Recent Progress

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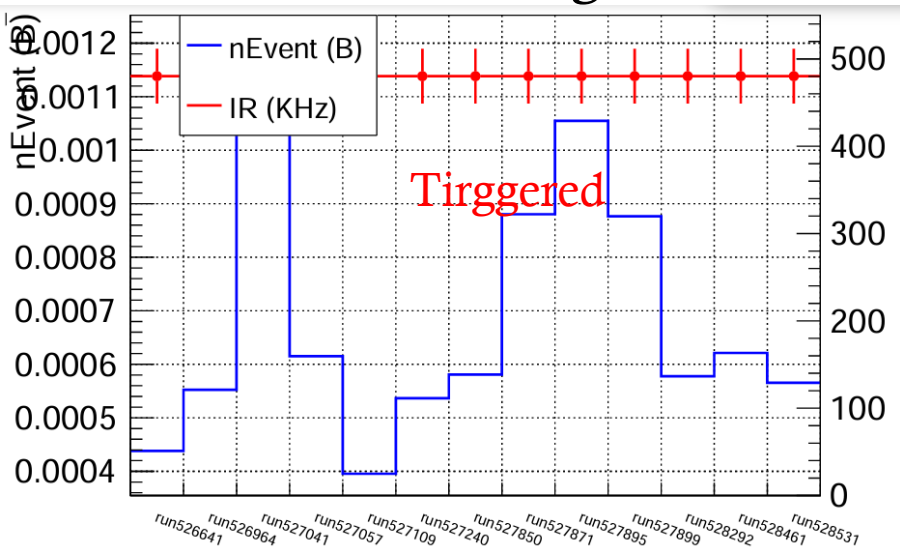
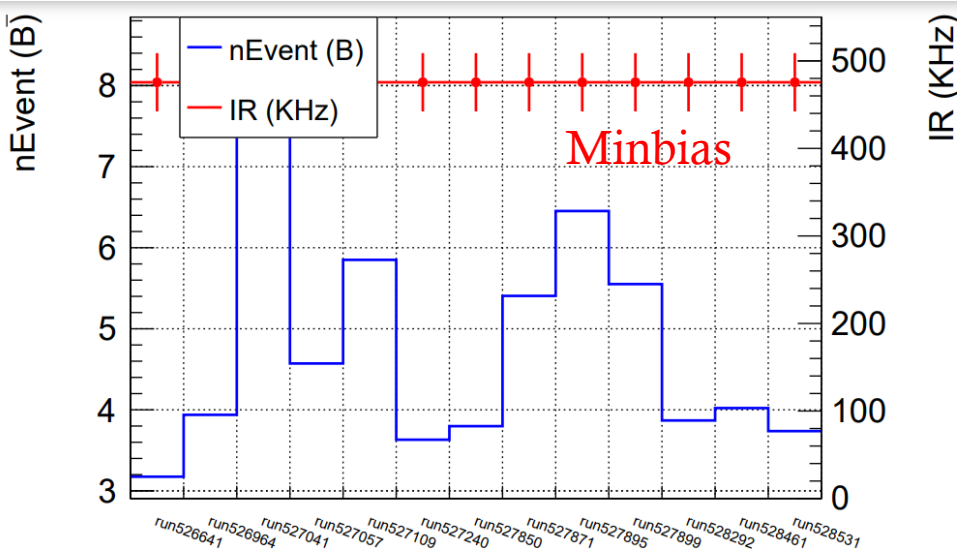
October 25, 2023

Analysis Cuts

- Run Period: LHC22o_pass4
- Cuts for skimmed tree creation
  - Event Cut: $|Vtx_z| < 10cm$
  - Track Cut:
    - $|\eta| < 0.9$
    - $p_T > 0.1GeV$
    - ITS Matching
- Analysis Cut For Qc and J/ψ
  - TPC $\chi^2 < 4$
  - 2<ITSncls
  - 90<TPCncls<159
  - -3<$n\sigma_{elec} < 3$
  - $n\sigma_{\pi}$>3
  - $n\sigma_{proton}$>3
- Track Cut For Reference Flow
  - $\chi^2_{TPC} < 4$
  - $ncls_{TPC} > 90$
  - $ncls_{ITS} > 2$
  - $isSPDAny$
  - $-1cm < DCA_{xy} < 1cm$
  - $-3cm < DCA_Z < 3cm$
  - $0.2 < p_T < 3GeV/c$
  - $Mult_{track} > 30$





