



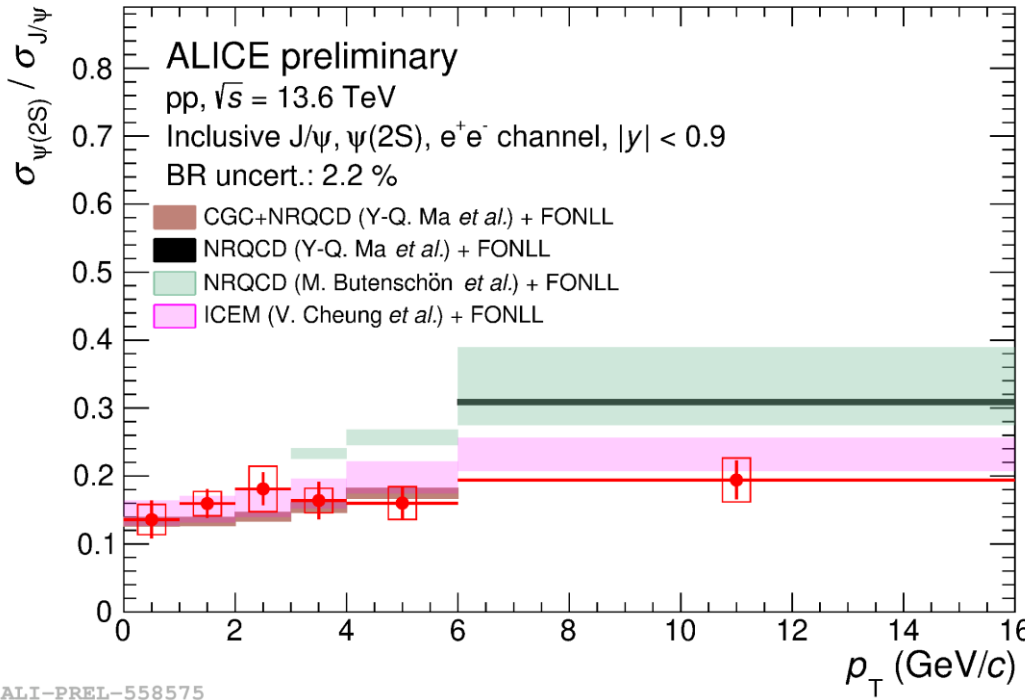
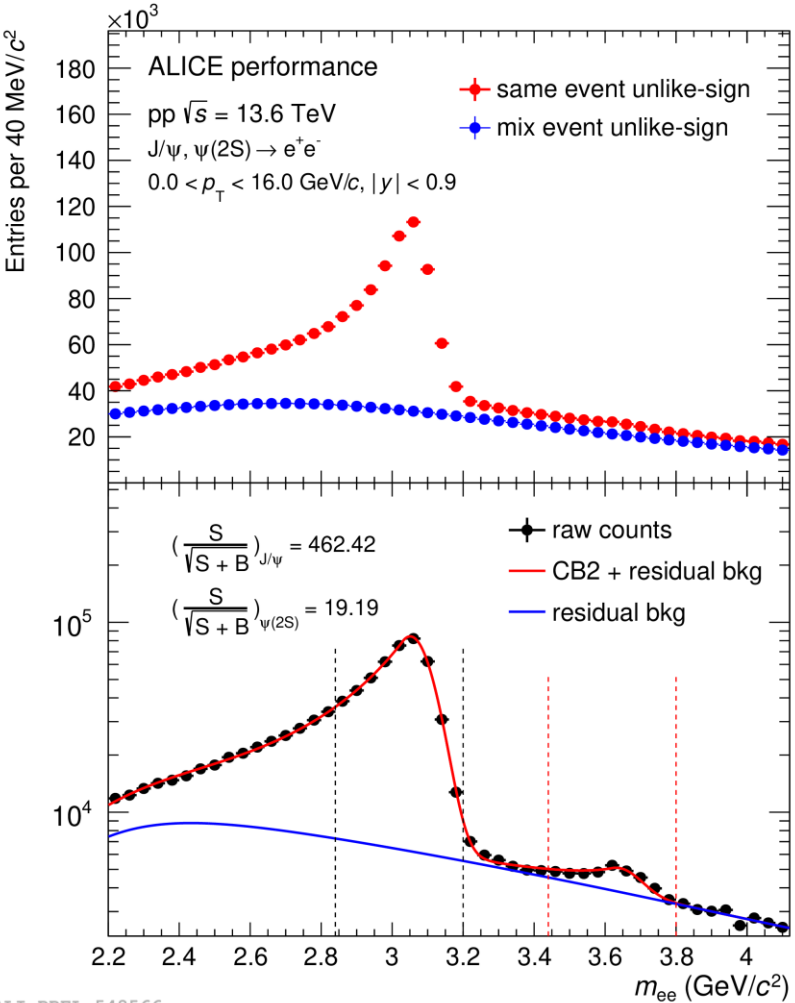
Update on the measurement of $\psi(2S)$ -to- $J\psi$ ratio in pp collisions in Run 3

