Efficiency obtain by divide the raw yield by "truth" spectrum which is from R_{AA} analysis



J/psi decay electron tracking efficiency from embedding ("JpsiMB_200_20215101")



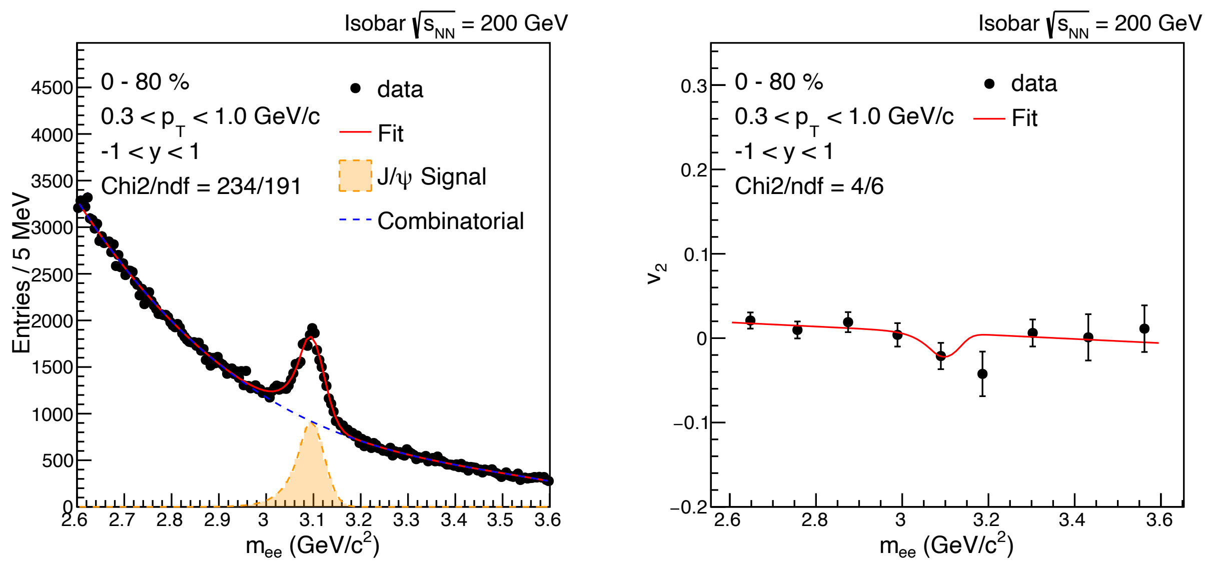




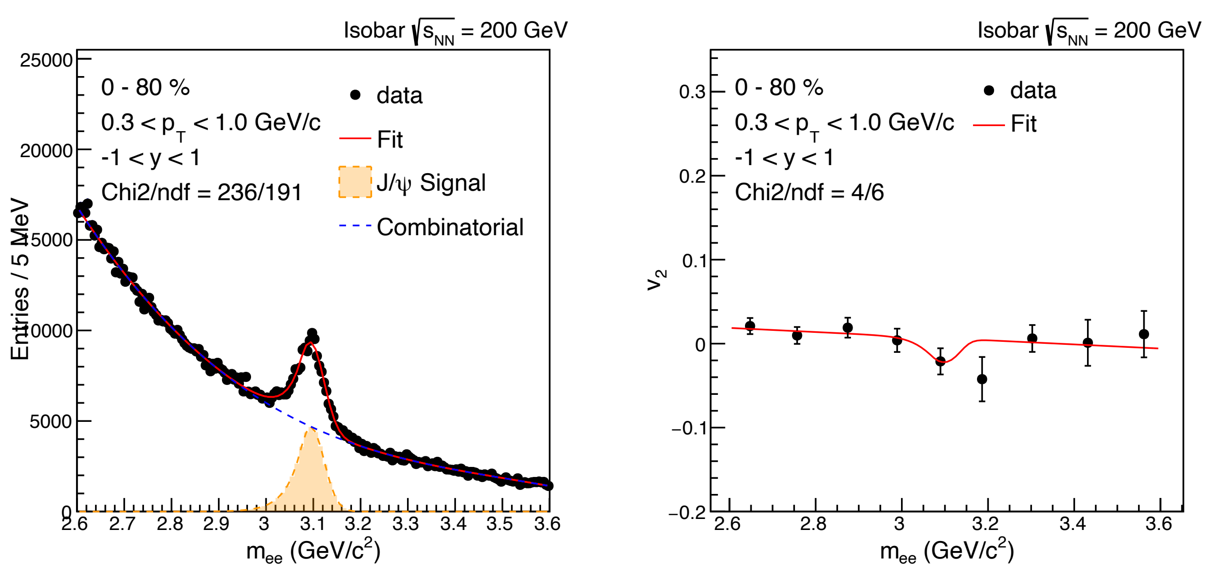
- Different pT cuts on daughter pT shown limited impact on efficiency due to a width pT distribution of electron