Analysis Cuts For Reference

- Track Cut

  $\chi^2_{TPC} < 4$

  $ncls_{TPC} > 90$

  $ncls_{ITS} > 2$

  $isSPDAny$

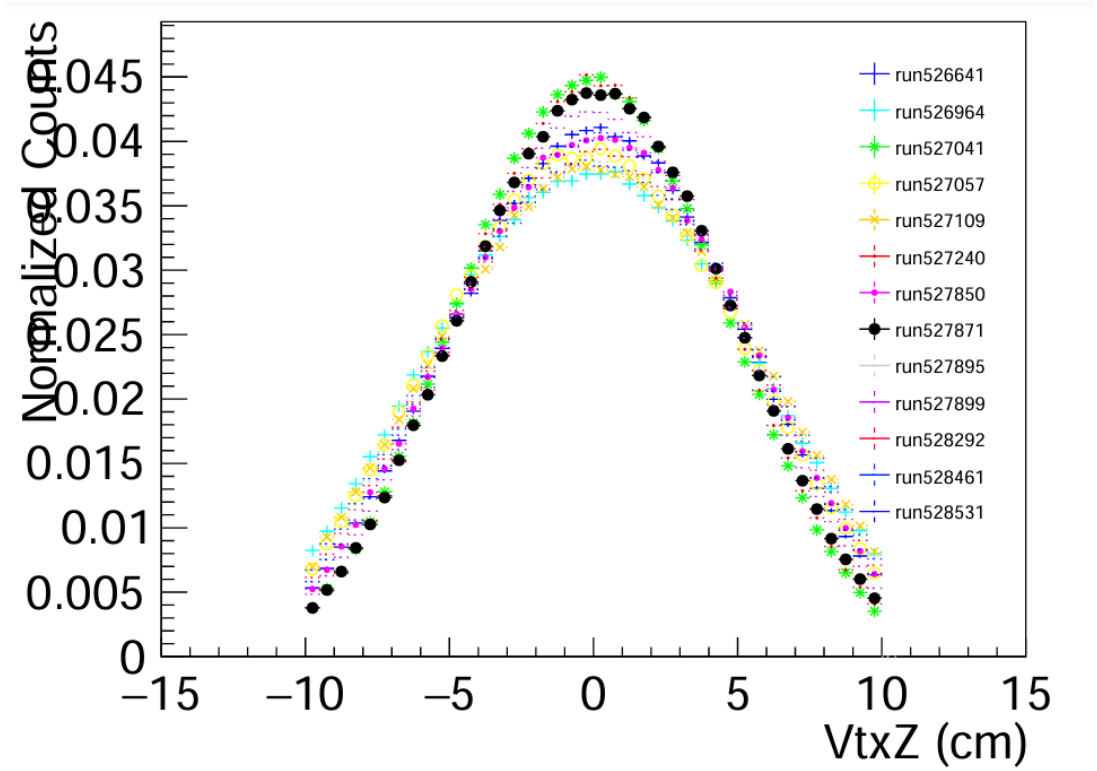
  $-1cm < DCA_{xy} < 1cm$

  $-3cm < DCA_Z < 3cm$

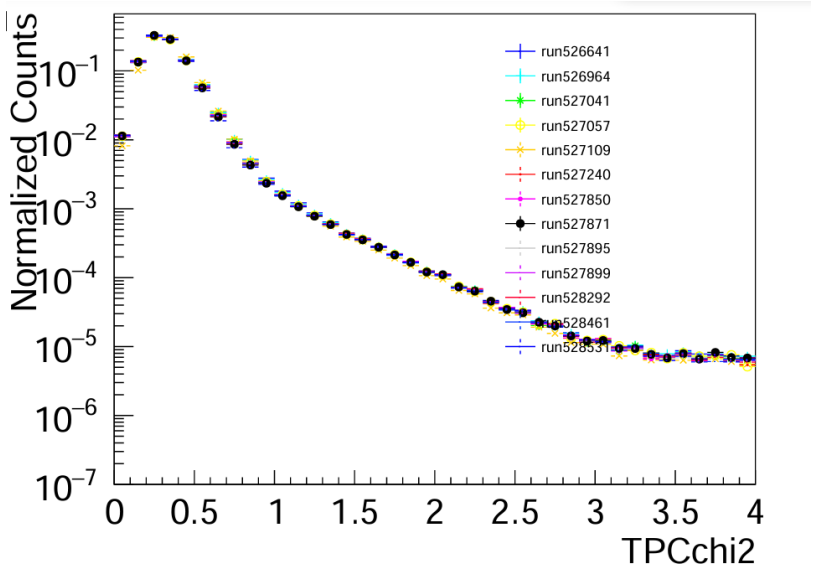
  $0.2 < p_T < 3GeV/c$

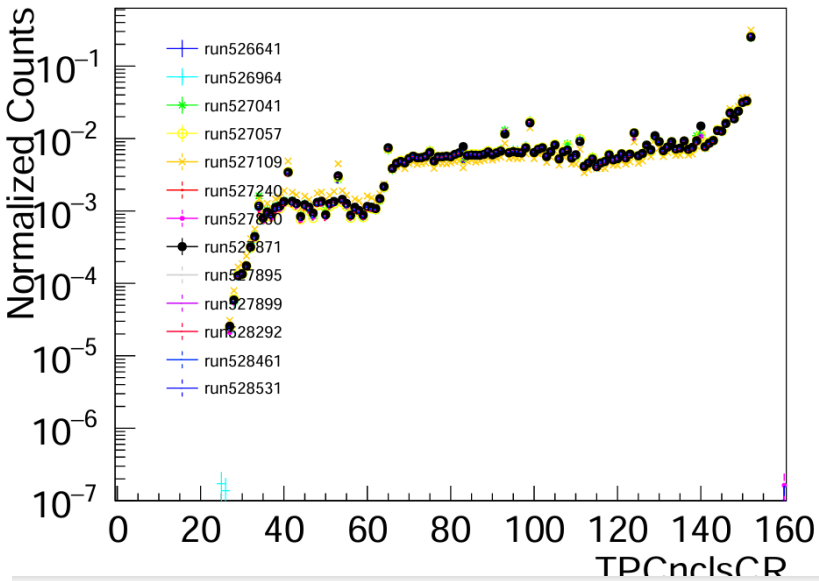
  $Mult_{track} > 30$

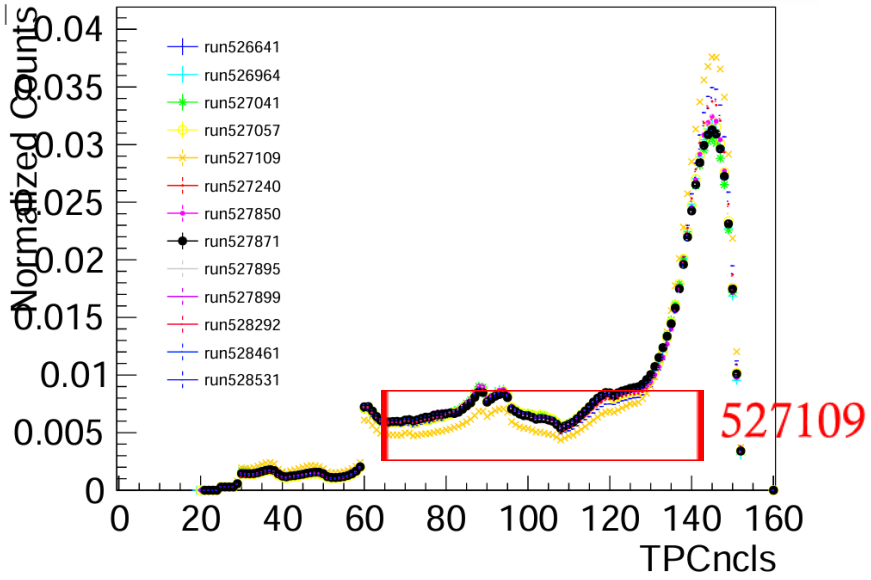
Before Analysis Cuts

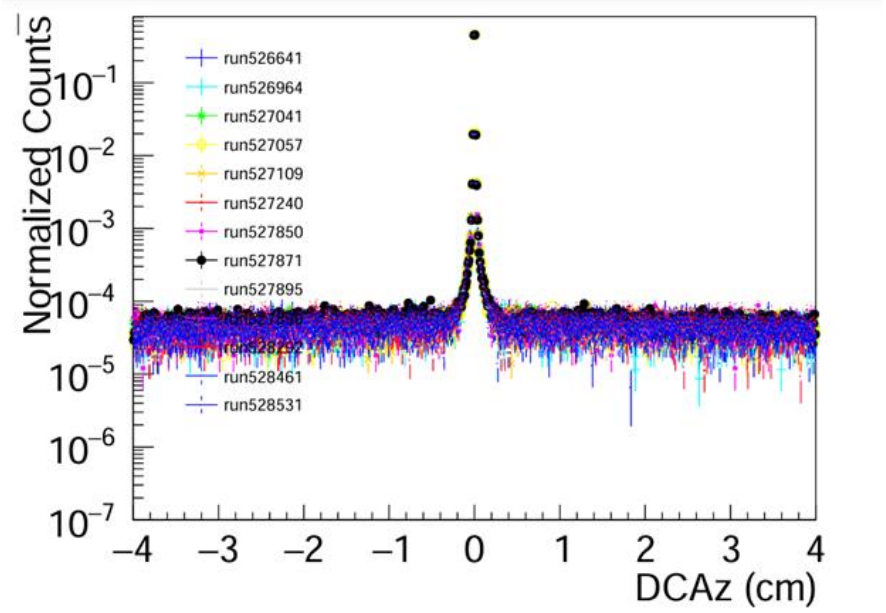


Before Analysis Cuts

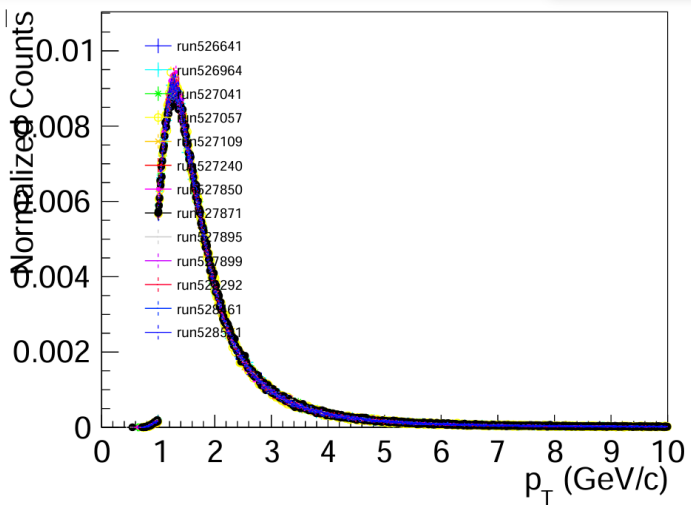


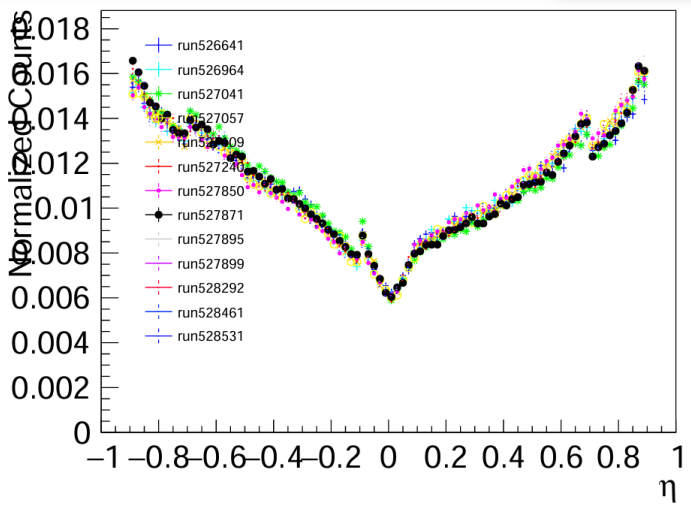