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2024/10/28

$J\psi$ 2ee PAG meeting

Preliminary results



Previous preliminary results measured using LHC22 pass4 data.

Datasets

▣ LHC23 pass4 skimmed

LHC23f, LHC23g, LHC23h, LHC23j, LHC23k, LHC23l, LHC23m, LHC23n, LHC23o, LHC23q, LHC23r, LHC23s, LHC23t, LHC23u, LHC23v, LHC23w, LHC23y, LHC23z, LHC23za, LHC23zb, LHC23zc, LHC23zd, LHC23ze, LHC23zf, LHC23zg, LHC23zh, LHC23zi, LHC23zj, LHC23zk, LHC23zm, LHC23zn, LHC23zq, LHC23zr, LHC23zs, LHC23zt

▣ LHC24 pass1 skimmed

LHC24aj

Analysis cuts

□ ppfilter cuts:

- ✓ $p_T > 0.7 \text{ GeV}/c$
- ✓ $|\eta| < 0.9$
- ✓ ITSibany
- ✓ $\text{ITSchi2} < 5$
- ✓ $\text{TPCncls} > 60$

- ✓ $-4 < \text{TPCnSigmaE} < 4$
- ✓ $\text{TPCnSigmaPi} > 2.5$ for $p_{in} < 3 \text{ GeV}/c$
- ✓ $\text{TPCnSigmaPi} > 1.5$ for $p_{in} > 3 \text{ GeV}/c$
- ✓ $\text{TPCnSigmaPr} > 2.5$ for $p_{in} < 3 \text{ GeV}/c$
- ✓ $\text{TPCnSigmaPr} > 1.5$ for $p_{in} > 3 \text{ GeV}/c$

□ Event selection:

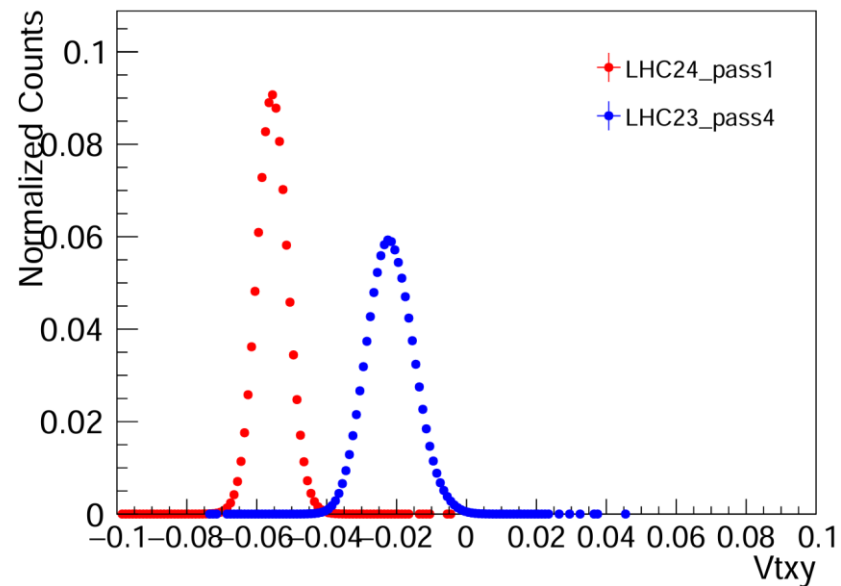
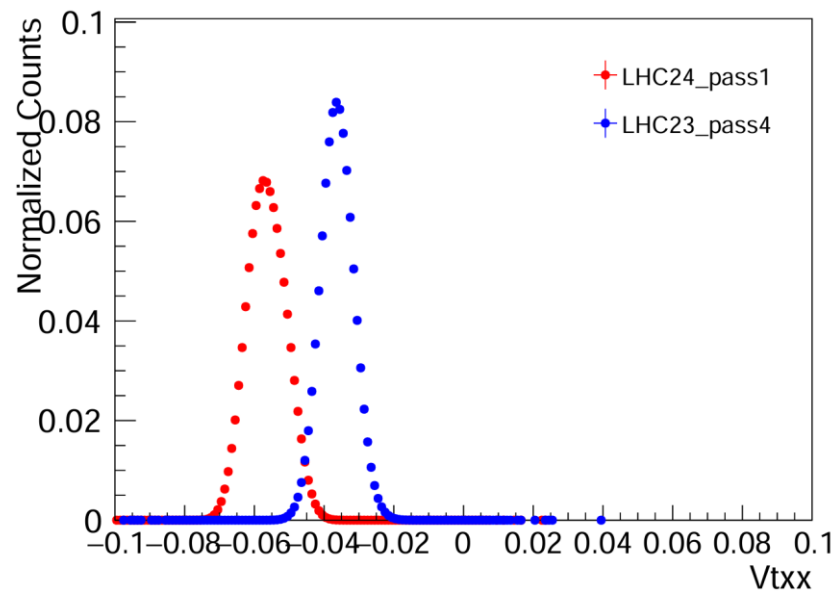
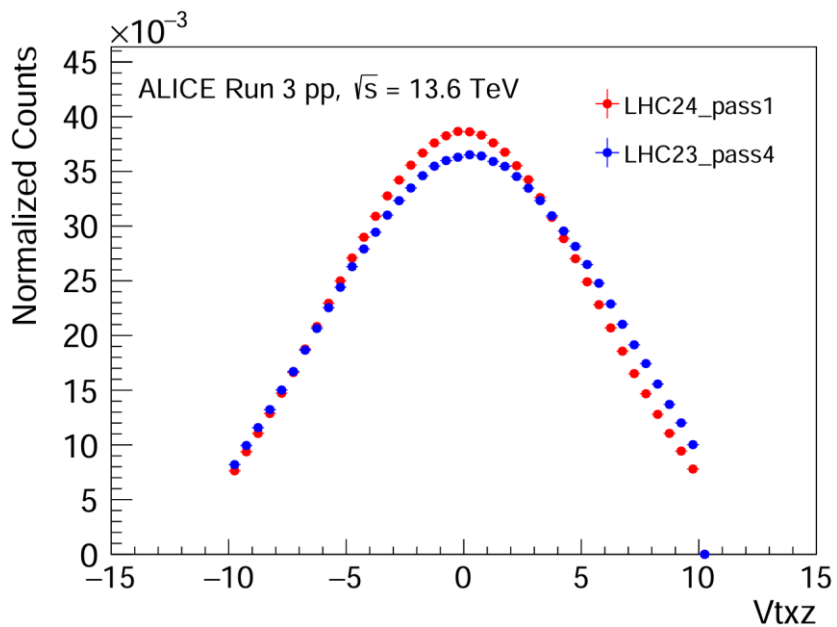
- ✓ $|\text{VtxZ}| < 10 \text{ cm}$
- ✓ lsel8
- ✓ NoTFBorder

□ Track cuts:

- ✓ $p_T > 1 \text{ GeV}/c$
- ✓ $|\eta| < 0.9$
- ✓ $\text{ITSncls} > 2$
- ✓ ITSibany
- ✓ $\text{ITSchi2} < 5$
- ✓ $\text{TPCncls} > 90$
- ✓ $\text{TPCchi2} < 4$
- ✓ $|\text{DCAxy}| < 1 \text{ cm}$
- ✓ $|\text{DCAz}| < 1 \text{ cm}$

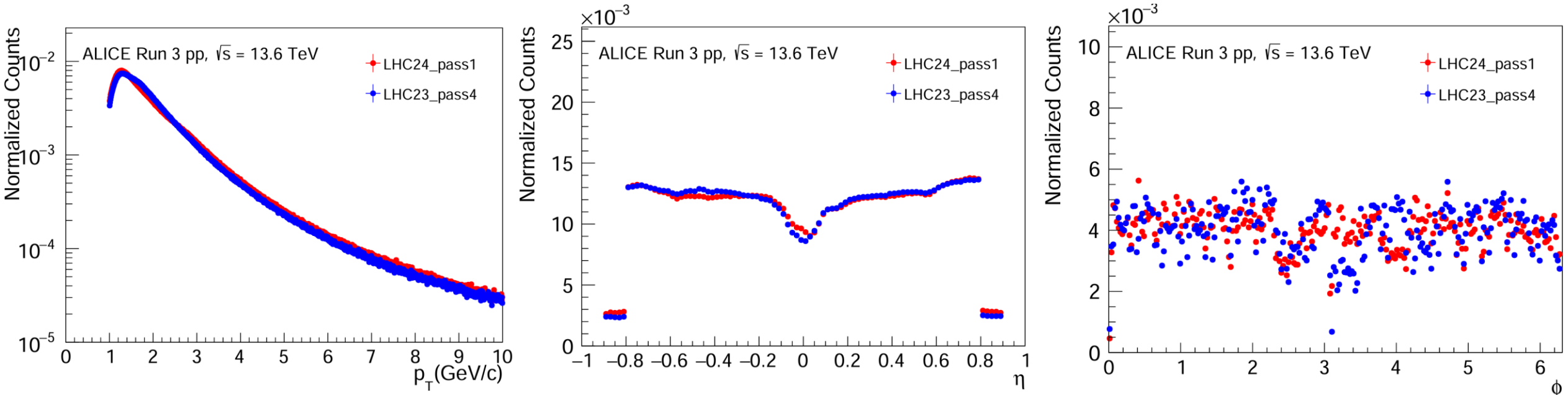
- ✓ $-2 < \text{TPCnSigmaE} < 3$
- ✓ $\text{TPCnSigmaPi} > 3$
- ✓ $\text{TPCnSigmaPr} > 3$