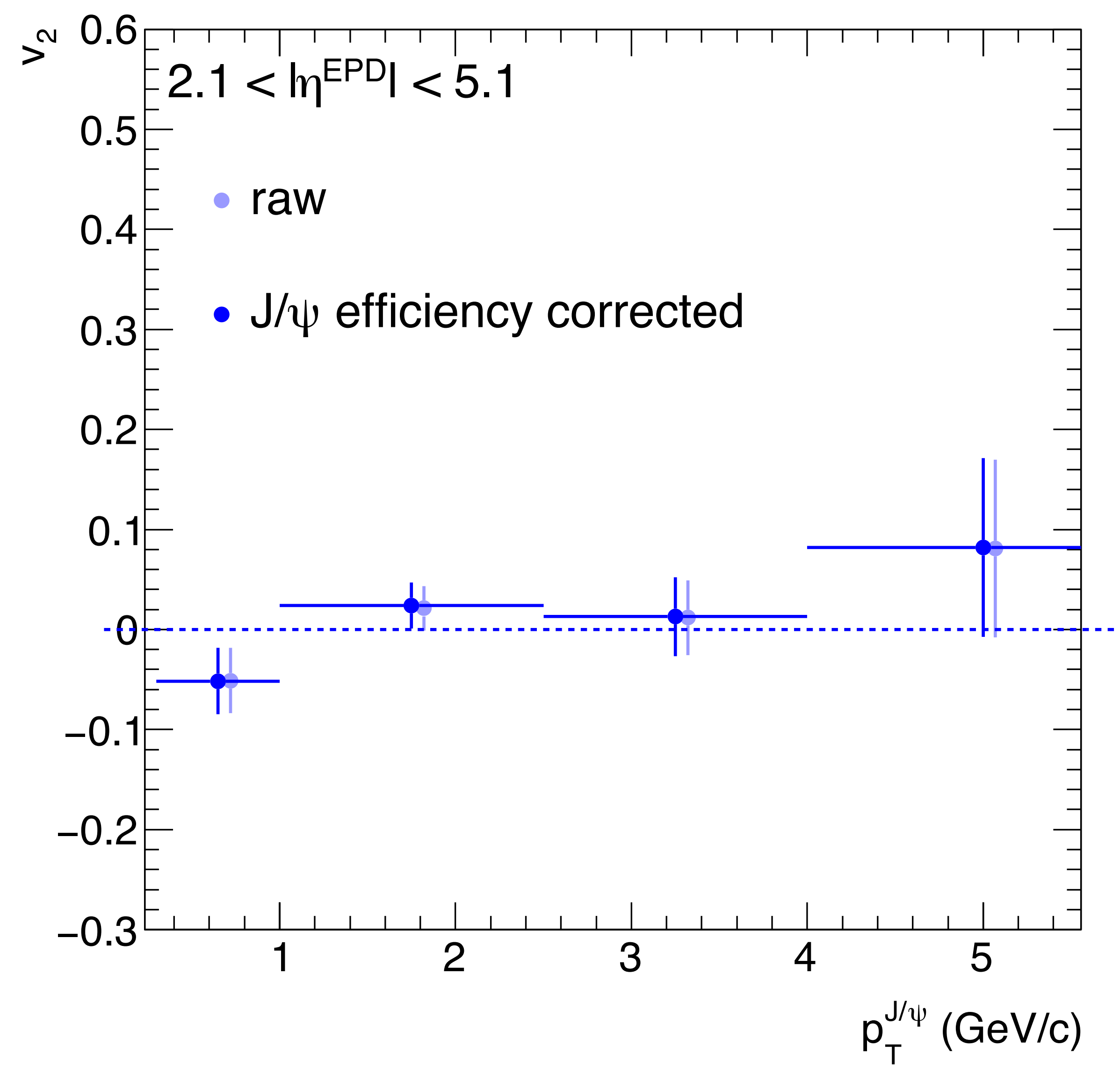
J/ψ elliptic flow

Before efficiency correction



After efficiency correction





- Very limited impact of efficiency on final v2 results

Event-plane method

Particle emission azimuthal angle measured with respect to the reaction plane

$$E\frac{d^3N}{d^3p} = \frac{1}{2\pi}\frac{d^2N}{p_T dp_T dy}(1 + \sum_{n=1}^{\infty} 2v_n cos[n(\phi - \Psi_r)])$$

for particle number distribution, $v_2 = < (p_x/p_T)^2 - (p_y/p_T)^2 >$

Estimation of the reaction plane :

$$Q_2 cos(2\Psi_2) = X_2 = \sum_i w_i cos(2\phi_i)$$

$$Q_2 sin(2\Psi_2) = Y_2 = \sum_i w_i sin(2\phi_i)$$

$$\Psi_2 = \frac{(tan^{-1}\frac{\sum_i w_i sin(2\phi_i)}{\sum_i w_i cos(2\phi_i)})}{2}$$

