中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

Status report

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Introduction

- Use AOD sample to get a series of weights
- Add vertex information
- Use AOD sample to do SPS and DPS fit

Thank you for Tsinghua to provide AOD sample !

fiducial inclusive cross section

The J/ψ pair production cross section is measured in the fiducial region where both J/ψ pt>6 and absolute rapidity below 2.2 (when absolute rapidity below 1, J/ψ pt>7). The fiducial inclusive cross section can be calculate as follow formula:

$$\sigma_{fid} = \frac{N^{corr}}{\mathcal{L}\mathcal{B}^2(J/\psi \to \mu\mu)} \qquad \mathcal{L} = 36.3 fb^{-1} \qquad \mathcal{B}^2(J/\psi \to \mu\mu) = 5.93 \pm 0.06\%$$

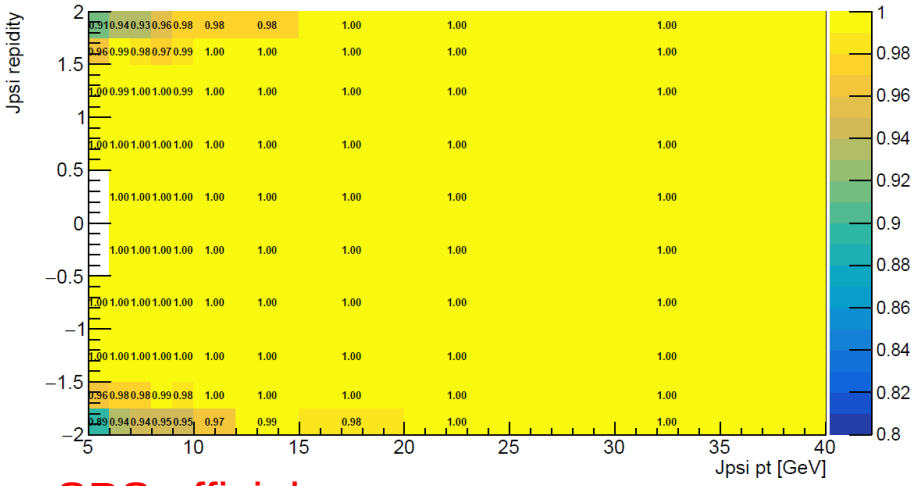
The N^{corr} can be obtained as:

$$N^{corr} = [\sum_i^{N^{obs}} \omega_{acc}^i(J/\psi_1)\, \omega_{acc}^i(J/\psi_2)\, \omega_{reco}^i(J/\psi_1)\, \omega_{reco}^i(J/\psi_2)\, \omega_{eff}^i(J/\psi_1)\, \omega_{eff}^i(J/\psi_2)\, \omega_{vtx}^i(J/\psi_1)\, \omega_{vtx}^i(J/\psi_2)\, \omega_{trig}^i(J/\psi_1, J/\psi_2)\, \omega_{evt}^i(J/\psi_1, J/\psi_2)]^{-1}$$

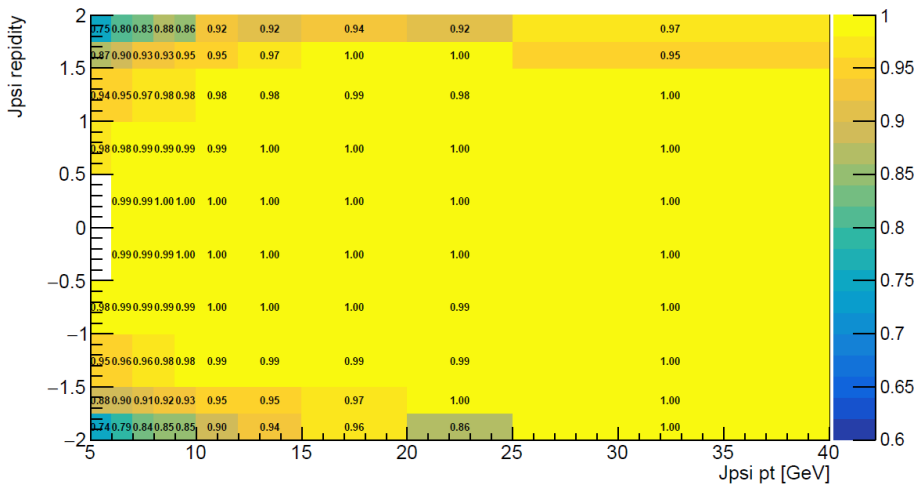
- N^{obs} number of observed J/ψ Pair events in fiducial region
- ω_{acc} the probability for a J/ψ (|η| <2.2 and decaying to a pair of muon) decay to two muon within the geometrical acceptance of detector(muon (|η| <2.4)
- ω_{reco} the probability for two muon from the J/ψ which pass ω_{acc} can be reconstructed by PF algorithm as muon
- ω_{eff} the probability for two muon from the J/ψ which pass the ω_{acc} and ω_{reco} can pass the event selection
- ω_{vtx} the probability for two muon from the J/ψ which pass the ω_{acc} , ω_{reco} and ω_{eff} to have a vertex probability above 0.005
- $\omega_{trigger}$ the probability of a event include a pair of J/ψ which have pass the ω_{acc} , ω_{reco}, ω_{eff} and ω_{vtx} can pass the trigger
- ω_{evt} the probability of a event include a pair of J/ψ which have pass the ω_{acc} , ω_{reco}, ω_{eff}, ω_{vtx} and $\omega_{trigger}$ to have a vertex probability of four muons above 0.05

