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ALICE

First look of inclusive J/ψ cross section in Run 3 pp collisions

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Introduction

$$\frac{d^2\sigma}{dydp_T} = \frac{N_{raw}^{J/\psi}}{(A \times \epsilon)BR_{J/\psi \to ee}\Delta y\ \Delta p_T Lumi.}$$

- BR: $(5.971 \pm 0.032)\%$
- Lumi: 19.3 pb^{-1}
- N: raw counts obtained from J/psi signal extraction using high IR data collected in 2022
- A $\times$ ε: obtained from data-driven and general purpose MC anchored to low IR data

Datasets

Data

- DQ-PWG-skimmed-Jpsi2eeTree:
  - 523142, 523148, 523182, 523186, 523298, 523306, 523308, 523309, 523397, 523399, 523401, 523441, 523541, 523559, 523669, 523671, 523677, 523728, 523731, 523779, 523783, 523786, 523788, 523789, 523792, 523797, 523821, 526463, 526465, 526466, 526467, 526468, 526486, 526505, 526512, 526525, 526526, 526528, 526559, 526596, 526606, 526612, 526639, 526641, 526647, 526649, 526713, 526714, 526715, 526716, 526719, 526720, 526776, 526886, 526938, 526963, 526964, 526966, 526967, 526968, 527015, 527016, 527028, 527031, 527033, 527034, 527038, 527039, 527041, 527057, 527076, 527109, 527237, 527240, 527259, 527260, 527261, 527262, 527349, 527446, 527518, 527523, 527690, 527694, 527731, 527734, 527736, 527821, 527825, 527826, 527828, 527848, 527850, 527852, 527863, 527864, 527865, 527869, 527871, 527895, 527898, 527899, 527902, 527963, 527976, 527978, 527979, 528021, 528026, 528036, 528094, 528097, 528105, 528107, 528109, 528110, 528231, 528232, 528233, 528263, 528266, 528292, 528294, 528316, 528319, 528328, 528329, 528330, 528332, 528336, 528347, 528359, 528379, 528381, 528386, 528448, 528451, 528461, 528463, 528530, 528531, 528534, 528537, 528543, 528602, 528604, 528617, 528781, 528782, 528783, 528784, 528798, 528801, 529077, 529078, 529084, 529088, 529115, 529116, 529117, 529128, 529208, 529209, 529210, 529211, 529237, 529242, 529248, 529252, 529270, 529306, 529317, 529320, 529324, 529338, 529341, 529450, 529452, 529454, 529458, 529460, 529461, 529462, 529542, 529552, 529554, 529662, 529663, 529664, 529674, 529675, 529690, 529691

MC

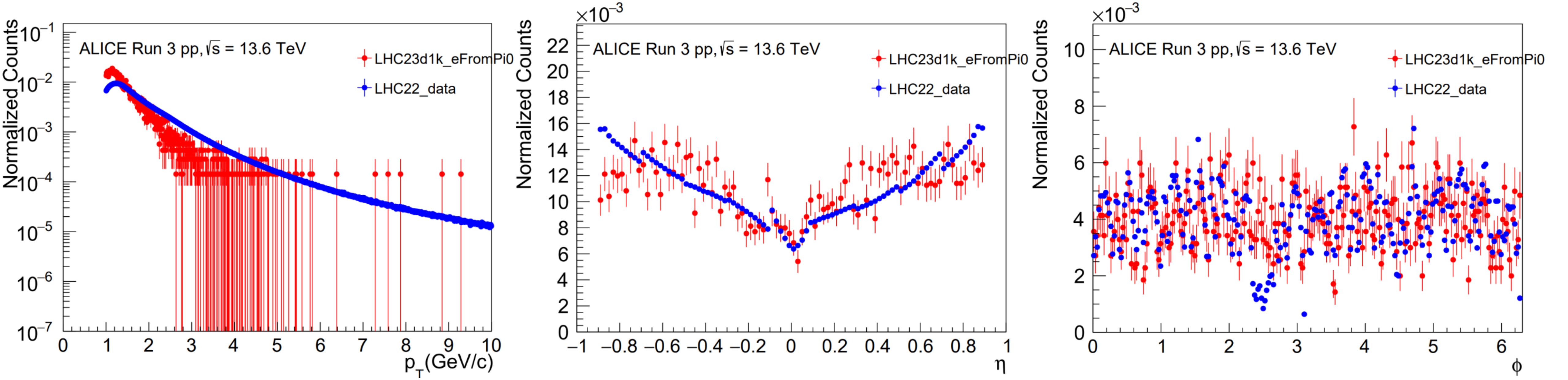
- LHC23d1k:
  - 520259, 520294, 520471, 520472, 520473