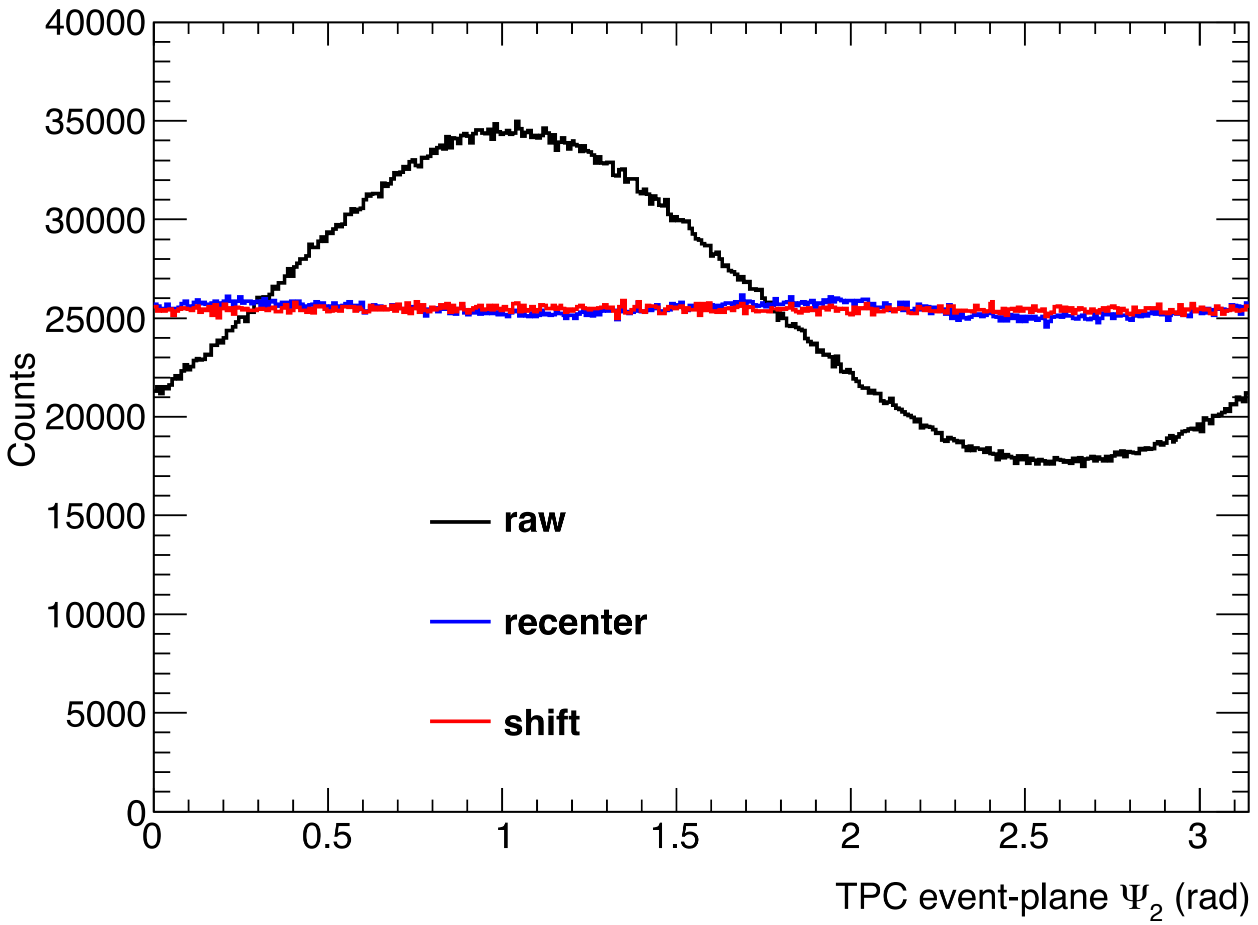
Weights are optimized to make the reaction plane resolution the best
: transverse momentum in this analysis

TPC event-plane reconstruction

Tracks for event plane reconstruction:

$0.4 < p_T < 5GeV/c$
$nHitsFit > 15$
$nHitsFit/nHitsPoss > 0.52$
$dca < 3$
$-0.5 < \eta < 0.5$

e that can be paired in the mass region of (2.2 - 3.8) has been removed from event-plane reconstruction



Recentering:

- correct azimuthally non-uniform TPC efficiency
- Corrected in in each run, and centrality with vz > 0 and vz <0 case respectively

Shift:
To remove higher order harmonics contribution. Up to 10th oder in the analysis

TPC event-plane resolution

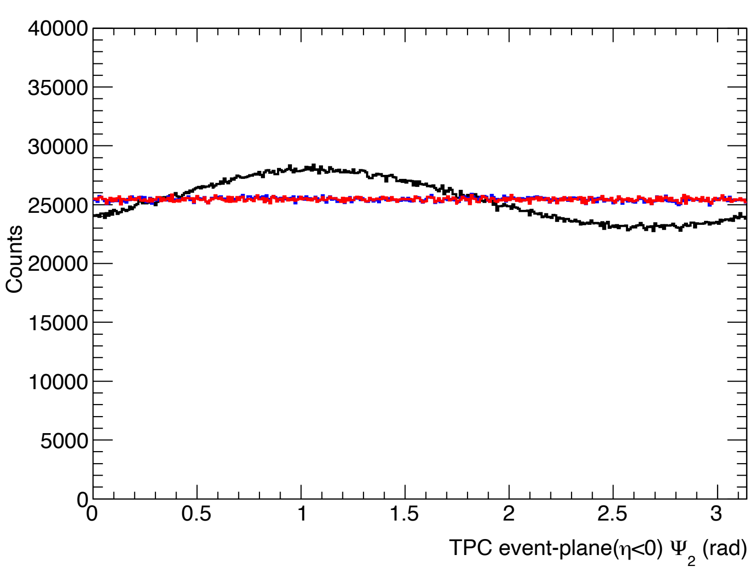
Using second order event plane to estimate event plane resolution