Acceptance probability

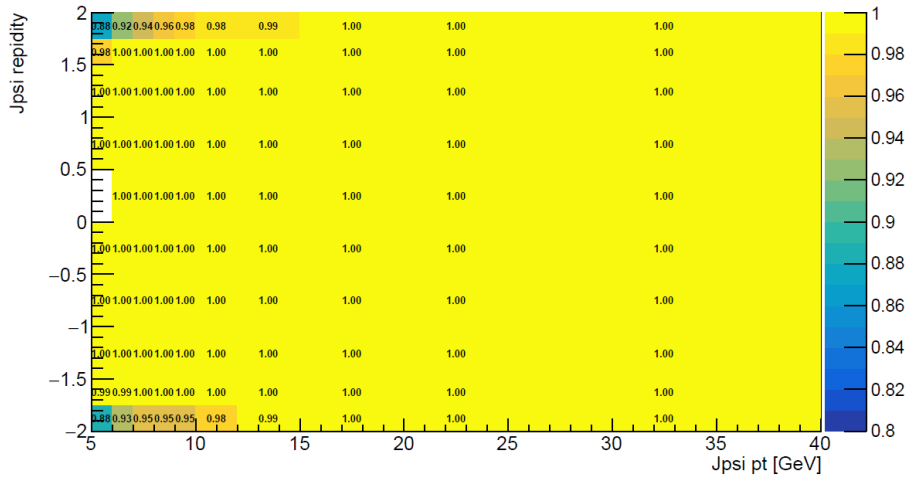
DPS official



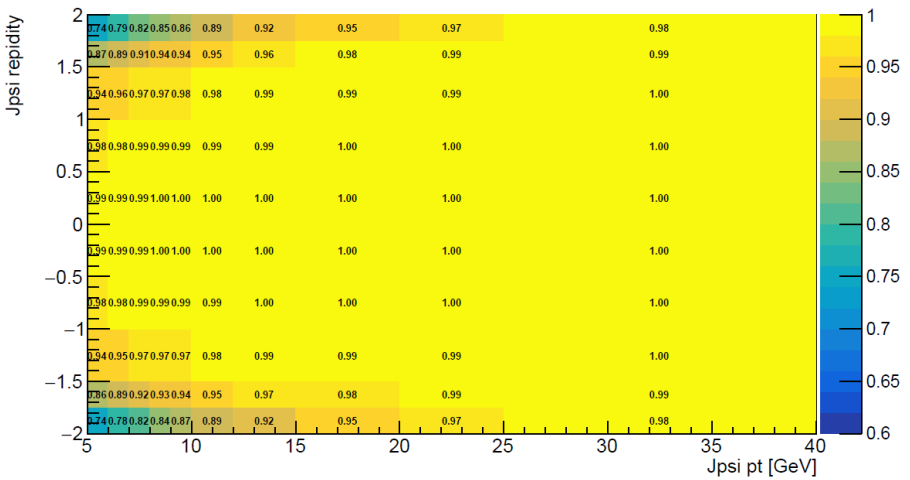
DPS private



SPS official



SPS private



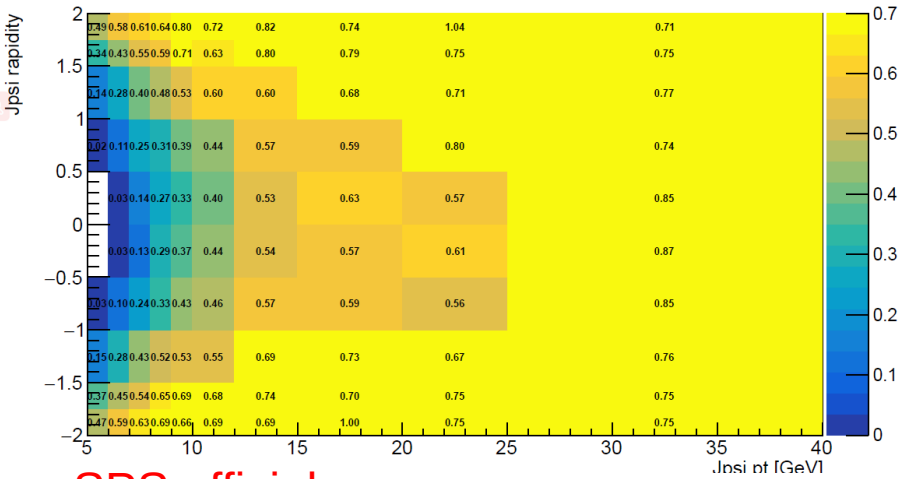
- The ω_{acc} was calculated in the J/ψ (pt , rapidity) plane
- DEN and NUM were calculated in generator level

$$\omega_{acc} = \frac{NUM}{DEN}$$

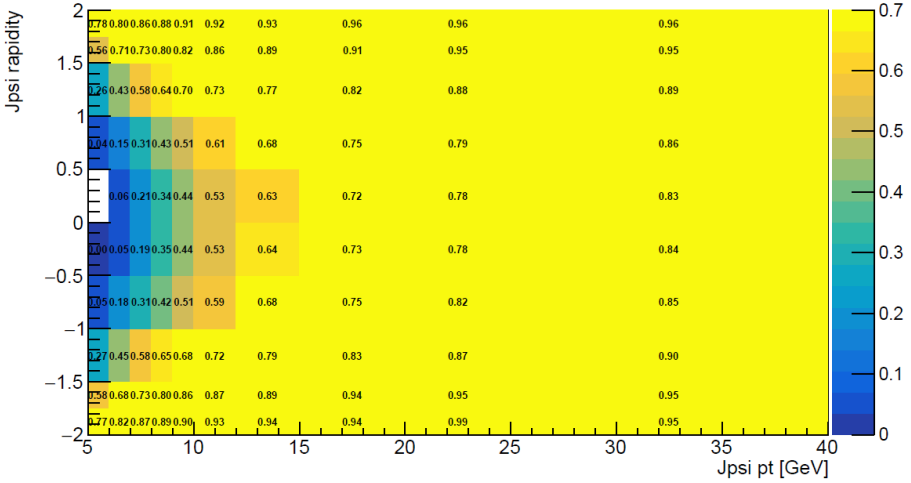
DEN = Number of J/ψ with $|\eta|$ <2 and decaying to a pair of muons
NUM = DEN && muon $|\eta|$ < 2.4