Analysis cuts

- Event selection:
  - |VtxZ| < 10 cm

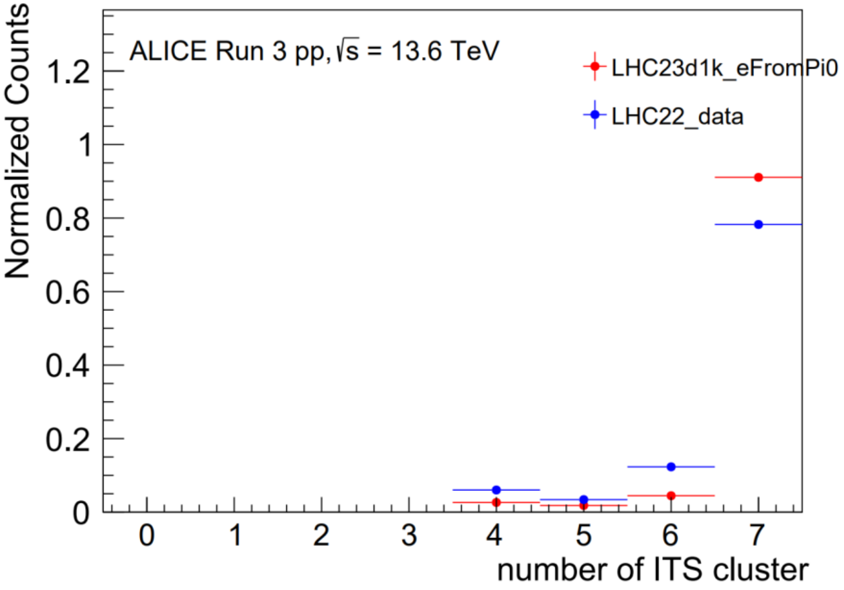
- Tracking cuts:
  - p_T > 1 GeV/c
  - |η| < 0.9
  - TPCncls > 90
  - TPCchi2 < 4
  - ITSncls > 3
  - ITSchi2 < 5
  - At least one hit at the first two layers of ITS
  - |DCAz | < 1.5 cm
  - |DCAzy | < 1 cm
- PID cuts:
  - -2 < TPC$n\sigma^{e}$ < 3
  - TPC$n\sigma^{p}$ > 3
  - TPC$n\sigma^{\pi}$ > 3

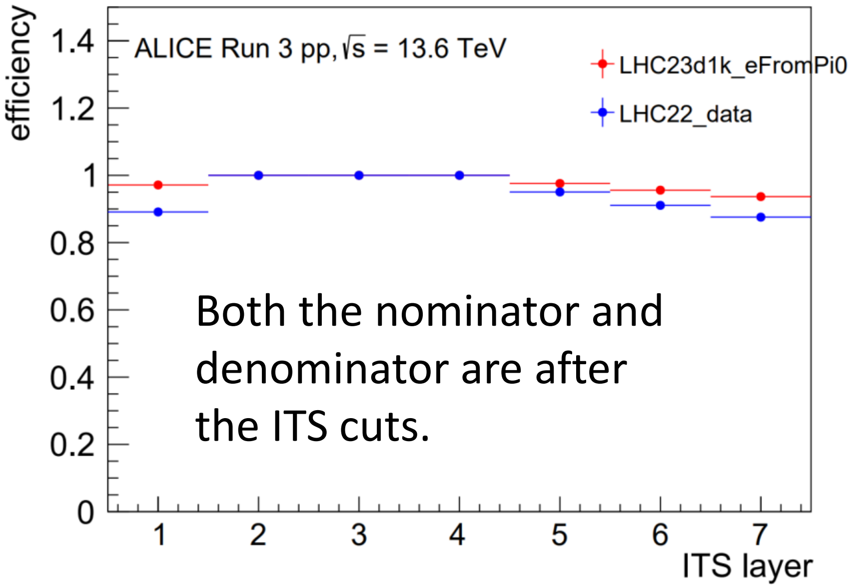
kinematics distribution



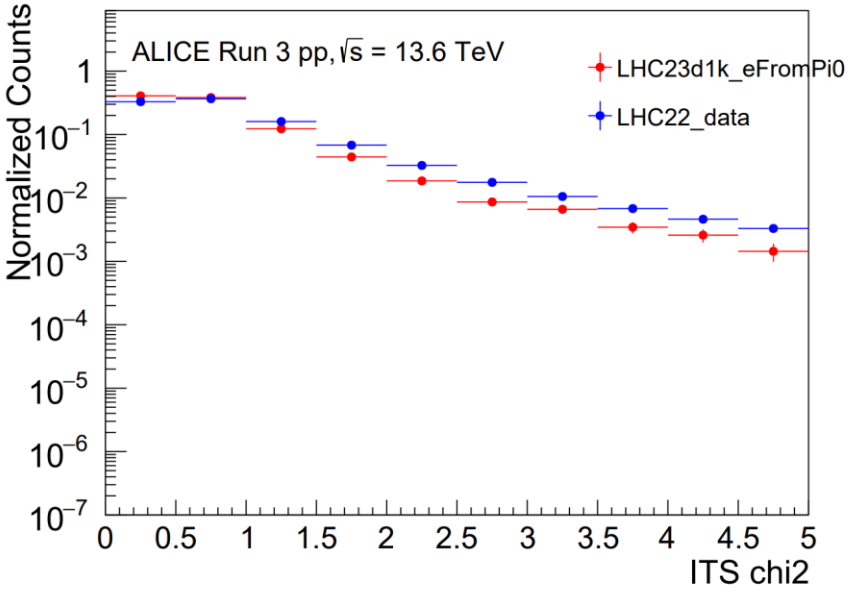
- The same cuts are applied on data and MC when drawing the QA plots.
- The pT distribution are different between data and eFromPi0 in MC.
- The eta and phi distributions are similar between data and MC.
- The statistics of tracks with high pT in MC is low.