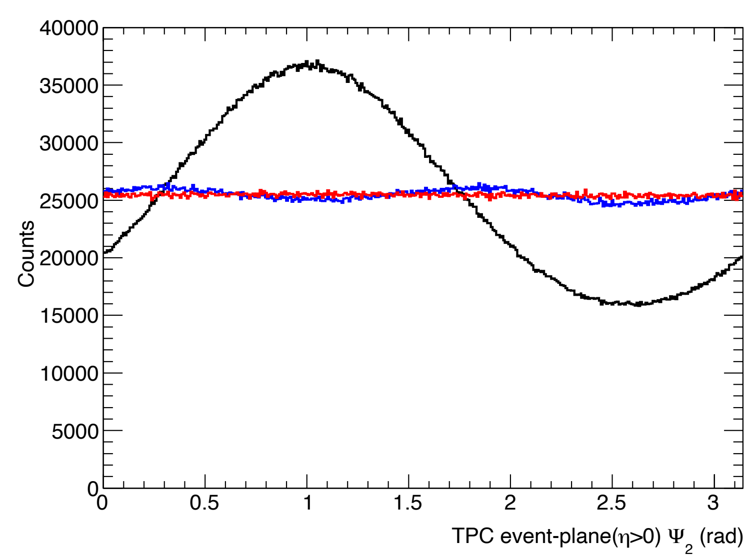
$$< cos[2(\Psi_2 - \Psi_2^T)] > = \sqrt{2} < cos[2(\Psi_2^{sub} - \Psi_2^T)] >$$

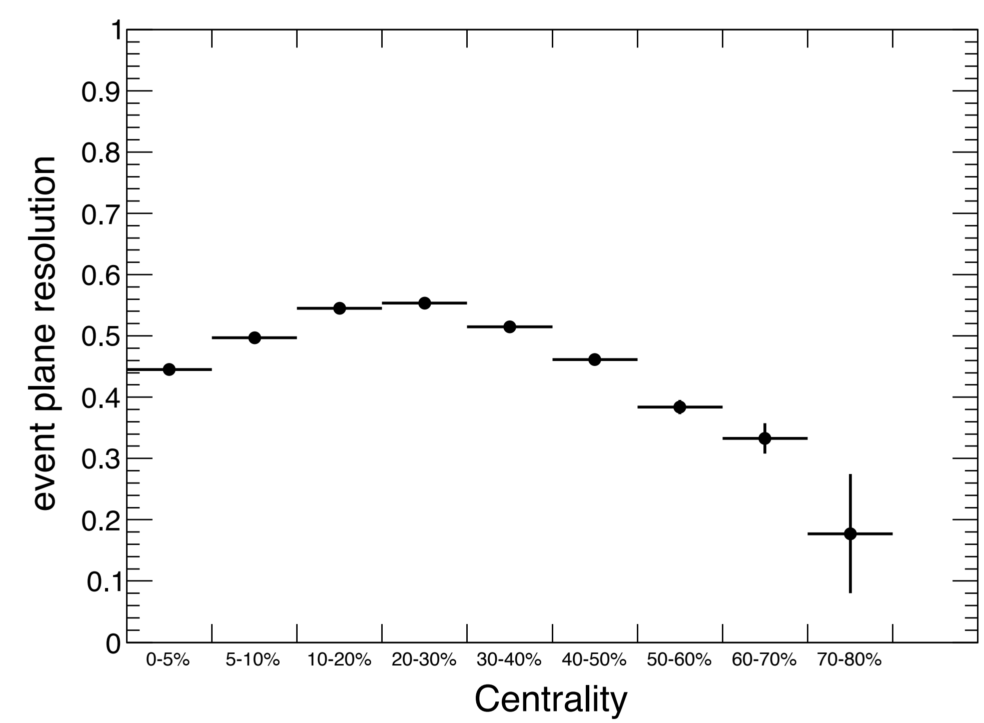
$$= \sqrt{2}\sqrt{< cos[2(\Psi_2^{sub1} - \Psi_2^{sub2})] >}$$