Reconstruct probability

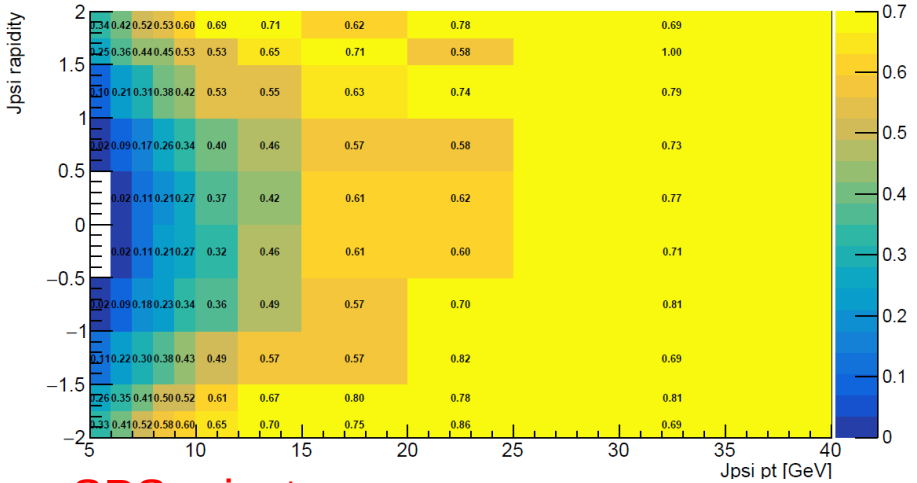
DPS official reconstruct probability



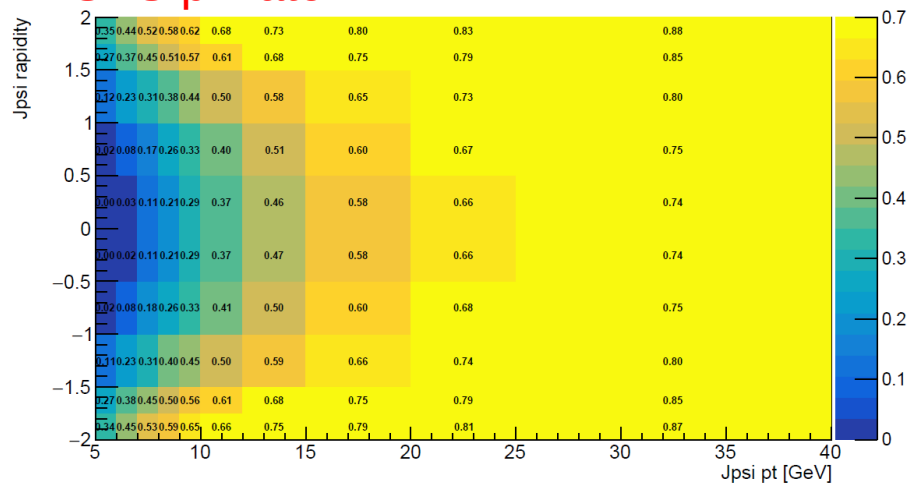
SPS official reconstruct probability



DPS private reconstruct probability



SPS private reconstruct probability



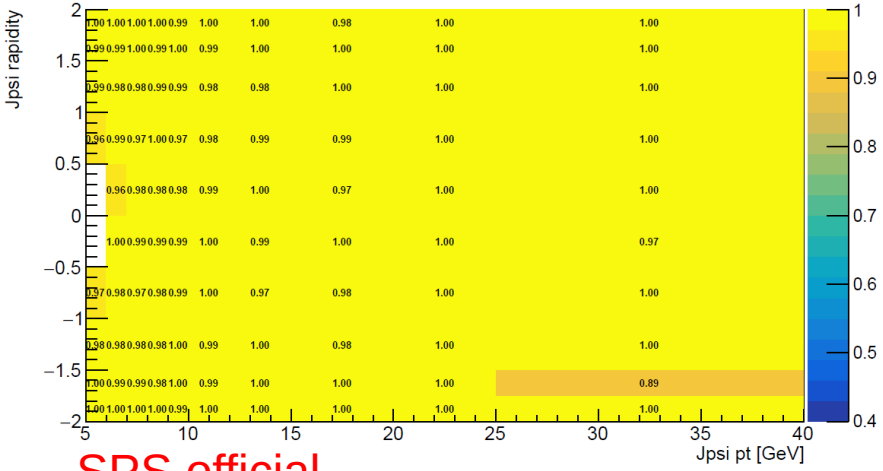
- The ω_{reco} was calculated in the J/ψ (pt , rapidity) plane
- DEN were calculated in generator level but NUM were calculated in reconstructed level
- Reconstructed events in NUM do GEN matched

$$\omega_{reco} = \frac{NUM}{DEN}$$

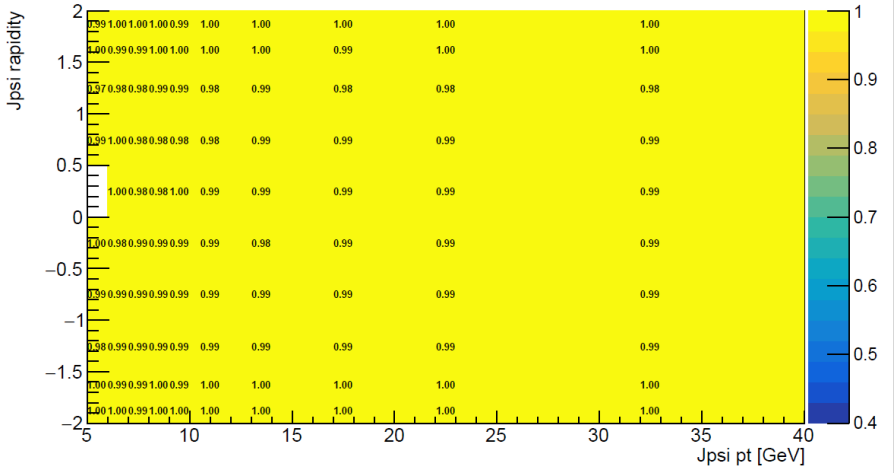
DEN = Number of J/ψ with $|\eta|$ <2 and decaying to a pair of muons with muon $|\eta|$ <2.4(the NUM in ω_{acc})
NUM = DEN && Pair of muons reconstructed by PF algorithm as muon