ITS distribution



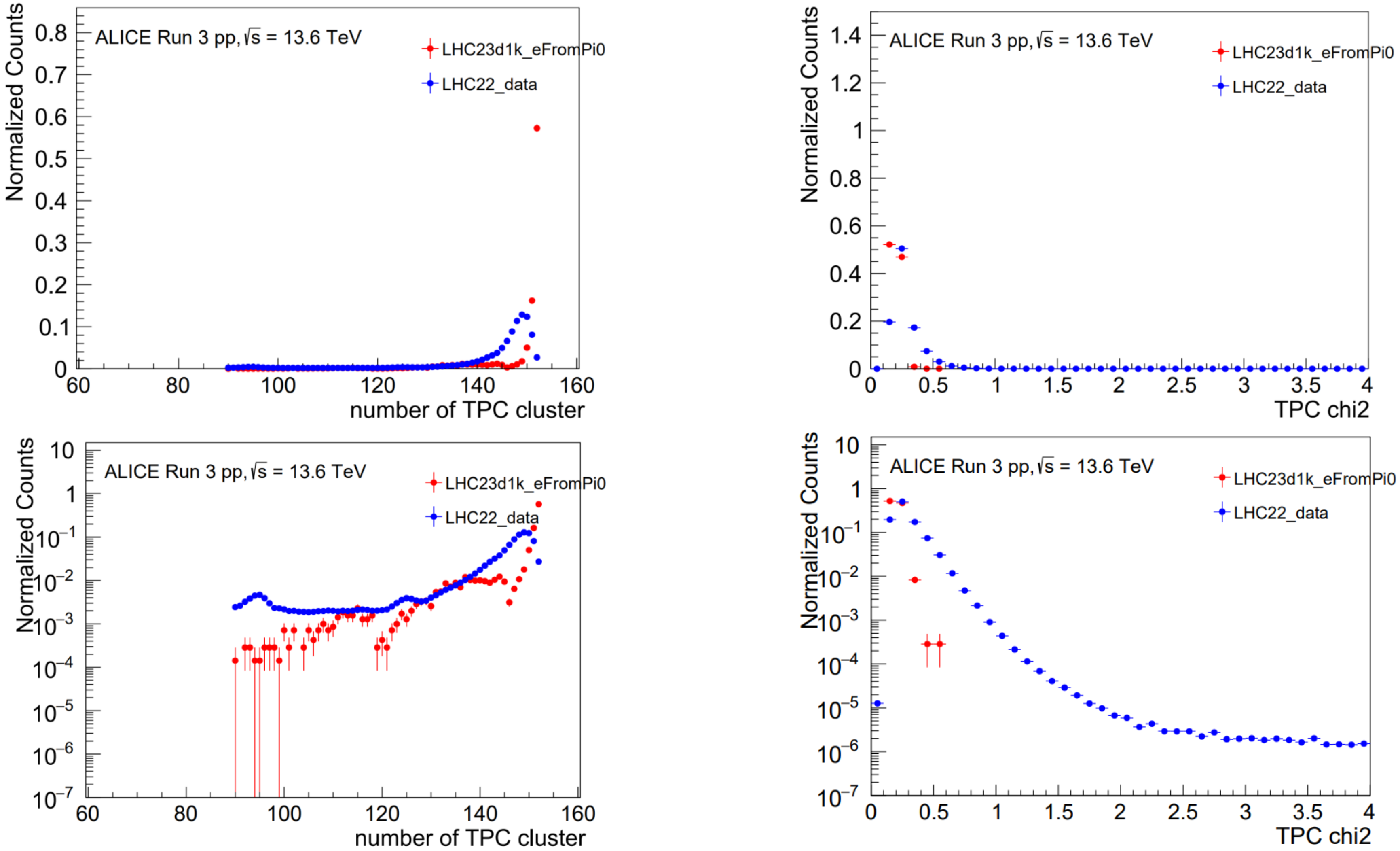


Both the nominator and denominator are after the ITS cuts.



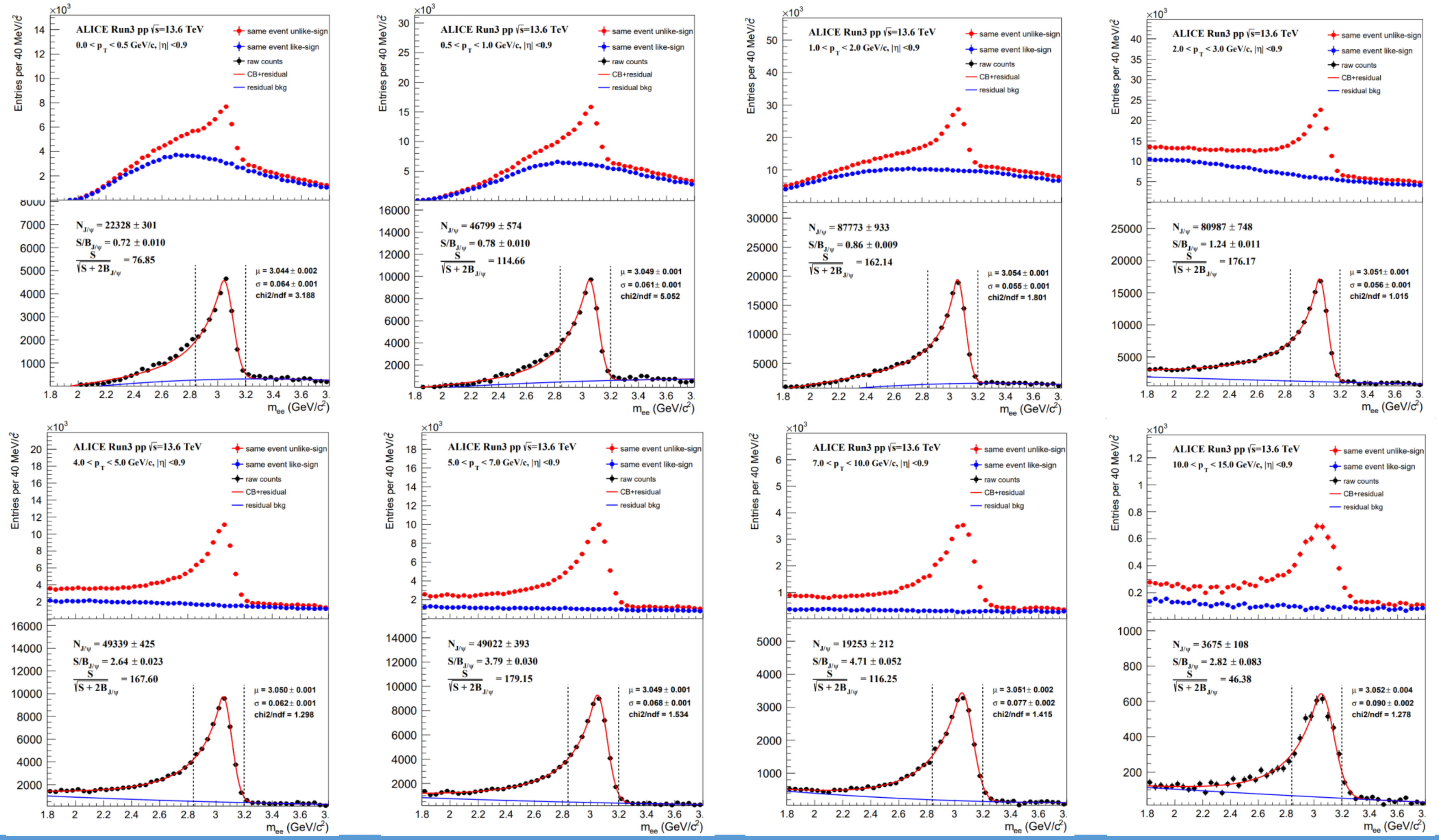
- The ITSncls distribution are different between data and MC.
- The ITS perform better in MC, since the data is high IR but MC is anchored to low IR.