Two sub-event: $\eta > 0$ and $\eta < 0$

Recenter are done in each run, centrality and vz > 0 and vz <0 case respectively

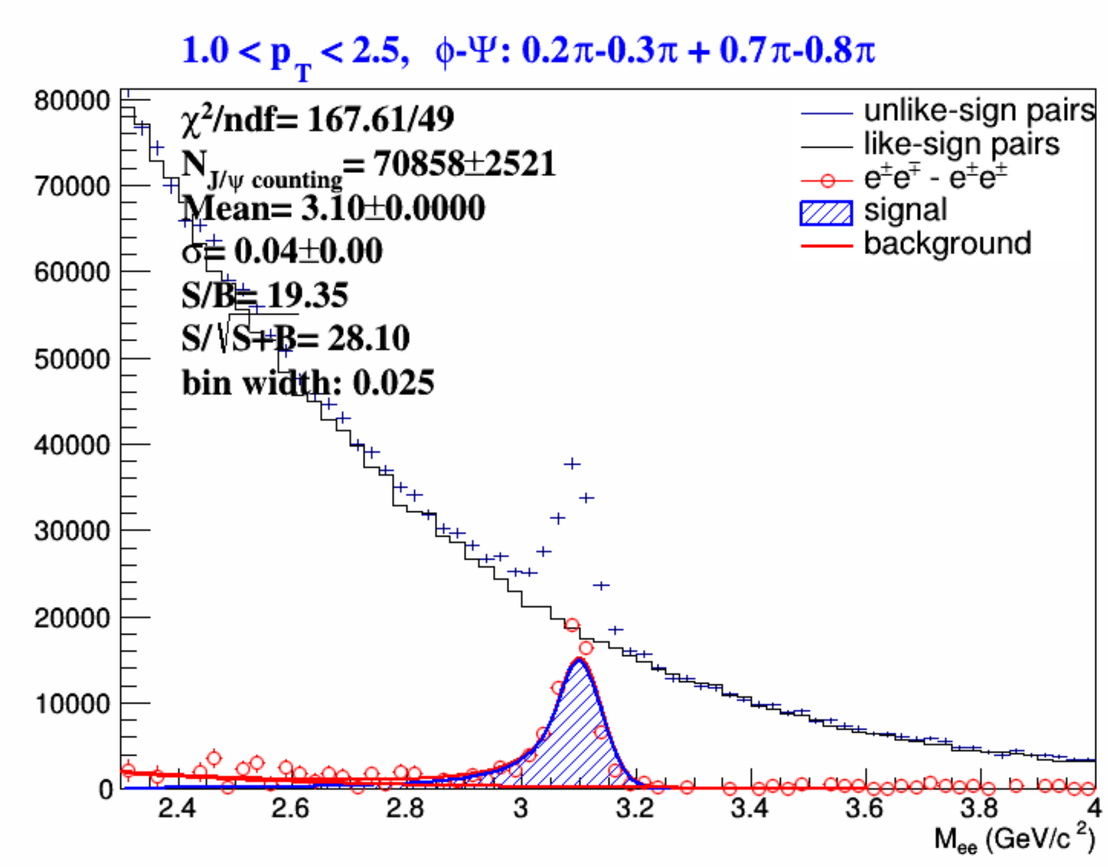


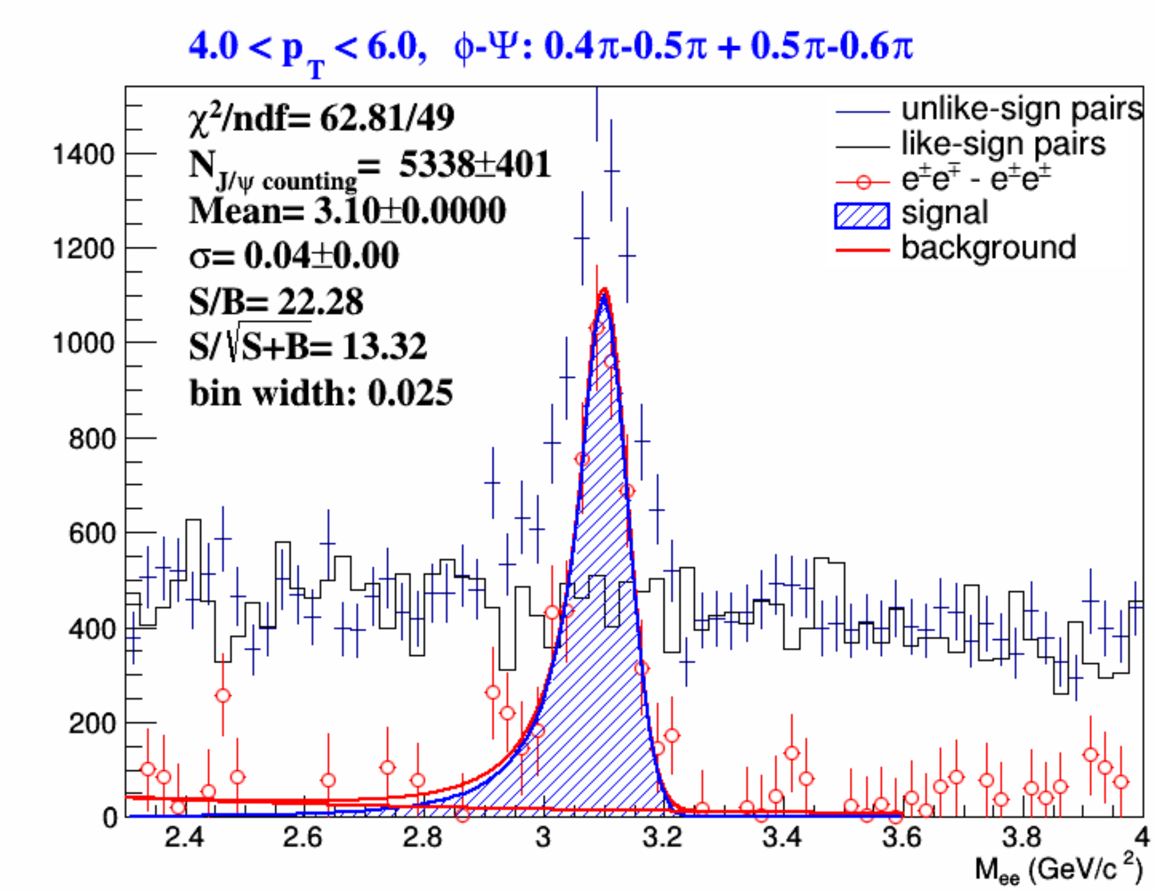




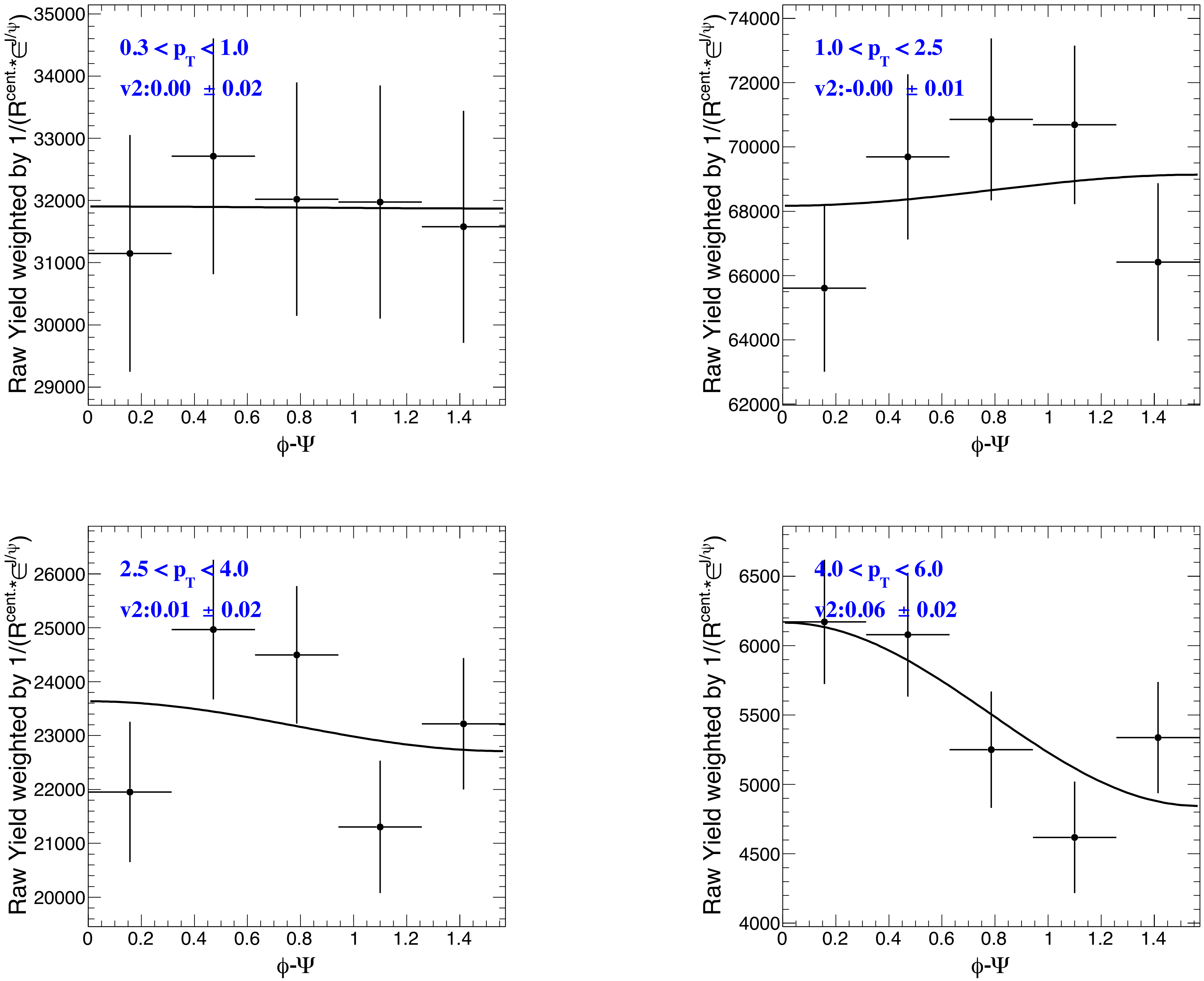
mass distribution in different $\Delta\phi$ bins

- To cope with event plane resolution in large centrality bin, the histogram is weighted by inverse event plane resolution and J/psi efficiency in each centrality bin
- the counts are divided into 10 ϕ−Ψ bins, and each 2 bins symmetrical to π/2 are combined into one





J/psi yield in different $\phi - \Psi$ bins



ϕ bin width correction

$$\int_{i\Delta}^{(i+1)\Delta} A(1 + 2v_2cos(2(\phi - \Psi)))d(\phi - \Psi)$$

$$= A(\Delta + v_2\int_{i\Delta}^{(i+1)\Delta} cos(2(\phi - \Psi))d(2(\phi - \Psi)))$$