Selection efficiency

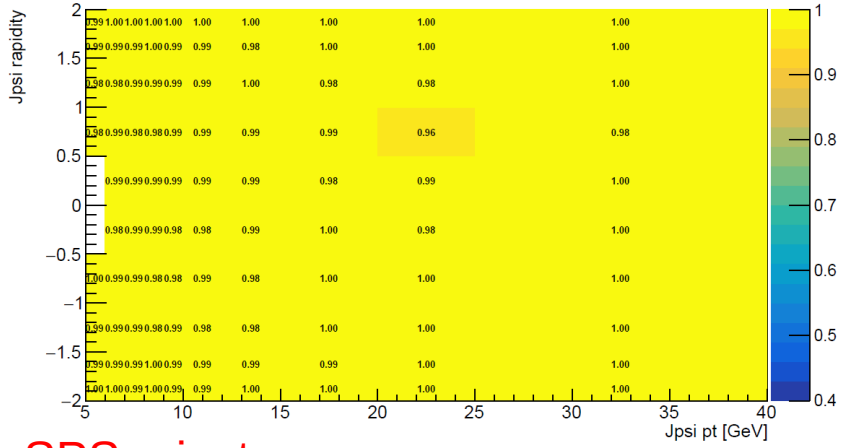
DPS official selection probability



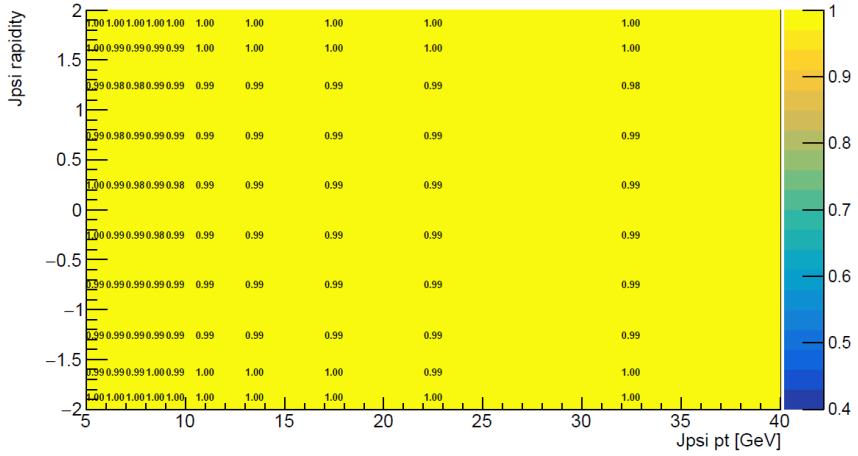
SPS official selection probability



DPS private selection probability



SPS private selection probability



- The ω_{eff} was calculated in the J/ψ (pt , rapidity) plane
- DEN and NUM were calculated in reconstructed level

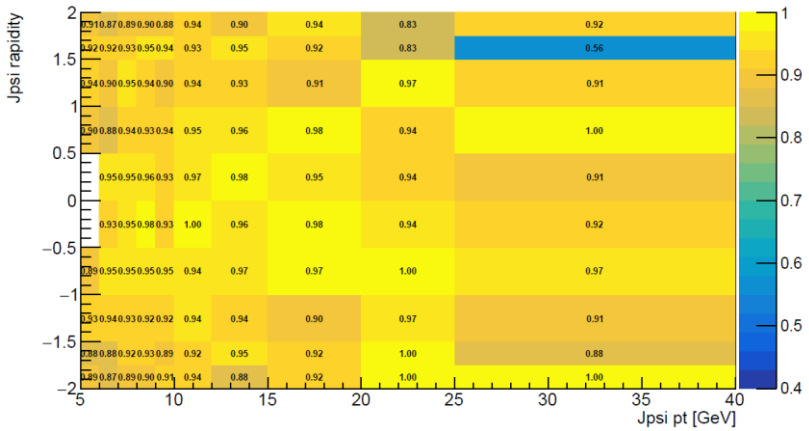
$$\omega_{eff} = \frac{NUM}{DEN}$$

DEN = The NUM in ω_{reco}

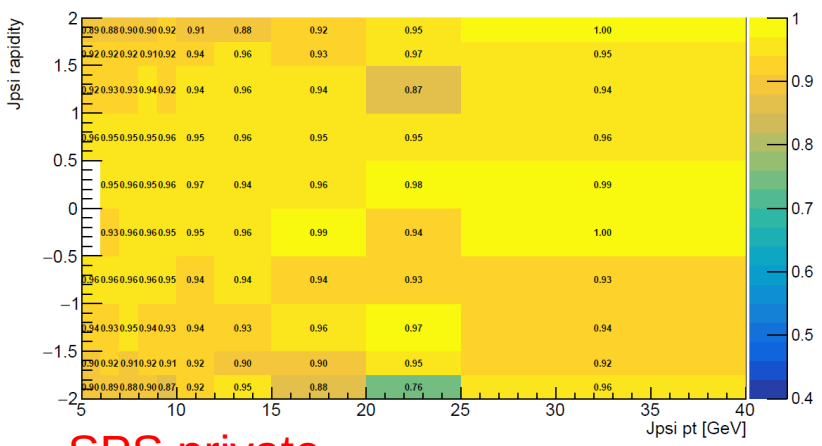
NUM = DEN && J/ψ and decayed muon pass the event selection(soft medium ID, pt and η cut for RECO muon)