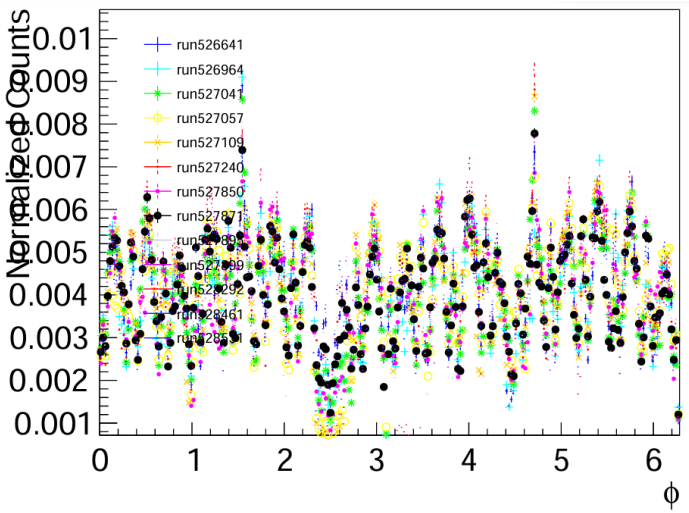


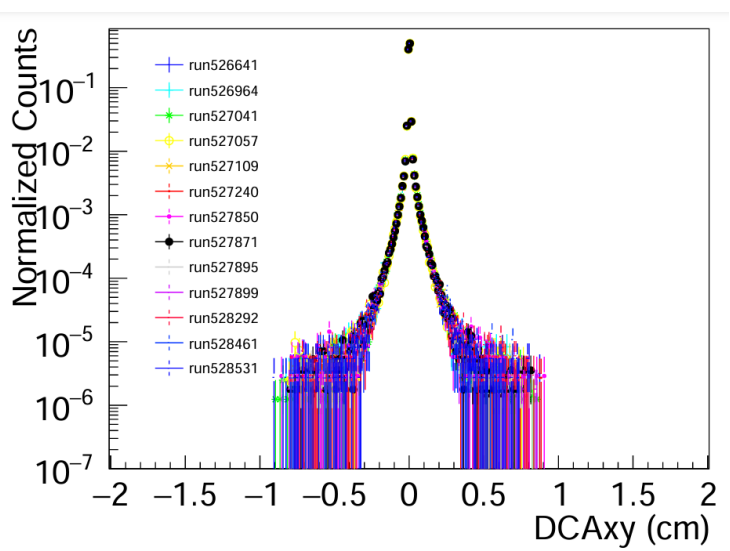


After Analysis Cuts

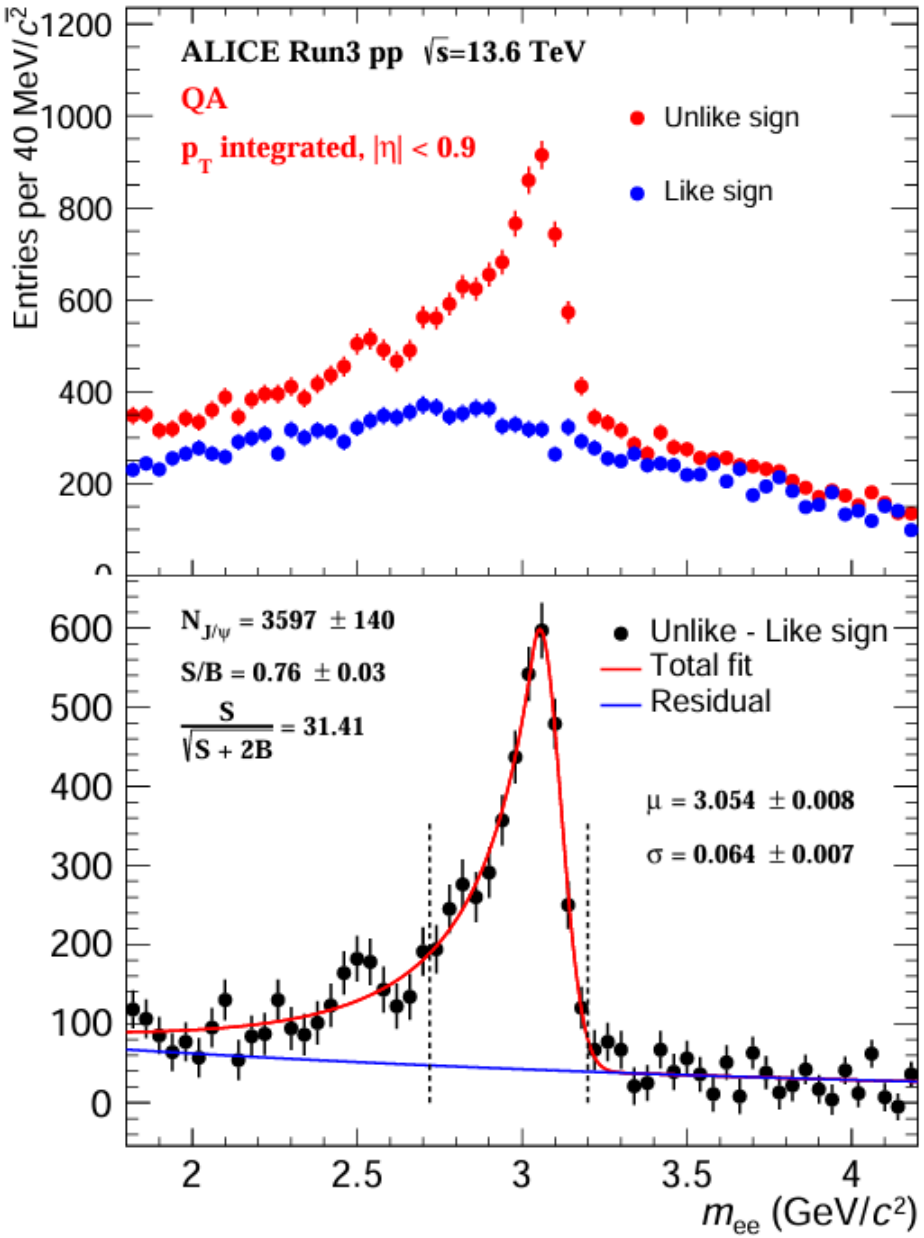


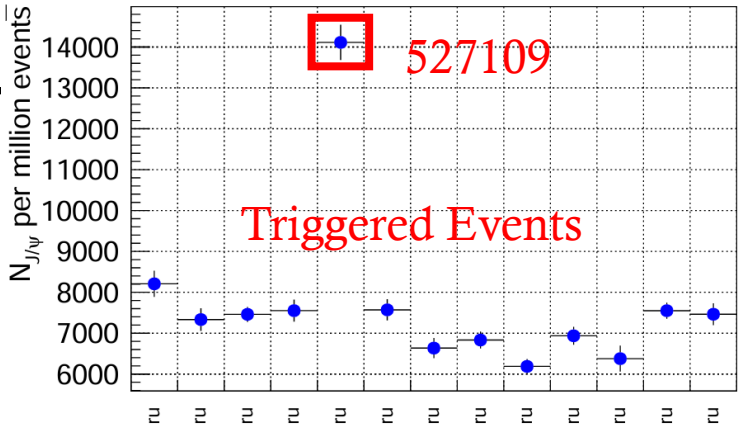


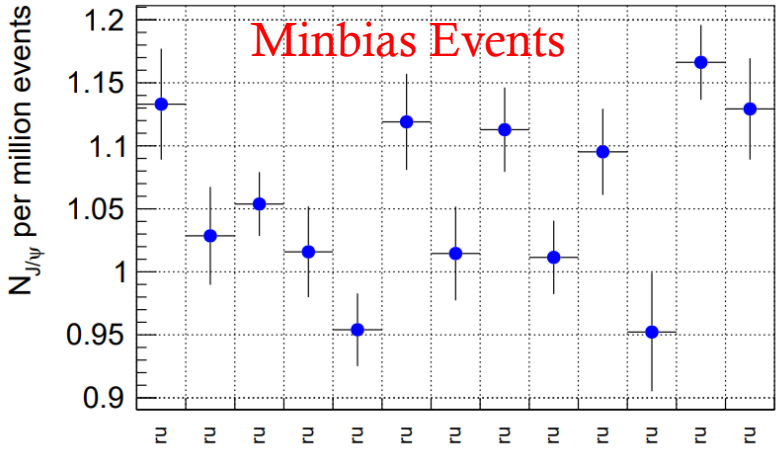


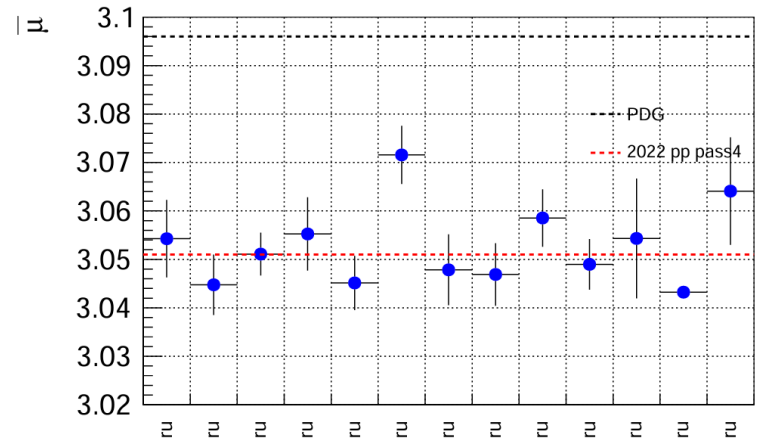


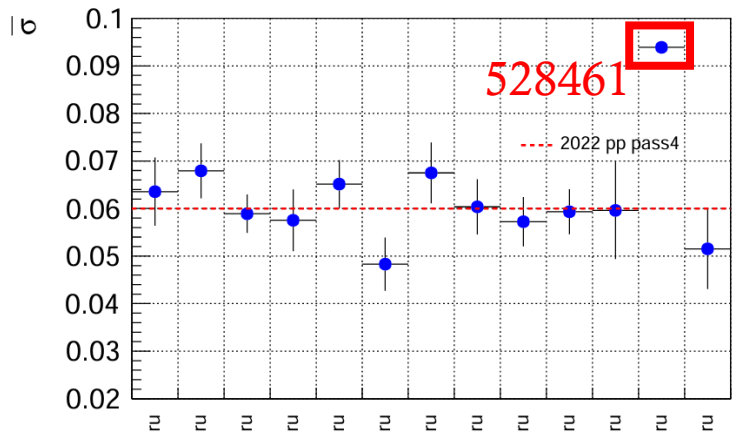
J/ψ Reconstruction





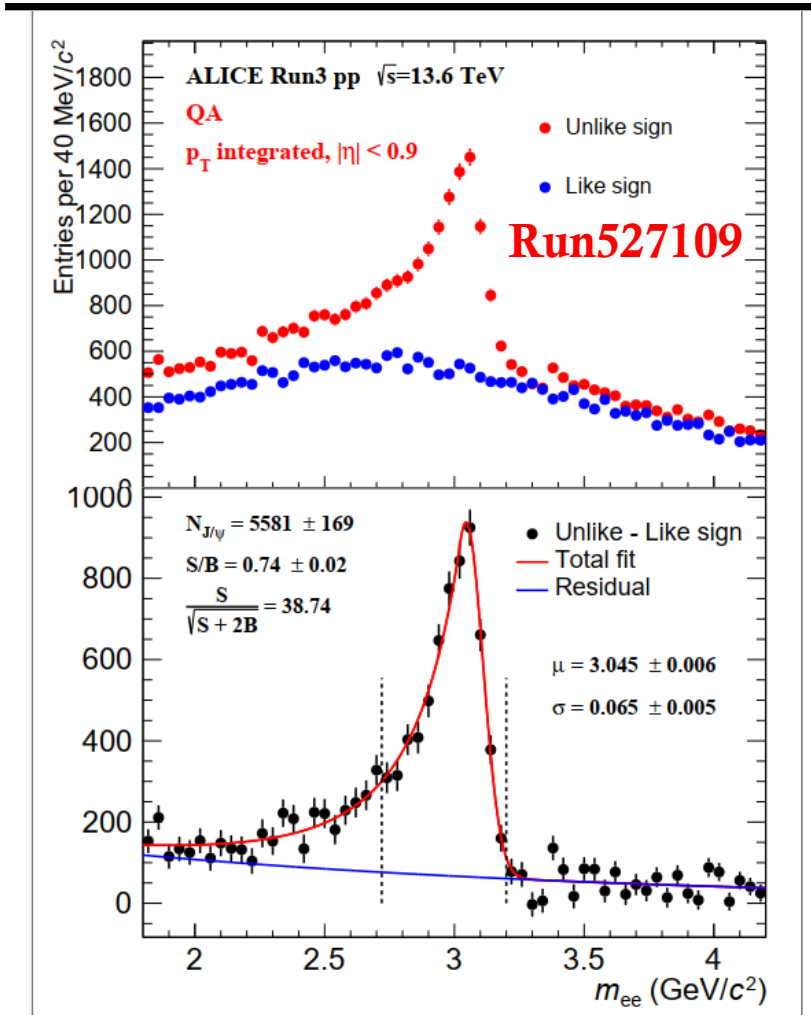


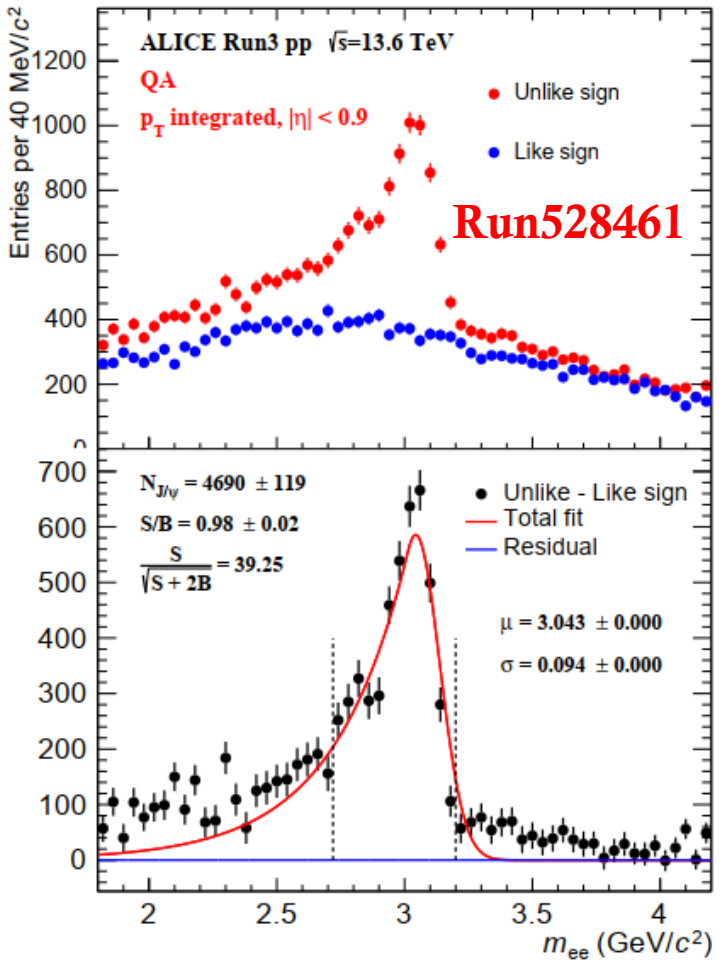




- 527109 and 528461 look strange.
- No other strange behavior for 528461.