$$= A(\Delta + v_2sin(2(\phi - \Psi))\,|_{i\Delta}^{(i+1)\Delta}))$$

$$= A(\Delta + v_2(sin(2(i + 1)\Delta) - sin(2i\Delta)))$$

$$= A(\Delta + v_2 2sin\Delta cos((2i + 1)\Delta))$$

$$= A\Delta(1 + 2v_2(sin\Delta/\Delta)cos(2(i + 1/2)\Delta))$$

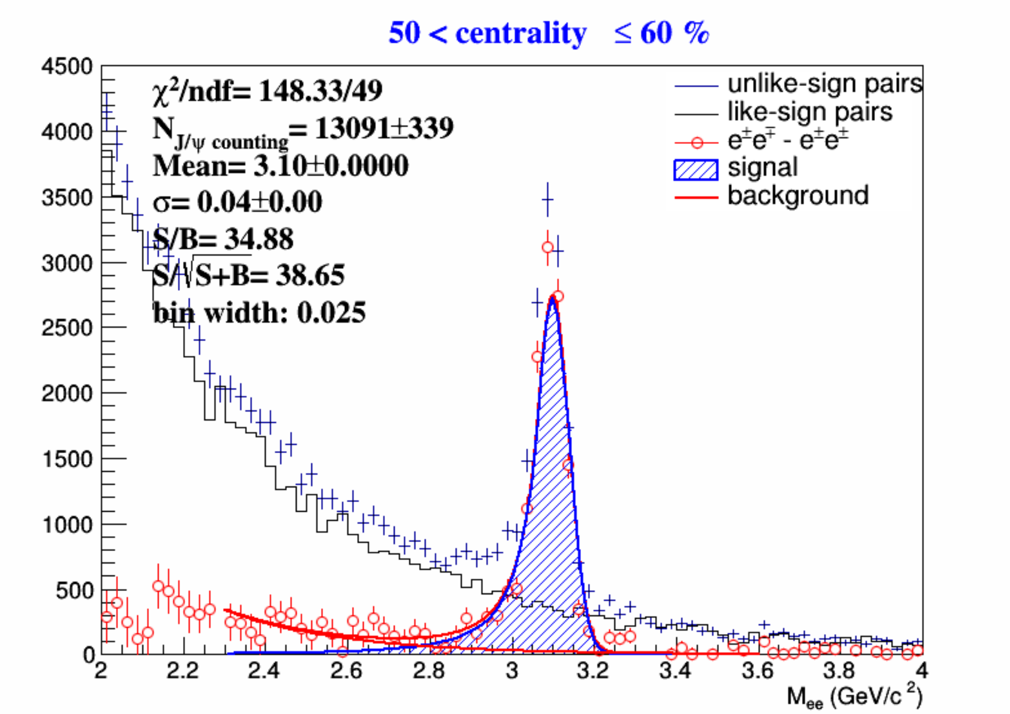
bin center

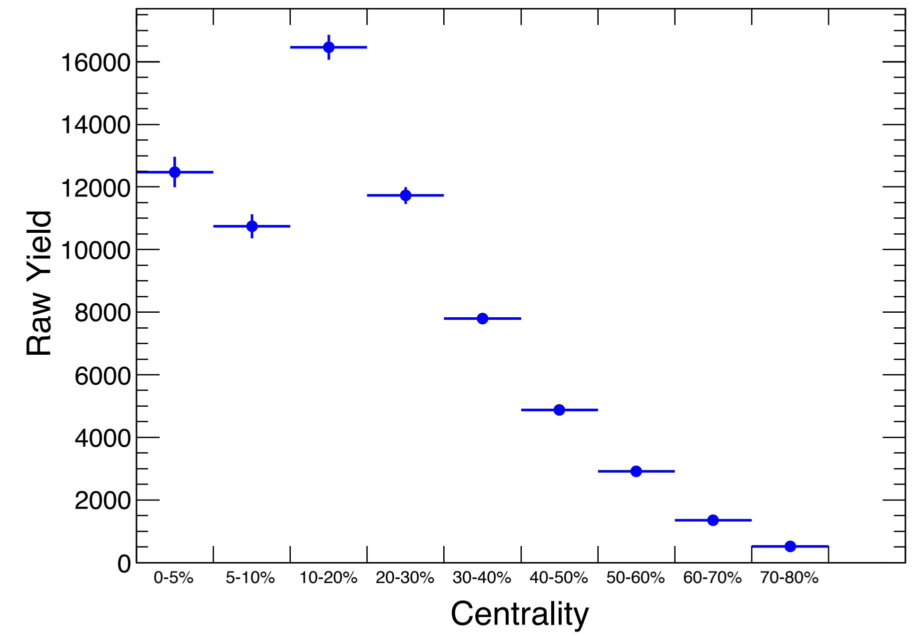
$$A(1 + 2v_2cos(2(\phi - \Psi)))$$

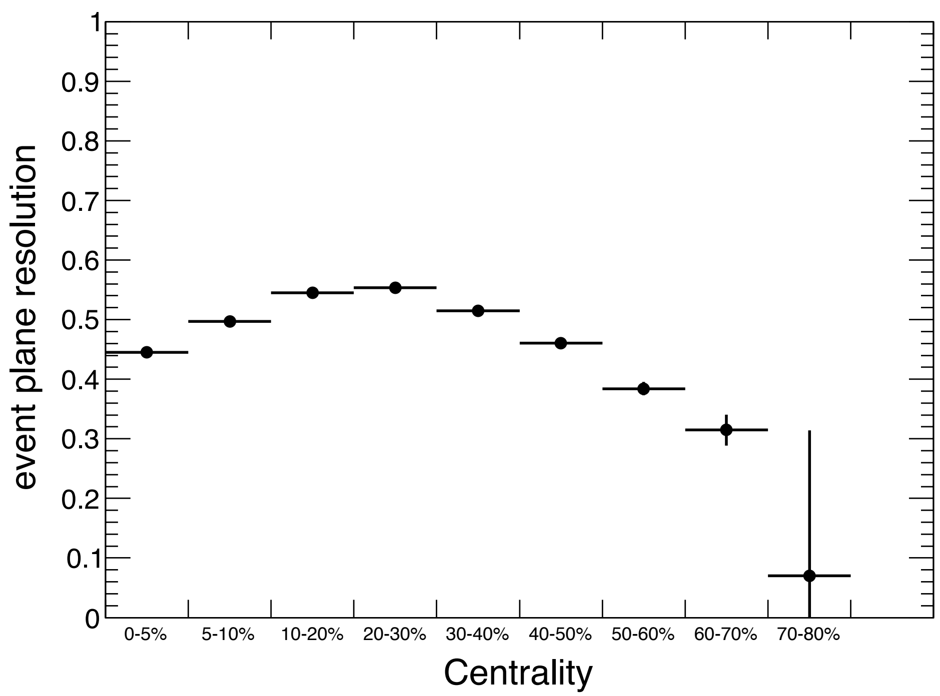
$$sin\Delta/\Delta = 1.01664, \Delta = 0.1\pi$$