TPC distribution



- The TPCncls distribution are different between data and MC.
- The TPC perform better in MC, since the data is high IR but MC is anchored to low IR.

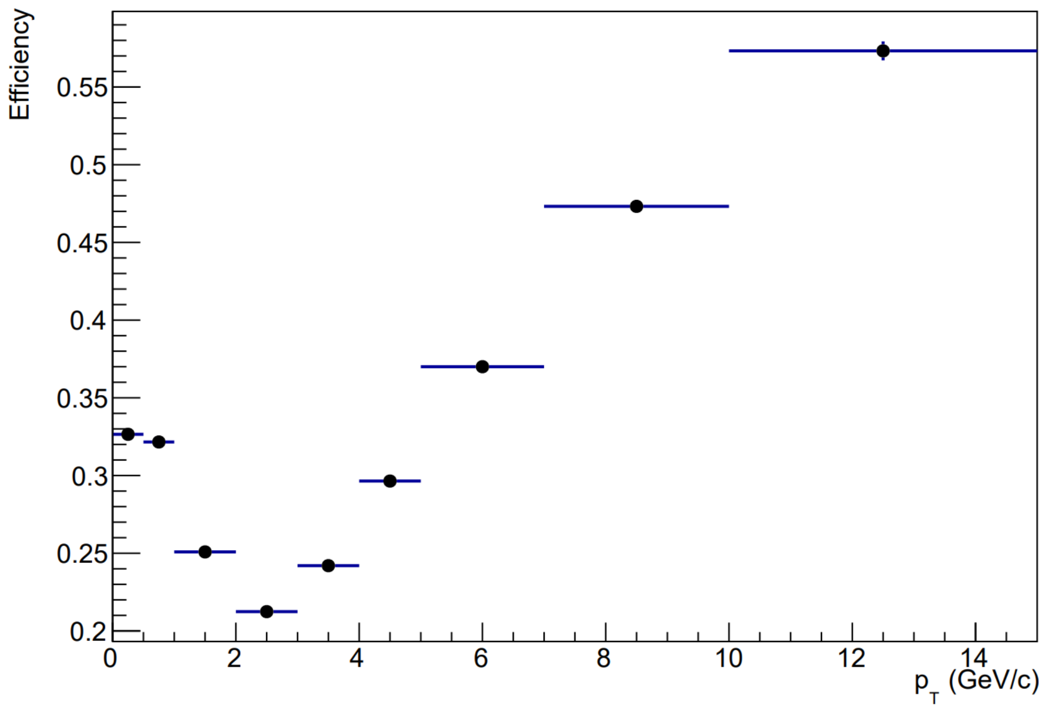
Signal extraction



- Signal shape is obtained by directly fitting the data using Crystal Ball function.
- Residual background is fitted by second order polynomial function