- Remove run 527109

J/ψ Reconstruction for run527109 and run528461





- Bad fit for 528461 can explain the big σ.
- The fit looks good for 527109.

Method Introduction

- Flow Definition: v_n

$$\frac{dN}{d\varphi} = \frac{1}{2\pi}\left\{1 + 2\sum_{n=1}^{\infty} v_n \cos[n(\varphi - \Psi_n)]\right\}$$

- Method with event plane(assuming $\Psi_n = 0$)

$$v_n(\mathcal{D}) \equiv \langle e^{in\phi} \rangle = \frac{\int_{\mathcal{D}} e^{in\phi} f(\mathbf{p})\, d^3\mathbf{p}}{\int_{\mathcal{D}} f(\mathbf{p})\, d^3\mathbf{p}}$$

- If there is no event plane, use particle correlation

$$\langle e^{in(\phi_1 - \phi_2)} \rangle_{\mathcal{D}_1 \times \mathcal{D}_2} = \frac{\int_{\mathcal{D}_1 \times \mathcal{D}_2} e^{in(\phi_1 - \phi_2)} f(\mathbf{p}_1, \mathbf{p}_2)\, d^3\mathbf{p}_1 d^3\mathbf{p}_2}{\int_{\mathcal{D}_1 \times \mathcal{D}_2} f(\mathbf{p}_1, \mathbf{p}_2)\, d^3\mathbf{p}_1 d^3\mathbf{p}_2}$$

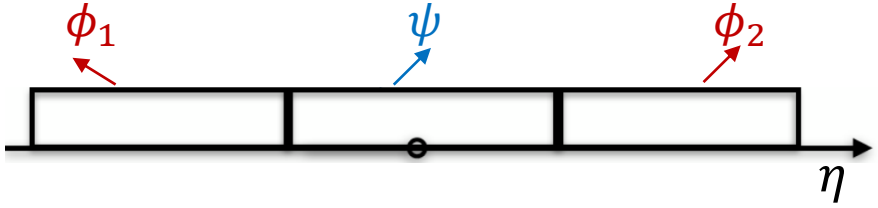
$$\langle e^{in(\phi_1 - \phi_2)} \rangle_{\mathcal{D}_1 \times \mathcal{D}_2} = v_n(\mathcal{D}_1) v_n(\mathcal{D}_2)$$