1.664% correction for the v2 results due to bin width

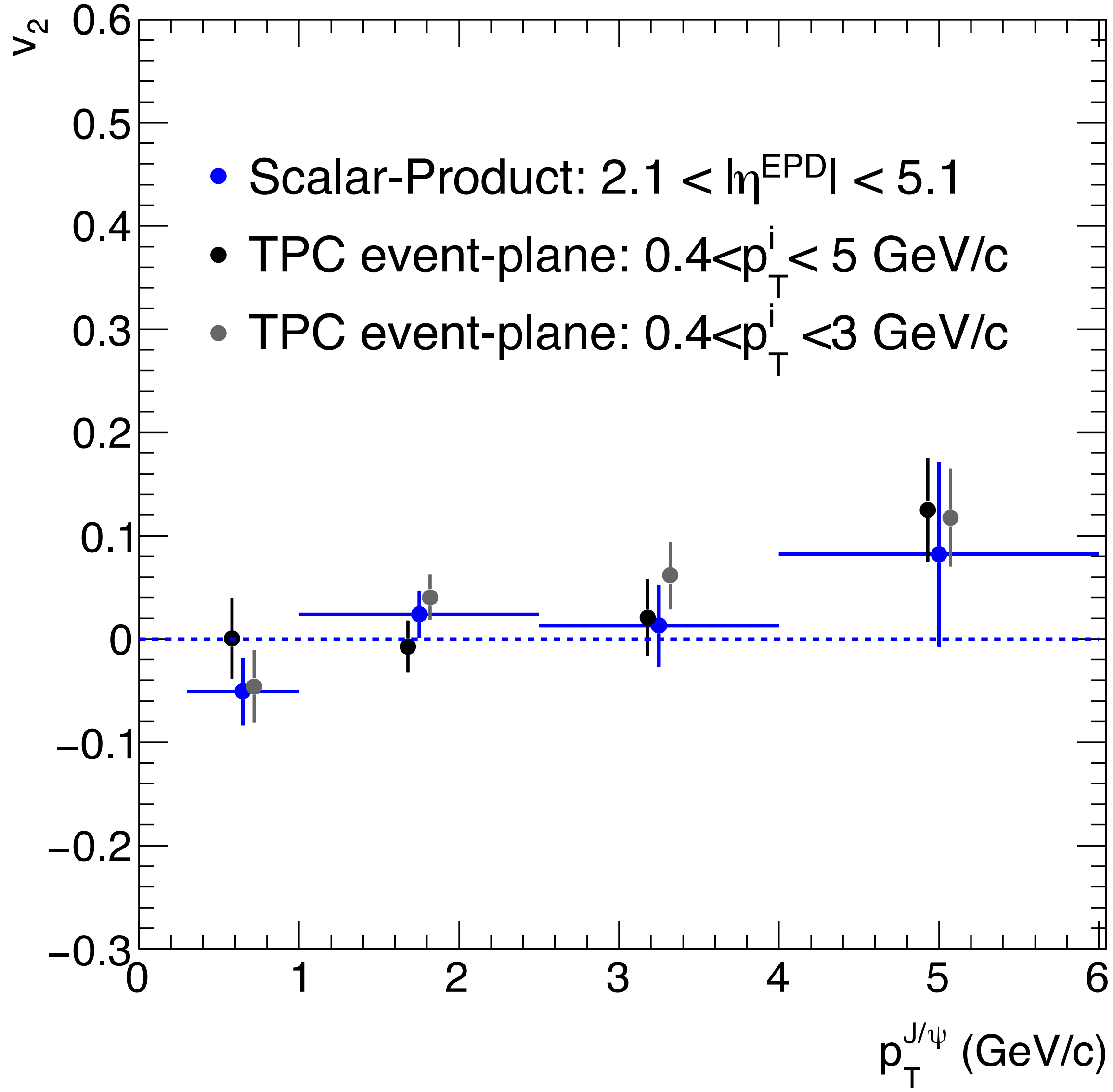
Total TPC event-plane resolution







J/ψ elliptic flow



- The J/psi elliptic flow is consistent with 0
- Consistent results between scalar-product method and TPC event-plane method

Summary

- The final J/psi v2 is obtained by using scalar-product method and event-plane method
- Both results are consistent with each other
- Sys. uncert. estimation is ongoing.