Vertex probability cut

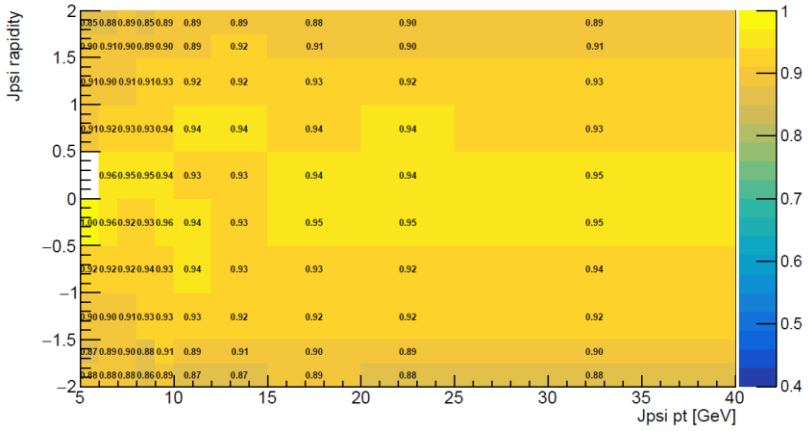
DPS official



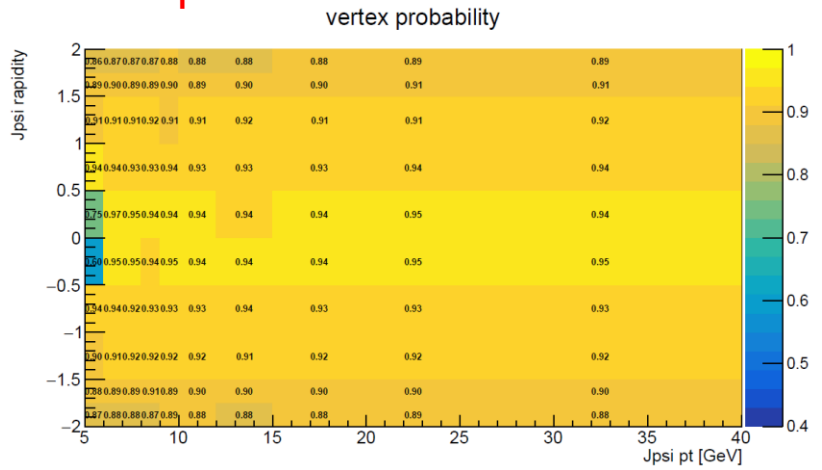
DPS private



SPS official



SPS private



- The ω_{vtx} was calculated in the J/ψ (pt , rapidity) plane
- DEN and NUM were calculated in reconstructed level

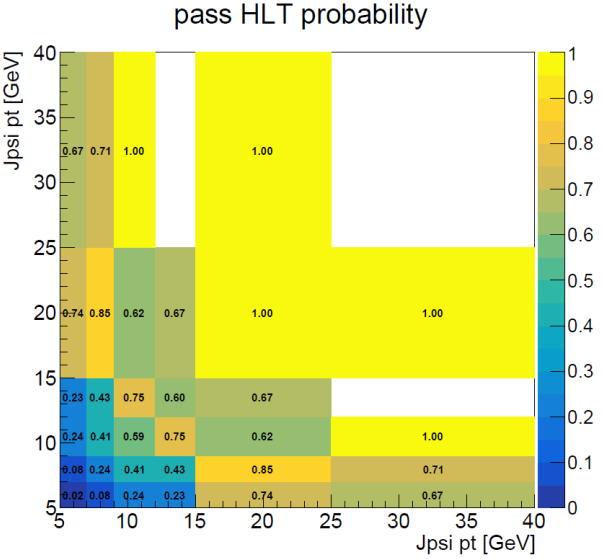
$$\omega_{vtx} = \frac{NUM}{DEN}$$

DEN = The NUM in ω_{eff}

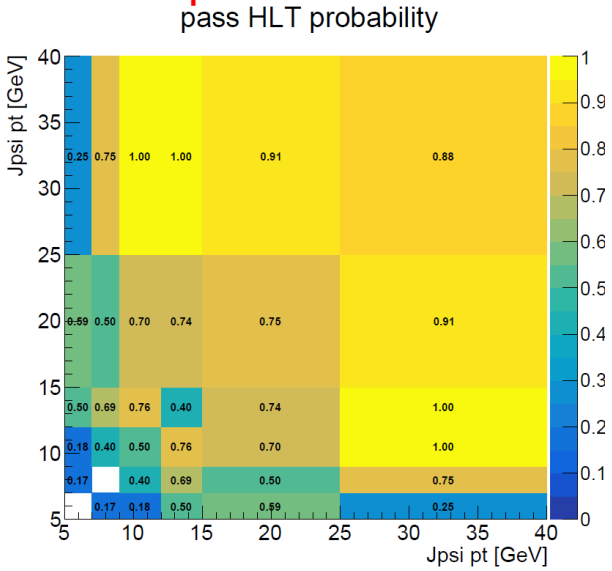
NUM = DEN && J/ψ and decayed muon have a vertex probability above 0.005