Event vertex check



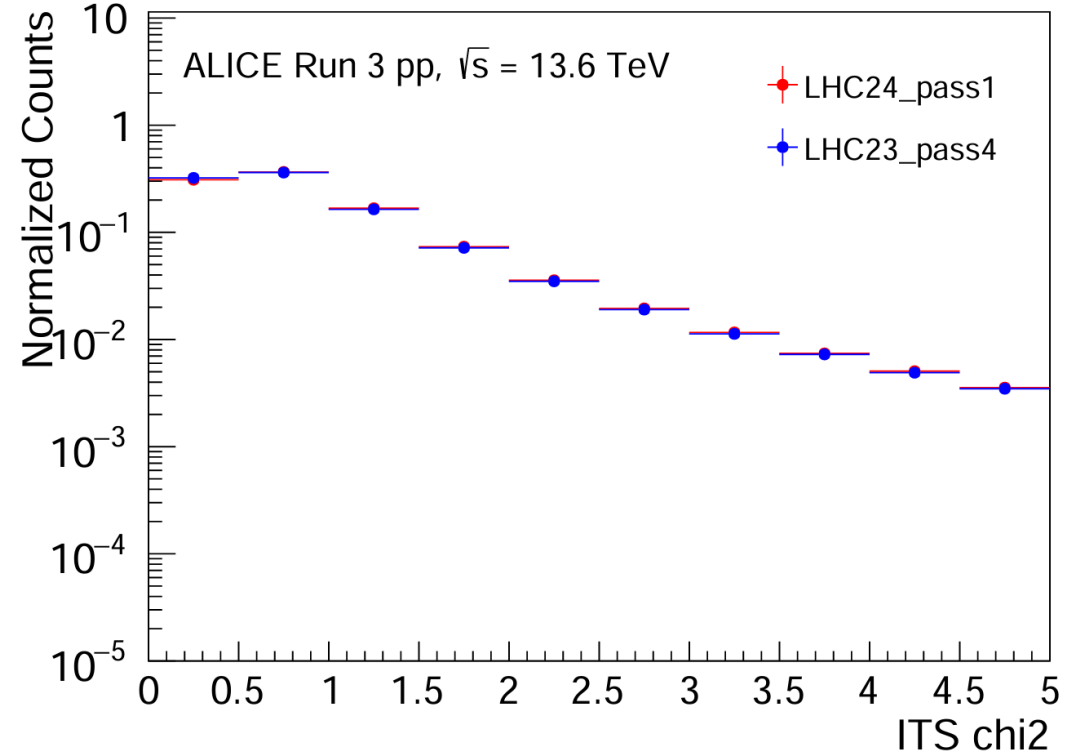
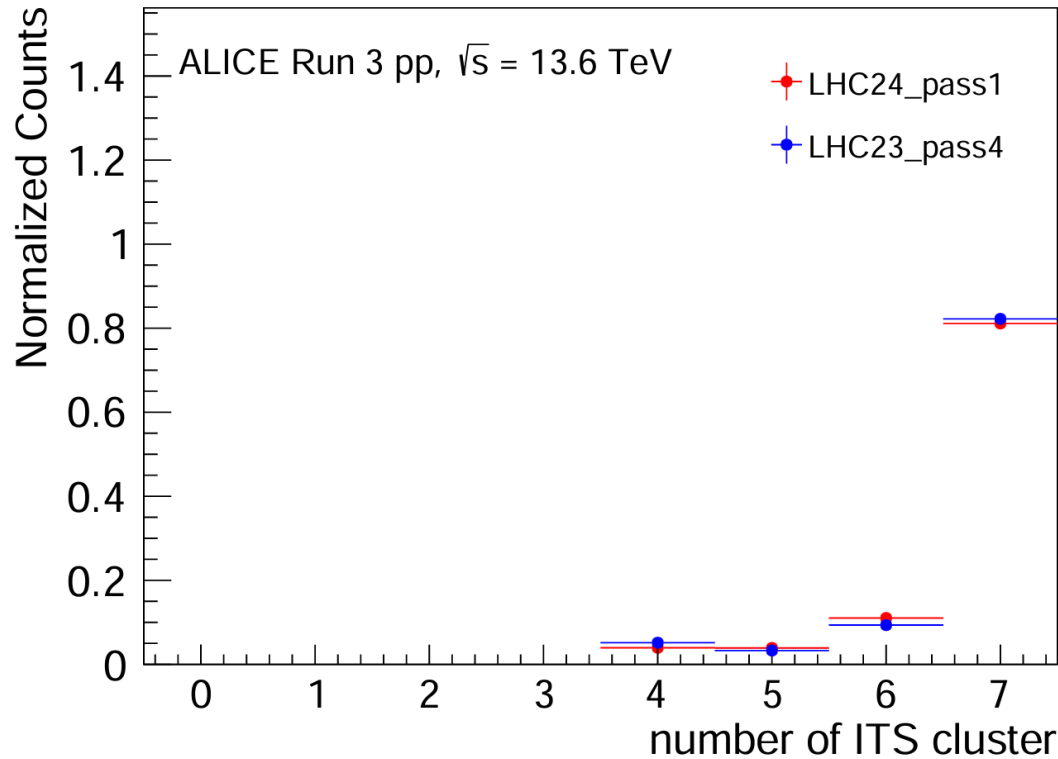
□ The Vtx distributions are different for LHC23 and LHC24 data.