- Particle Correlation with discrete summation formation

$$< e^{in(\phi_1 - \phi_2)} >_{D_1 \times D_2} = \frac{\Sigma_{D_1, D_2} e^{in(\phi_{D_1} - \phi_{D_2})}}{N_{D_1} N_{D_2}} = \frac{Q_{D_1} \bar{Q}_{D_1}}{N_{D_1} N_{D_2}}$$

$$Q_D = \Sigma_{\mu \in D} e^{in\phi_\mu}$$

- Method in this report



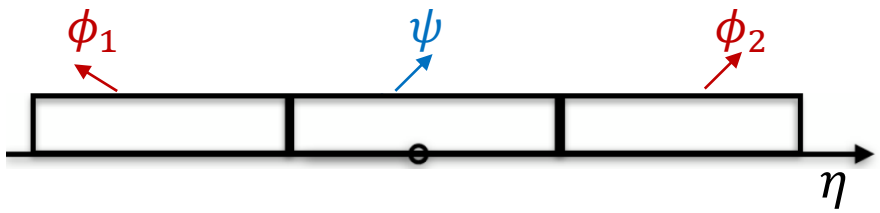
$< e^{i(2\psi - \phi_1 - \phi_2)} > = v_2' v_1^2$ → reference flow

→ flow

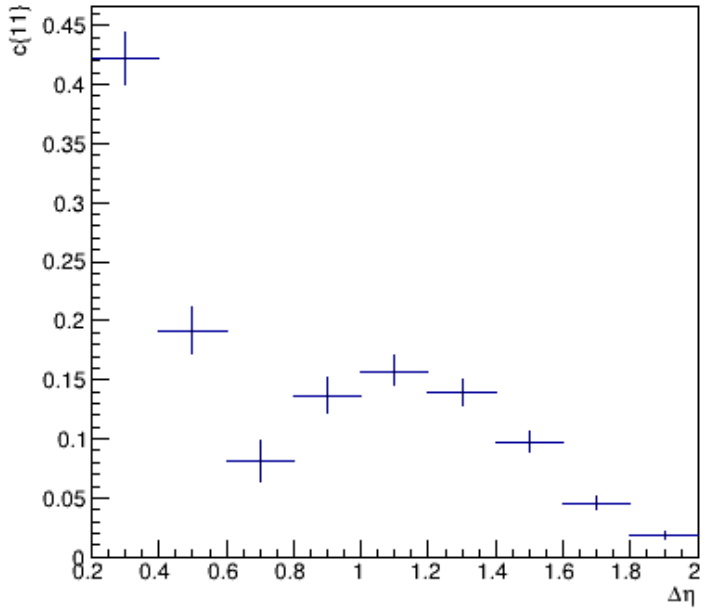
ψ is the spatial angle of J/ψ

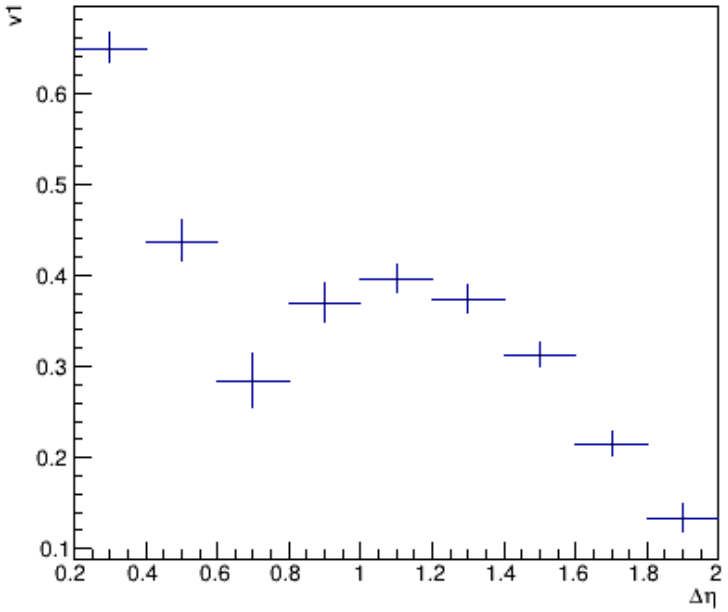
ϕ_1 and ϕ_2 are the azimuthal angles of reference particle.

Reference Flow(Two Particle Correlation v1) less event

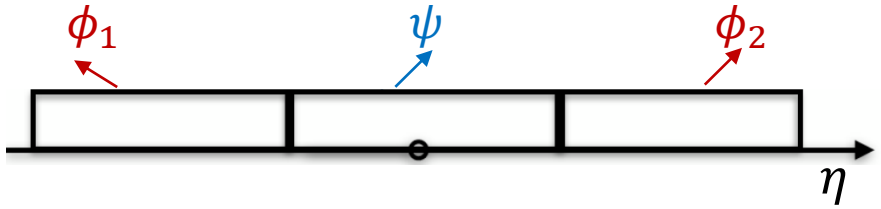


$$< e^{i(\phi_1 - \phi_2)} > = c\{11\} = v_1^2$$





Reference Flow(Particle Correlation v2)



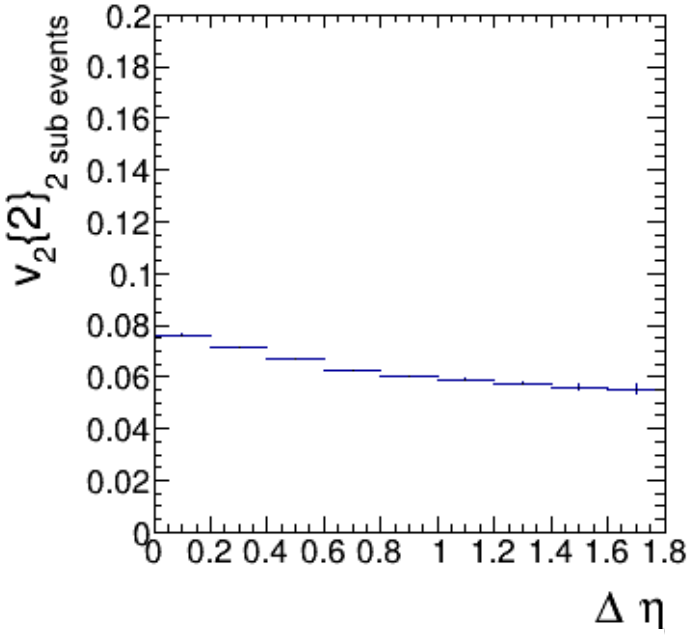
$$<< e^{2i(\phi_1-\phi_2)} >>= c_2\{2\} = v_2^2$$