Events pass trigger probability

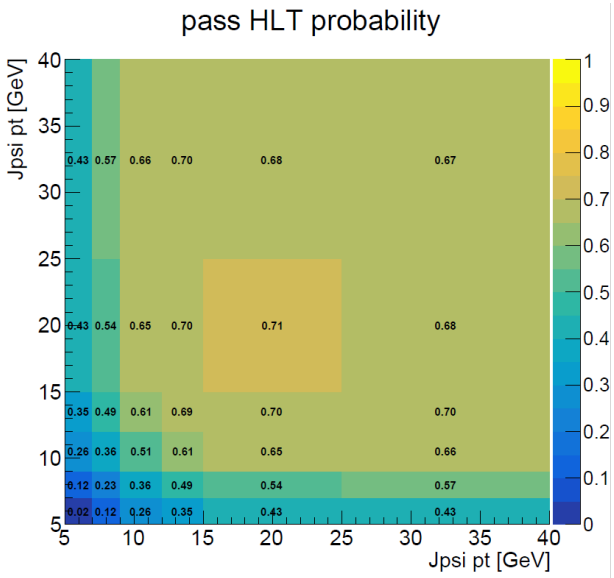
DPS official



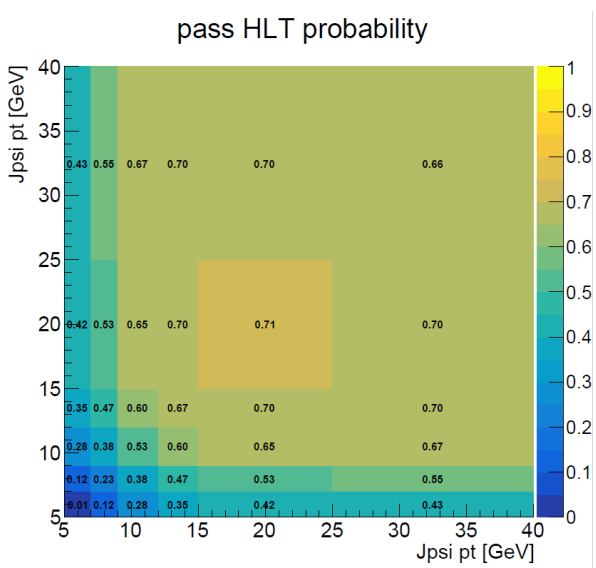
DPS private



SPS official



SPS private



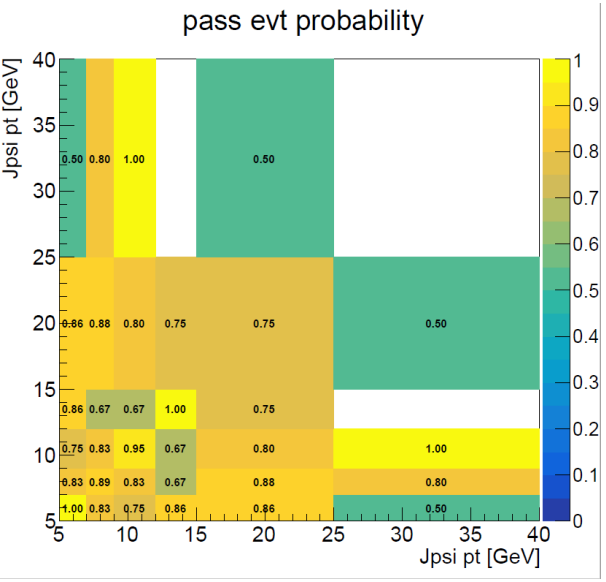
$$\omega_{trig} = \frac{NUM}{DEN}$$

DEN = event included a pair of muons which pass the ω_{acc} , ω_{reco}, ω_{eff} and ω_{vtx}
NUM = DEN && event pass trigger

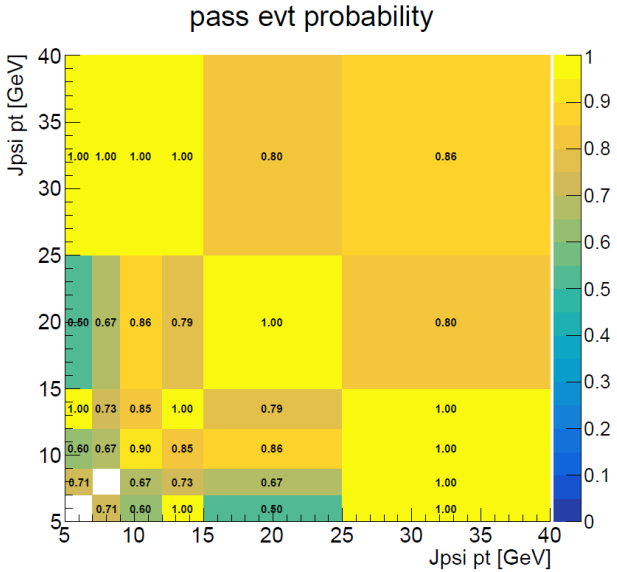
- The ω_{trig} was calculated in the(J/ψ_1 pt , J/ψ_2 pt) plane
- DEN and NUM were calculated in reconstructed level
- Since J/ψ pairs assigned randomly, ω_{trig} should be symmetric for J/ψ_1 and J/ψ_2