Efficiency calculation

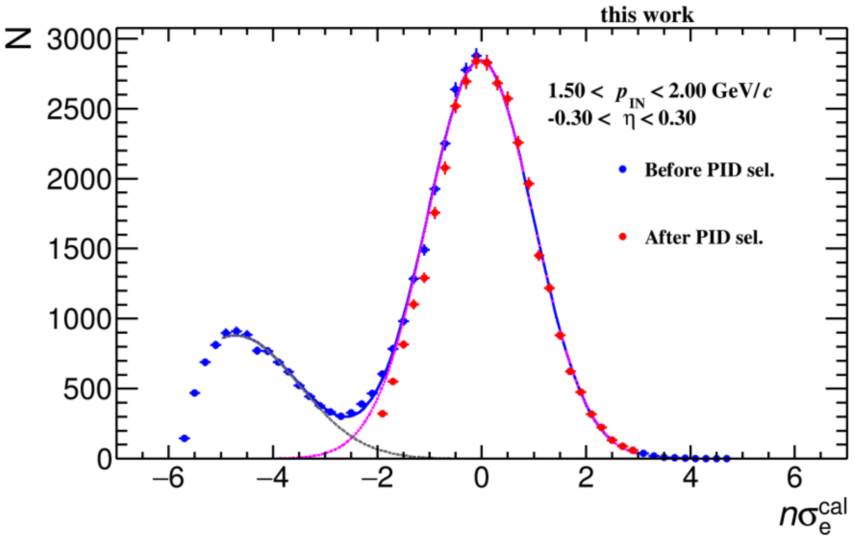
Acceptance



- Toy MC is used to simulate J/psi decay to dielectron.
- Apply the acceptance cut on electron.
- The J/psi pass the cut only if the two daughters pass the acceptance cut.

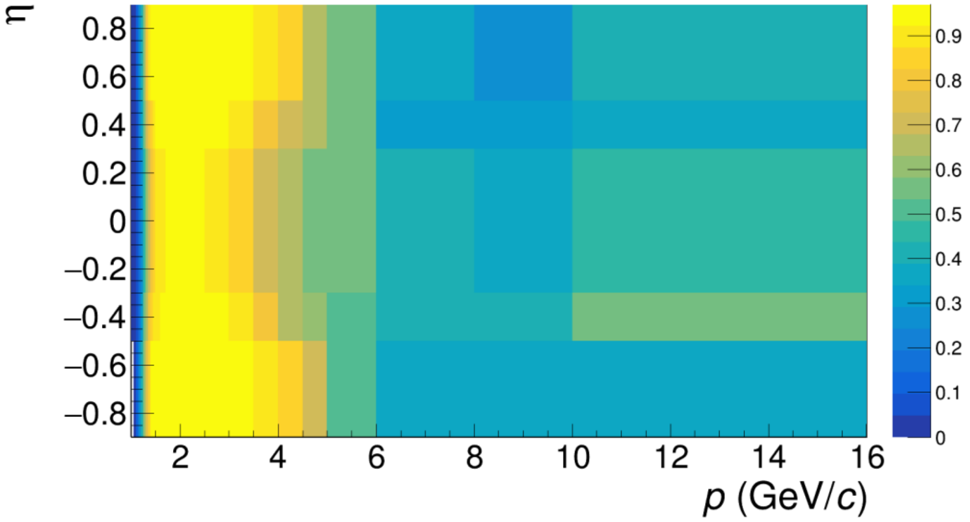
Efficiency calculation

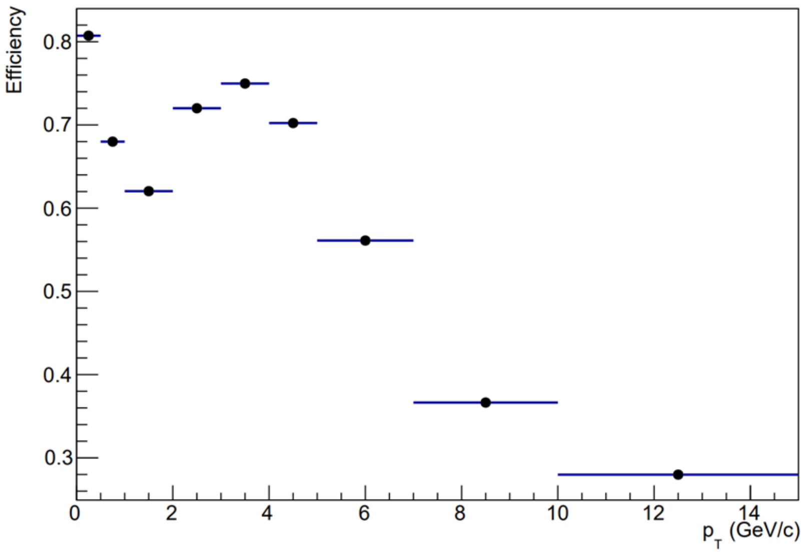
PID efficiency



$$Pur(n^1_{\sigma_e}, n^2_{\sigma_e}) = \frac{\int_{n^1_{\sigma_e}}^{n^2_{\sigma_e}} G_e(n_{\sigma_e}) dn_{\sigma_e}}{\int_{n^1_{\sigma_e}}^{n^2_{\sigma_e}} (G_\pi(n_{\sigma_e}) + G_e(n_{\sigma_e})) dn_{\sigma_e}}$$

$$Eff^{leg}_{PID} = \frac{\sum_1^{N_{bins}} N^i_{after}(n_{\sigma_e}) \times Pur^i(n_{\sigma_e})}{\sum_1^{N_{bins}} N^i_{before}(n_{\sigma_e}) \times Pur^i(n_{\sigma_e})}$$