Kinematics distribution



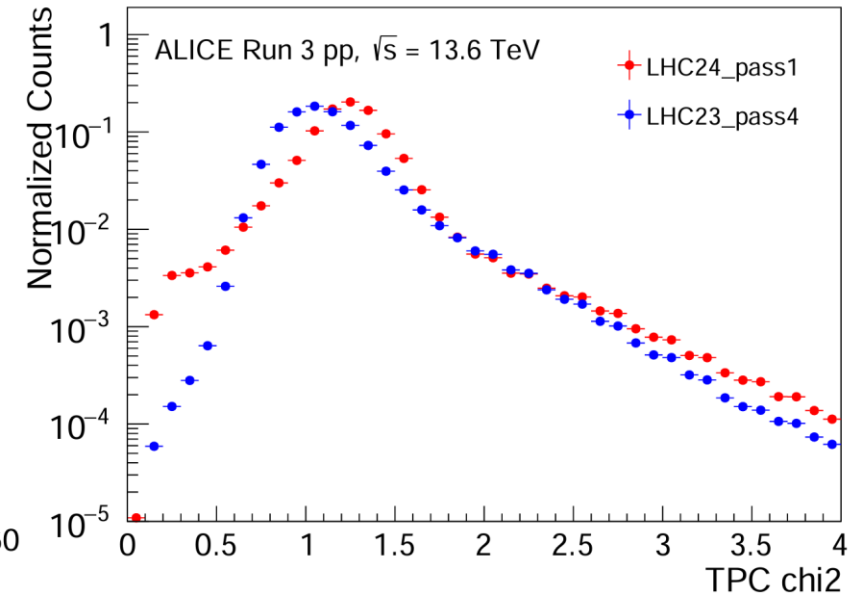
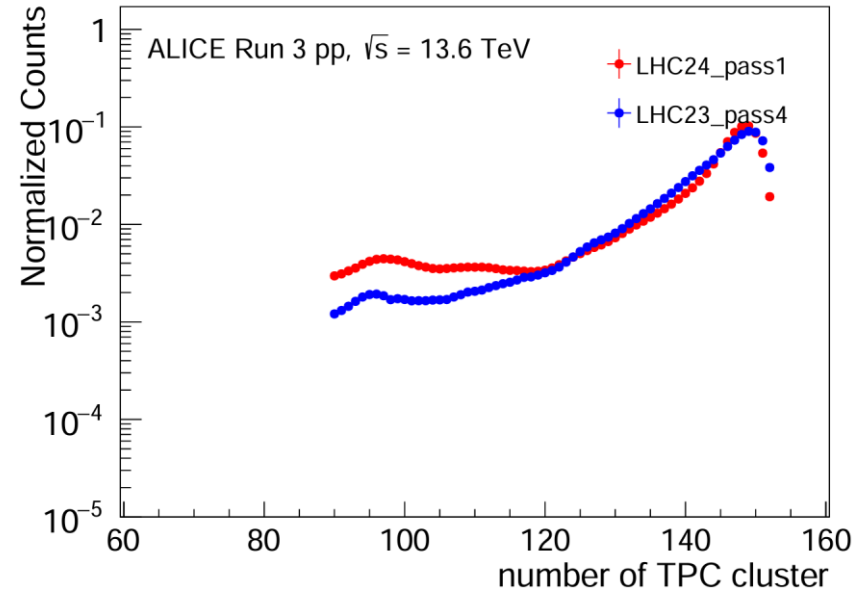
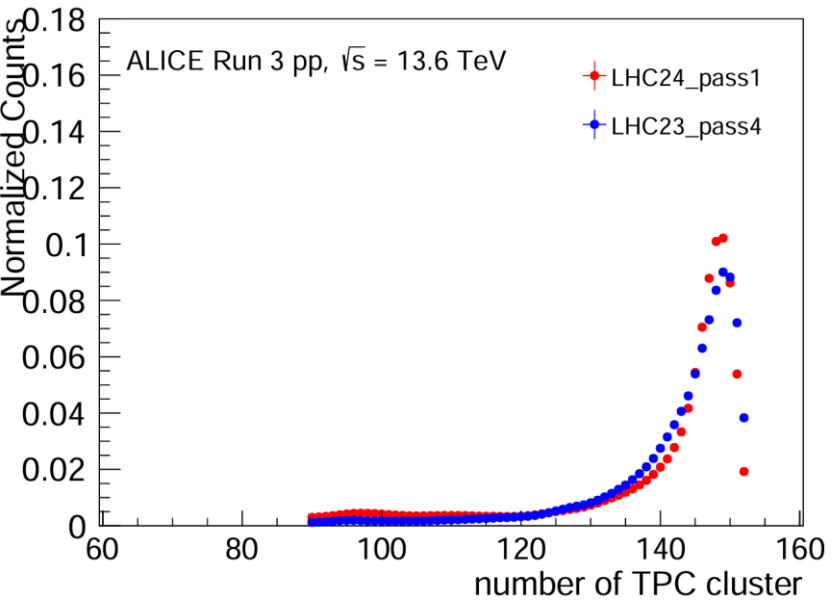
- ❑ The p_T distributions are different with $p_T \sim 2$ GeV/c.
- ❑ The η distributions are dropped with $|\eta| > 0.8$ because of the wrong config of track-selection task.