Four muon vertex probability cut

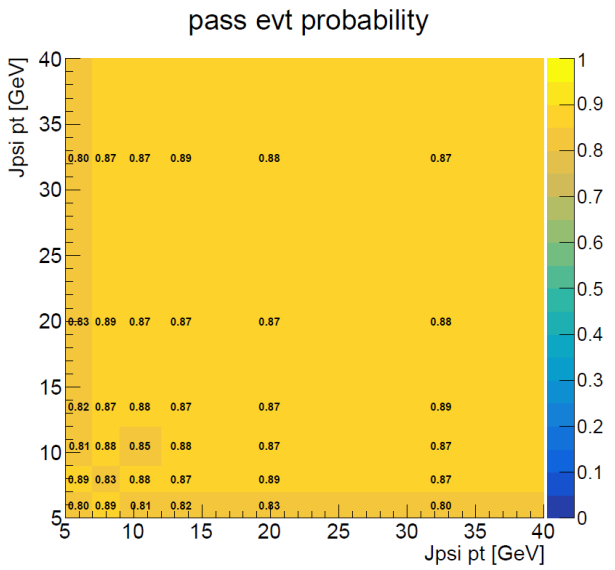
DPS official



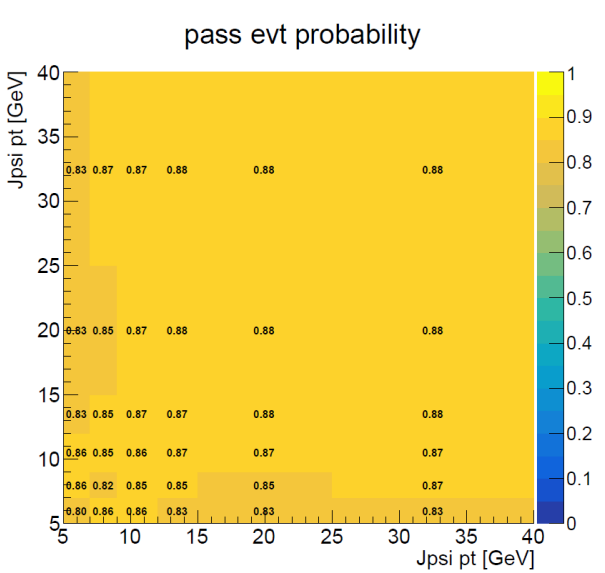
DPS private



SPS official



SPS private



$$\omega_{evt} = \frac{NUM}{DEN}$$

DEN = event included a pair of muons which pass the ω_{acc} , ω_{reco}, ω_{eff}, ω_{vtx} and $\omega_{trigger}$
NUM = DEN && event pass trigger

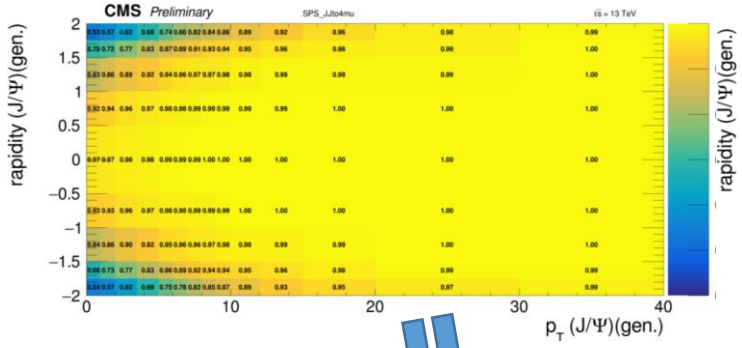
- The ω_{evt} was calculated in the(J/ψ_1 pt , J/ψ_2 pt) plane
- DEN and NUM were calculated in reconstructed level
- Since J/ψ pairs assigned randomly,ω_{evt} should be symmetric for J/ψ_1 and J/ψ_2