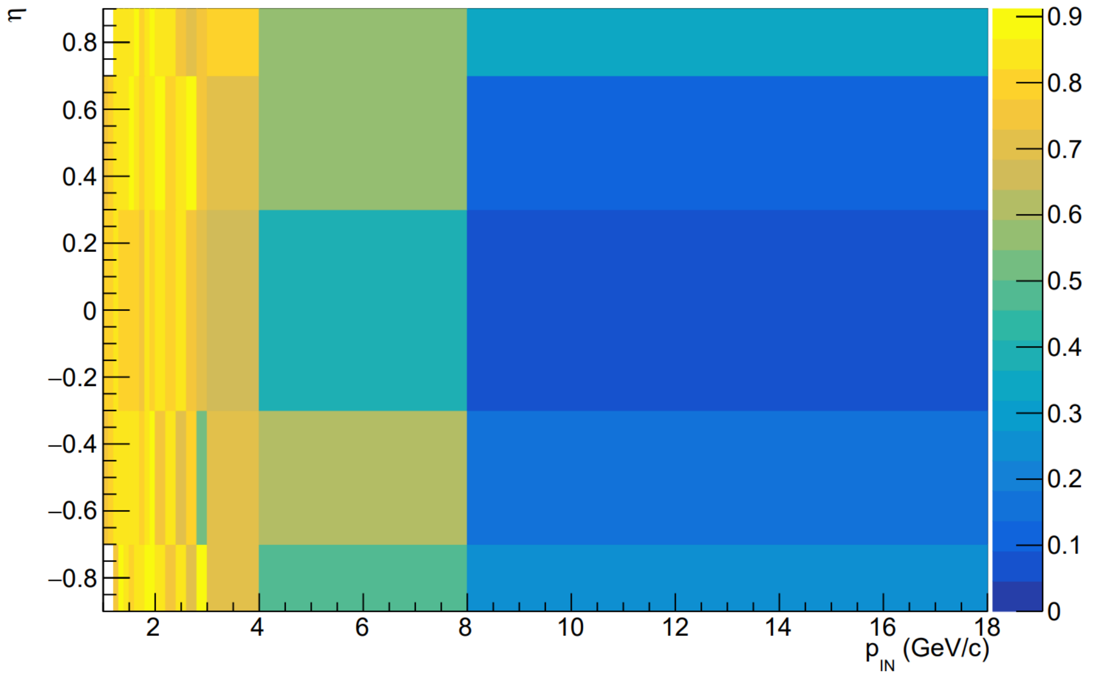


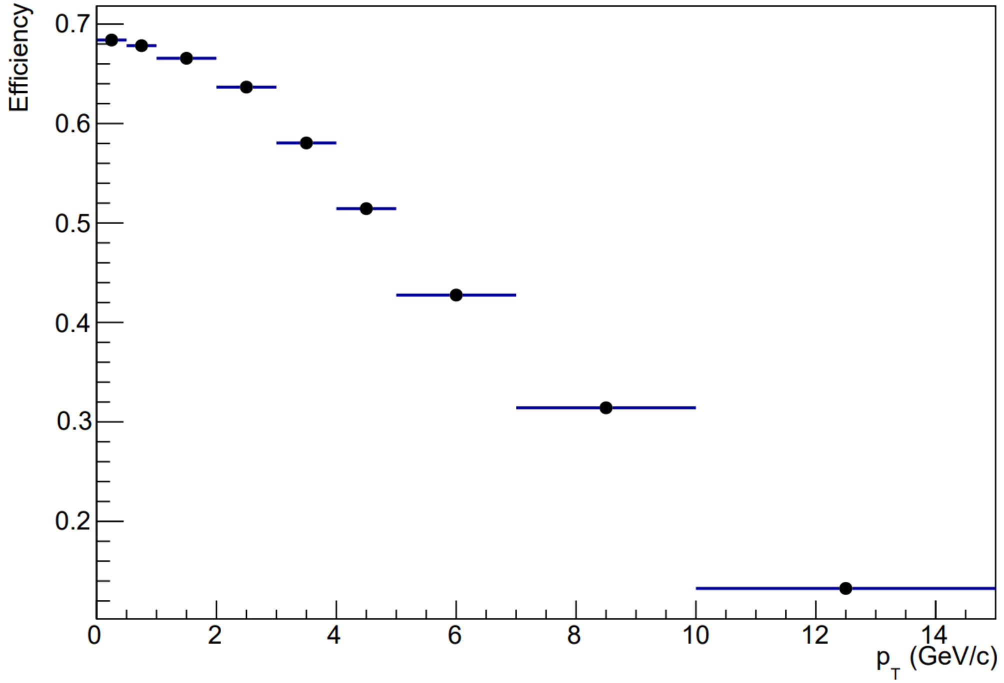


- ➢ The pure electrons are selected via V0 selection, Double Gaussian is used to fit the $n\sigma_e$ distribution.
- ➢ Evaluated the single-electron PID efficiency, and then propagate the electron PID efficiency to the pairs via toy MC