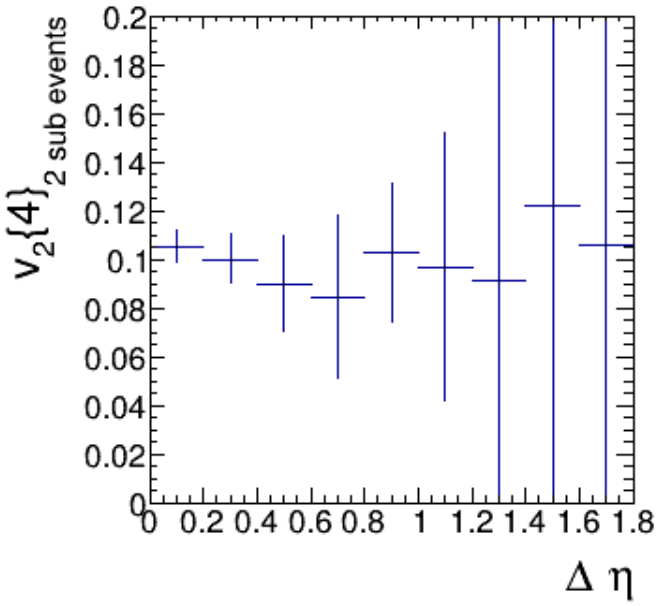
$$\langle\langle 4\rangle\rangle_{|\Delta\eta|} = \langle\langle \cos n(\varphi_1 + \varphi_2 - \varphi_3 - \varphi_4)\rangle\rangle$$

$$\begin{aligned}
\langle\langle 4\rangle\rangle_{|\Delta\eta|} &= \langle\langle \cos n(\varphi_1 + \varphi_2 - \varphi_3 - \varphi_4)\rangle\rangle \\
\langle\langle 2\rangle\rangle^2_{|\Delta\eta|} &= \langle\langle \cos n(\varphi_2 - \varphi_3)\rangle\rangle\langle\langle \cos n(\varphi_1 - \varphi_4)\rangle\rangle \\
\langle\langle 2\rangle\rangle^2_{|\Delta\eta|} &= \langle\langle \cos n(\varphi_1 - \varphi_3)\rangle\rangle\langle\langle \cos n(\varphi_2 - \varphi_4)\rangle\rangle \\
c_n\{4\}_{|\Delta\eta|} &= \langle\langle 4\rangle\rangle_{|\Delta\eta|} - 2\cdot\langle\langle 2\rangle\rangle^2_{|\Delta\eta|}.
\end{aligned}$$

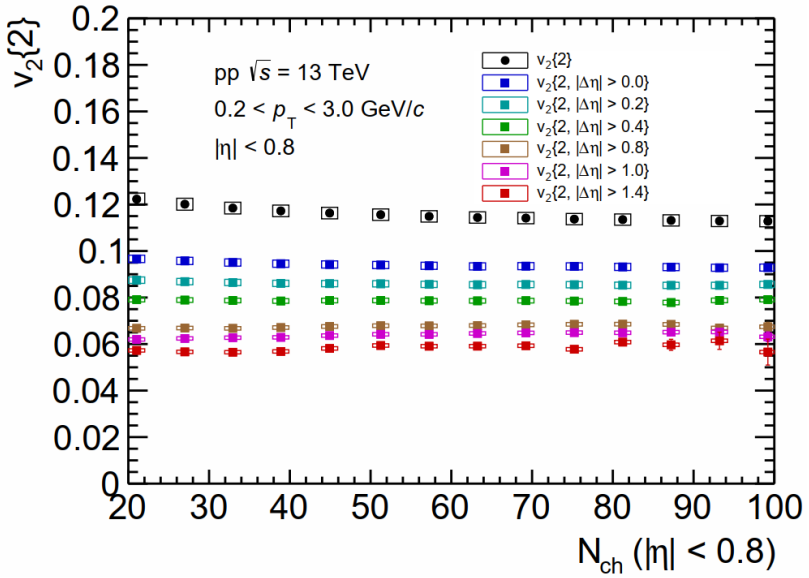
Auto-correlation Removed

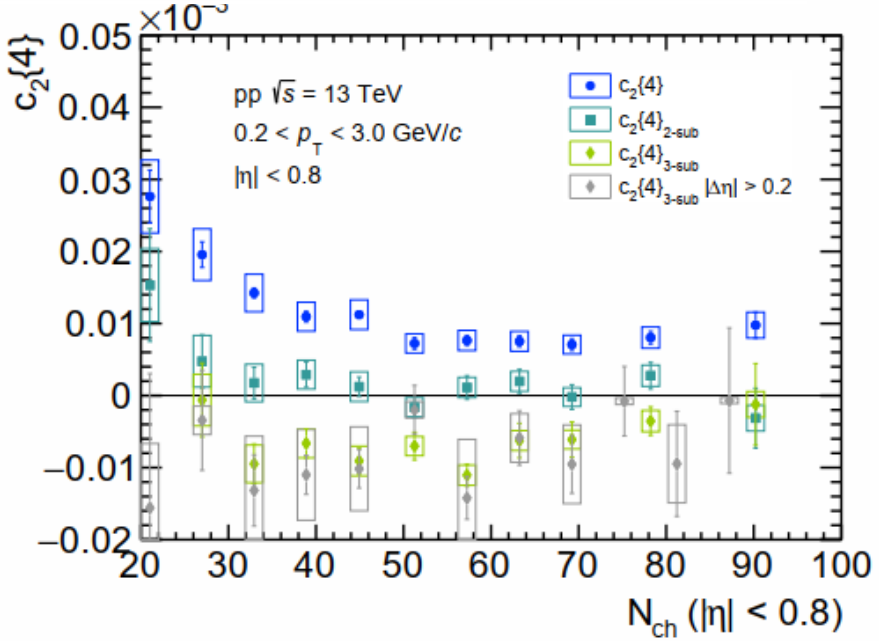
$$v_n\{2\} = \sqrt{c_n\{2\}} \quad v_n\{4\} = \sqrt[4]{-c_n\{4\}}$$