Difference between Tsinghua and IHEP

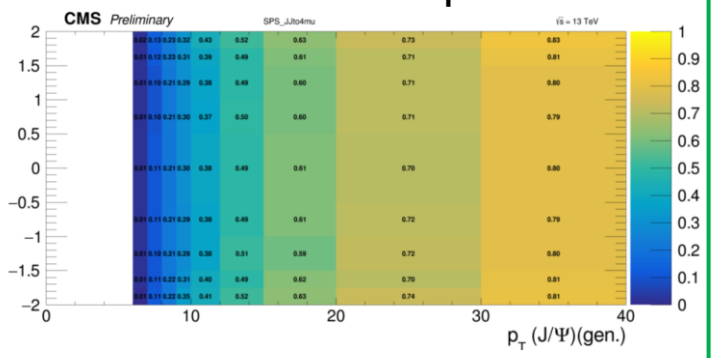
Tsinghua

Gen muon |η|<2.4

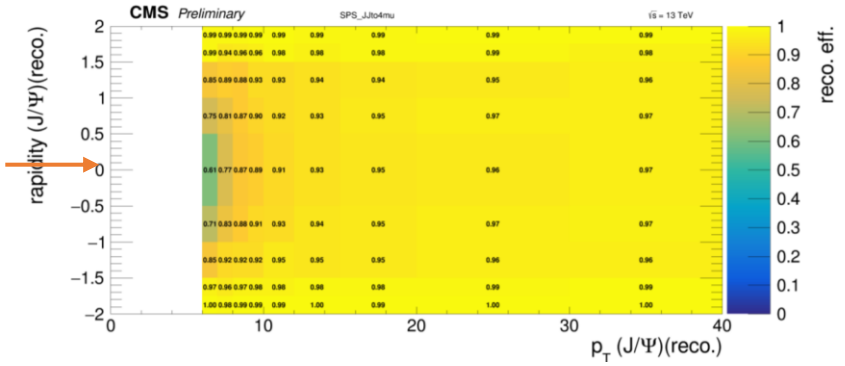
acceptance



Gen muon pt>3.5

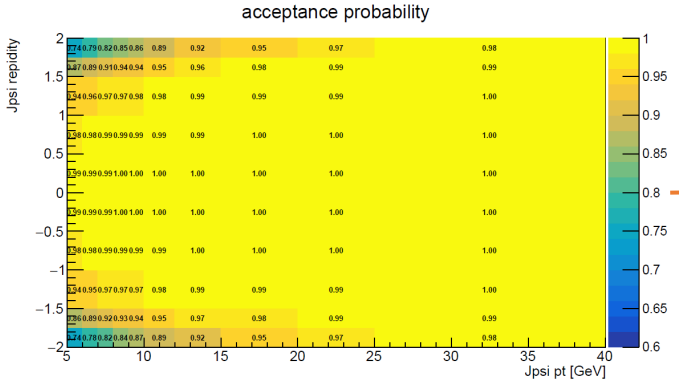


reconstruct

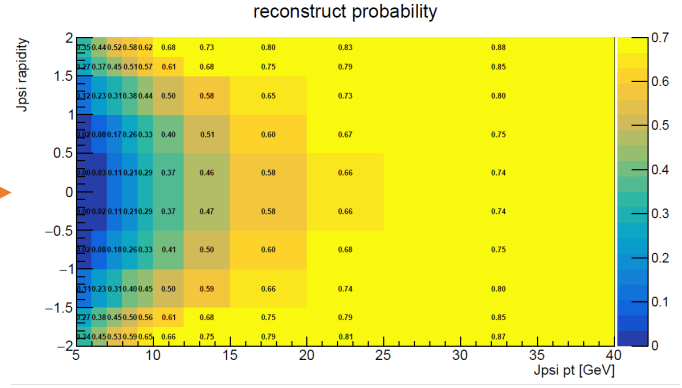


IHEP

acceptance



reconstruct



Gen muon |η|<2.4
No cut for pt

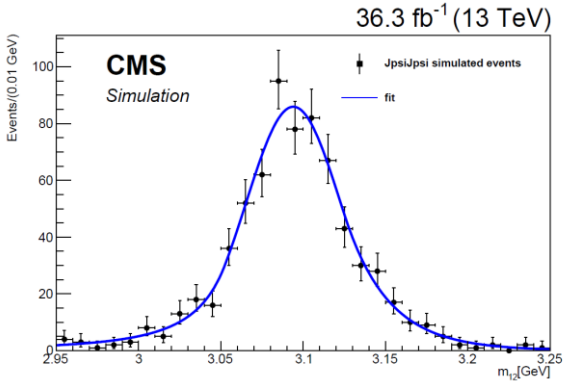
The reconstruct weights are different but other weights are similar

SPS and DPS Fit

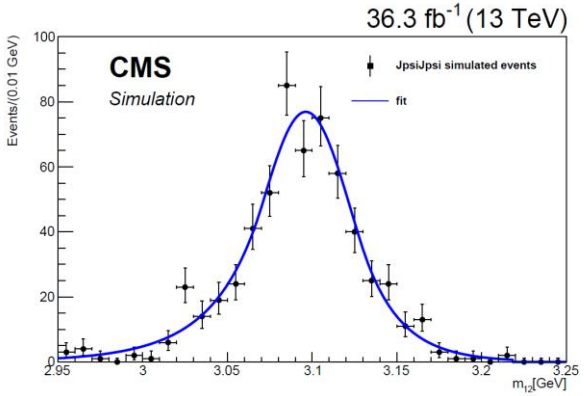
J/ψ: using double-sided Crystal Ball (DSCB) function

$$f_S(x;\vec{\theta}) = \begin{cases} \left(\frac{n_L}{|\alpha_L|}\right)^{n_L} \exp\left(\frac{-|\alpha_L|^2}{2}\right)\left(\frac{n_L}{|\alpha_L|} - |\alpha_L| - \frac{x-\mu}{\sigma}\right)^{-n_L}, & \text{for } \frac{x-\mu}{\sigma} \leq -\alpha_L \\ \exp\left(-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right), & \text{for } -\alpha_L < \frac{x-\mu}{\sigma} < \alpha_R \\ \left(\frac{n_R}{|\alpha_R|}\right)^{n_R} \exp\left(\frac{-|\alpha_R|^2}{2}\right)\left(\frac{n_R}{|\alpha_R|} - |\alpha_R| + \frac{x-\mu}{\sigma}\right)^{-n_R}, & \text{for } \frac{x-\mu}{\sigma} \geq \alpha_R, \end{cases}$$

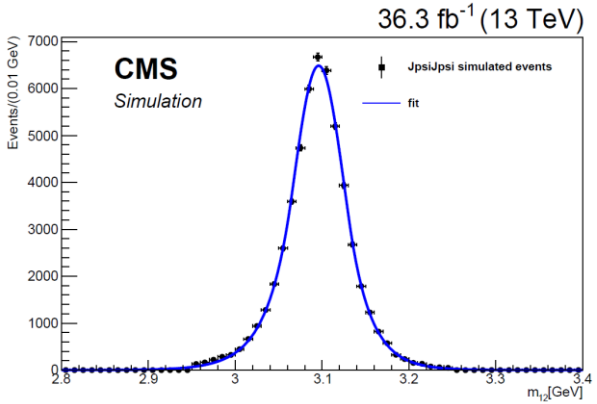
DPS official



DPS private



SPS official



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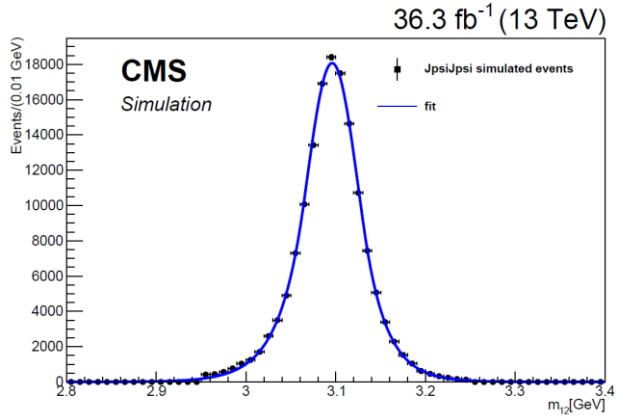

- Double-sided Crystal Ball (DSCB) is a good function to fit SPS and DPS shape

Next step

- Do the closure test

- Use AOD data to get cross section and fraction of DPS