Efficiency calculation

Tracking efficiency

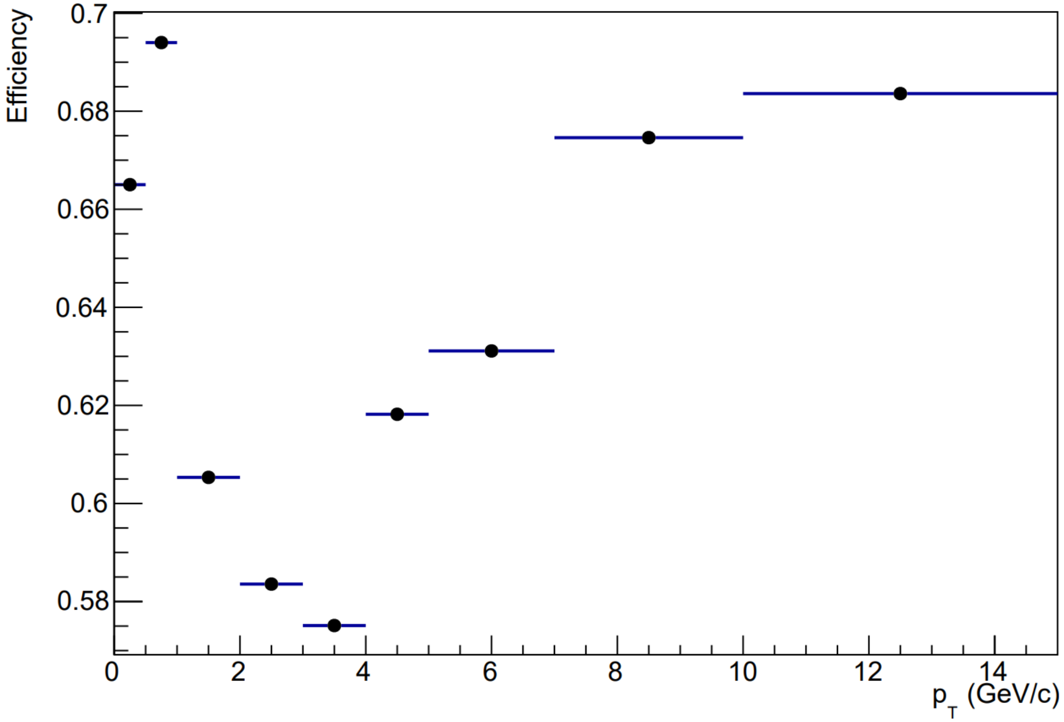




- Tracking efficiency of single electron is directly obtained from the electrons from Pi0 in General purpose MC LHC23d1k.
- The J/psi tracking efficiency is propagated using Toy MC.