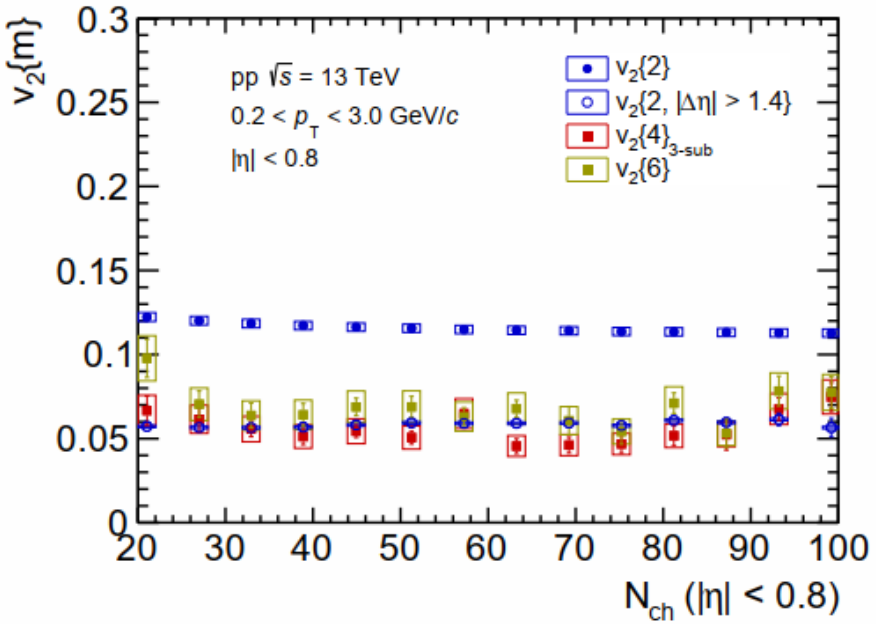




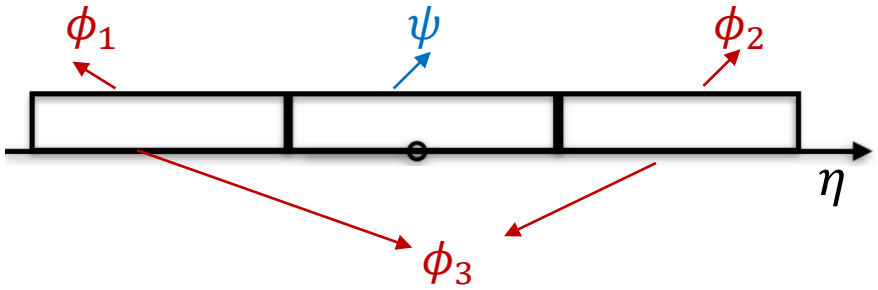
From Run2 13TeV pp Analysis Notes(For charged particle)







J/ψ Flow

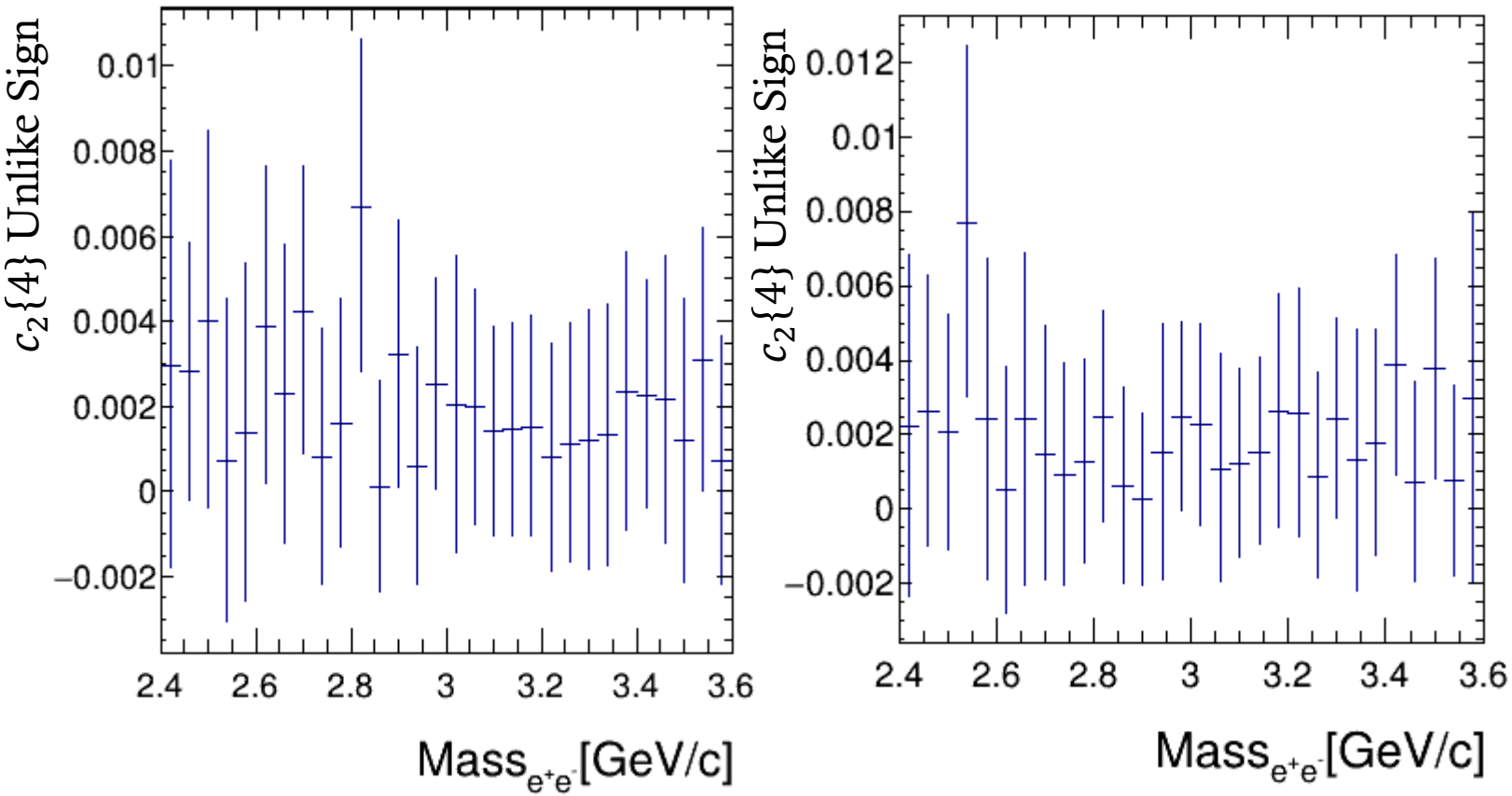


$<< e^{2i(\psi-\phi_1-\phi_2+\phi_3)} >>$

auto-correlation Removed

$\langle\langle e^{2i(\psi-\phi_1-\phi_2+\phi_3)}\rangle\rangle$
$-\langle\langle e^{2i(\psi-\phi_2)}\rangle\rangle\langle\langle e^{2i(\phi_3-\phi_1)}\rangle\rangle$
$-\langle\langle e^{2i(\psi-\phi_1)}\rangle\rangle\langle\langle e^{2i(\phi_3-\phi_2)}\rangle\rangle$
$= c_2\{4\} = v_2' \; v_2^3$

$\eta\ width = 1, p_T < 1$ GeV/c



$$v_2(m_{\ell\ell}) = v_2^{\text{sig}}\alpha(m_{\ell\ell}) + v_2^{\text{bkg}}(m_{\ell\ell})[1-\alpha(m_{\ell\ell})]$$

Next step: use the formula above to fit v_2 J/ψ