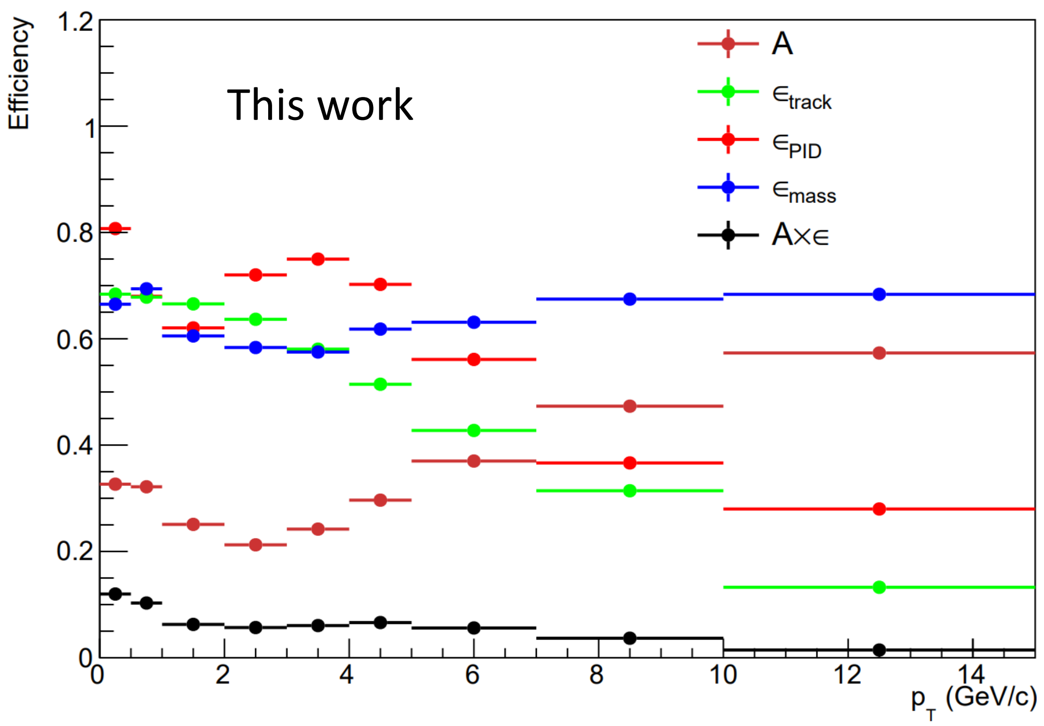
Efficiency calculation

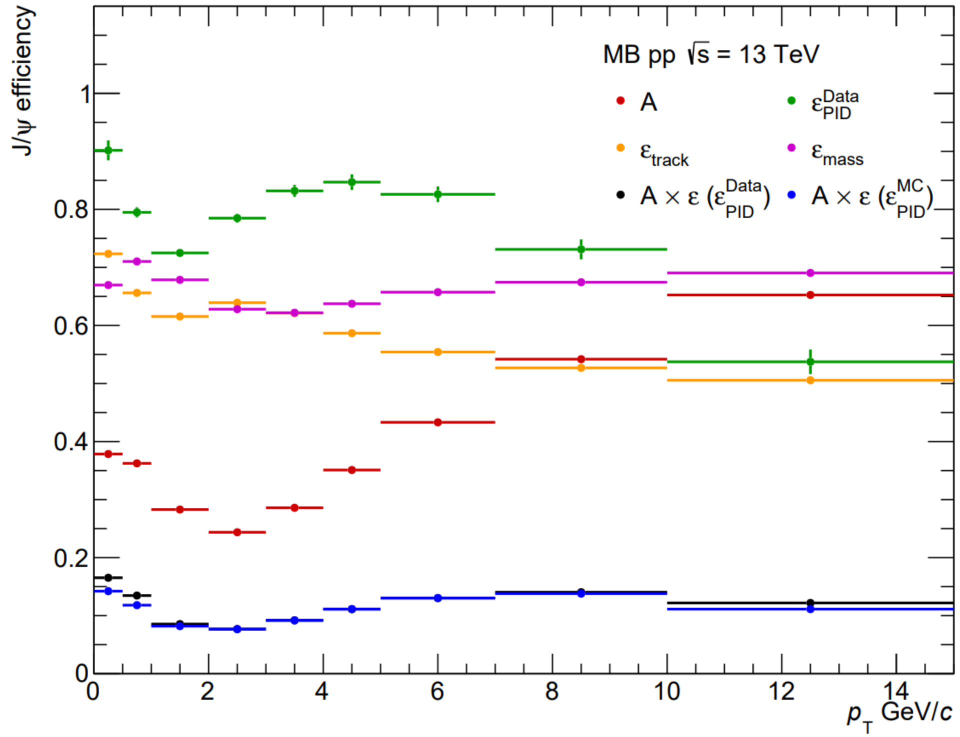
Mass window efficiency



- Mass window efficiency is obtained from integration of Crystal Ball function in the mass window divided by the integration in the fit range.

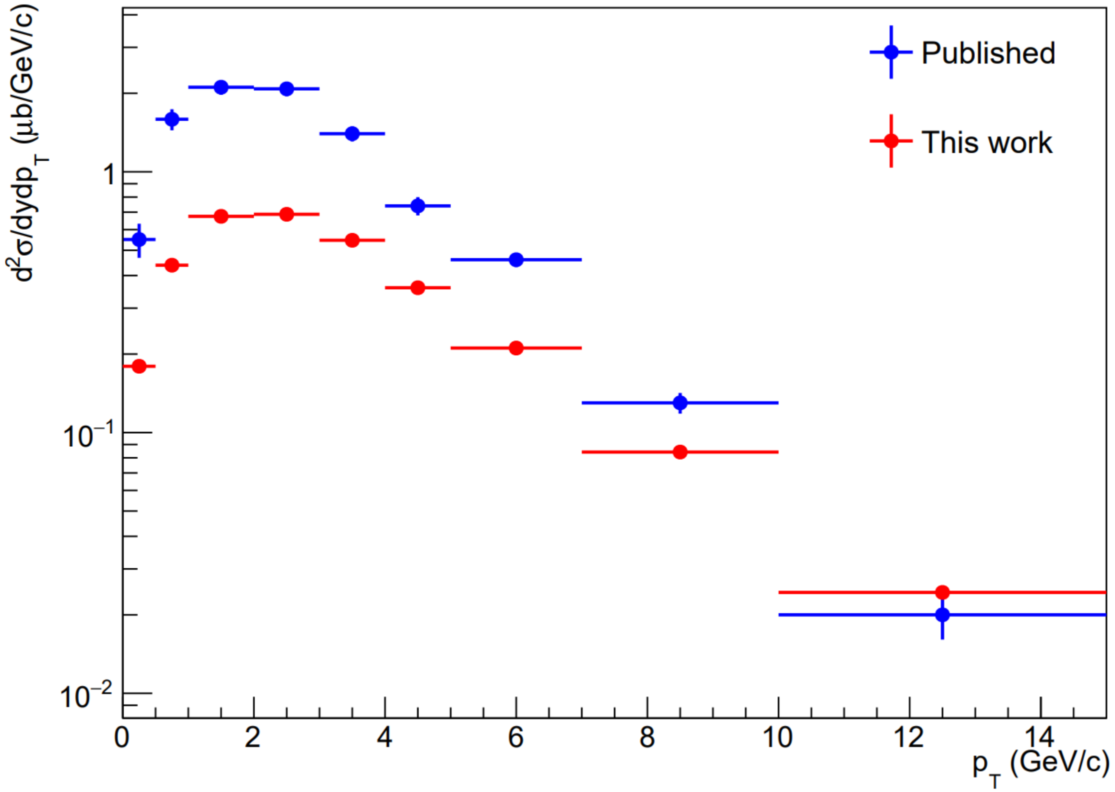
Efficiency calculation





- ➢ Efficiency obtained in this work is shown together and compared with the efficiency in run 2 analysis.
- ➢ Because the analysis cuts and detector status are different, the efficiency should be different.

Final results



- The cross section from this analysis is different from published result in run 2 pp collision.
- Luminosity is overestimated.
- Tracking and mass window efficiency are not trustable for now.
  - The MC is anchored to low IR data.
  - Double check using new produced J/psi injected MC.

Summary

- First look of J/psi cross section in run 3 pp collisions:
  - Efficiency obtained from data-driven and MC anchored to low IR data.
  - J/psi signal shape is obtained from fitting the data.
  - The first results are different from the publish results in run 2 pp collisions.

- Next to do:
  - Checking the new produced J/psi injected MC anchored to low IR data.
  - Using the J/psi injected MC to double check the efficiency.

Back up

Variable	cut value
$\|DCA_{xy}\|$	< 0.2 cm
$\|DCA_z\|$	< 0.4 cm
$\|\eta\|$	< 0.9
p_T	> 1 GeV/c
TPC n_σ electron	$\in [-2.0, 3.0]$
TPC n_σ proton	> 3
TPC n_σ pion	> 3
require ITS refit	yes
require TPC refit	yes
reject kinks	yes
require SPD any	yes
TPC $\|\chi^2\|$	$\in [0.0, 4.0]$
ITS $\|\chi^2\|$	$\in [0.0, 36.0]$
TPC $N_{cls.}$	$\in [70, 160]$
TPC N track segments	≥ 6
ITS $N_{cls.}$ shared	≤ 1

Table 3: Electron and positron track selection cuts.