ITS tracking



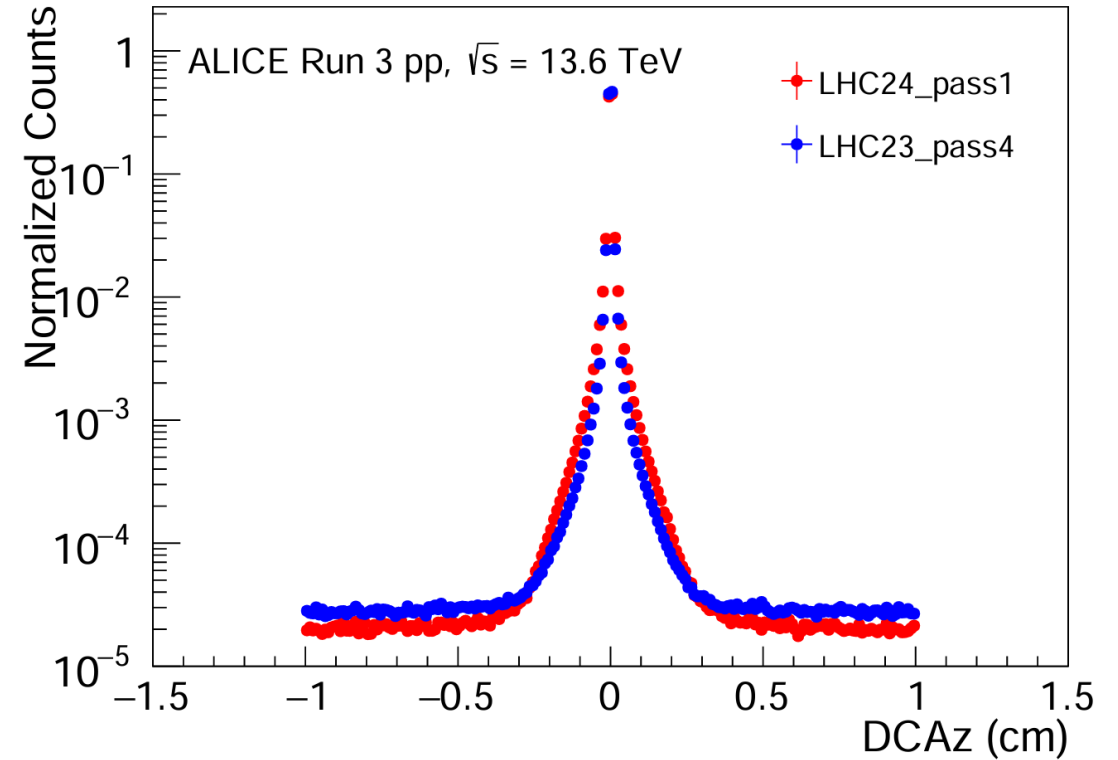
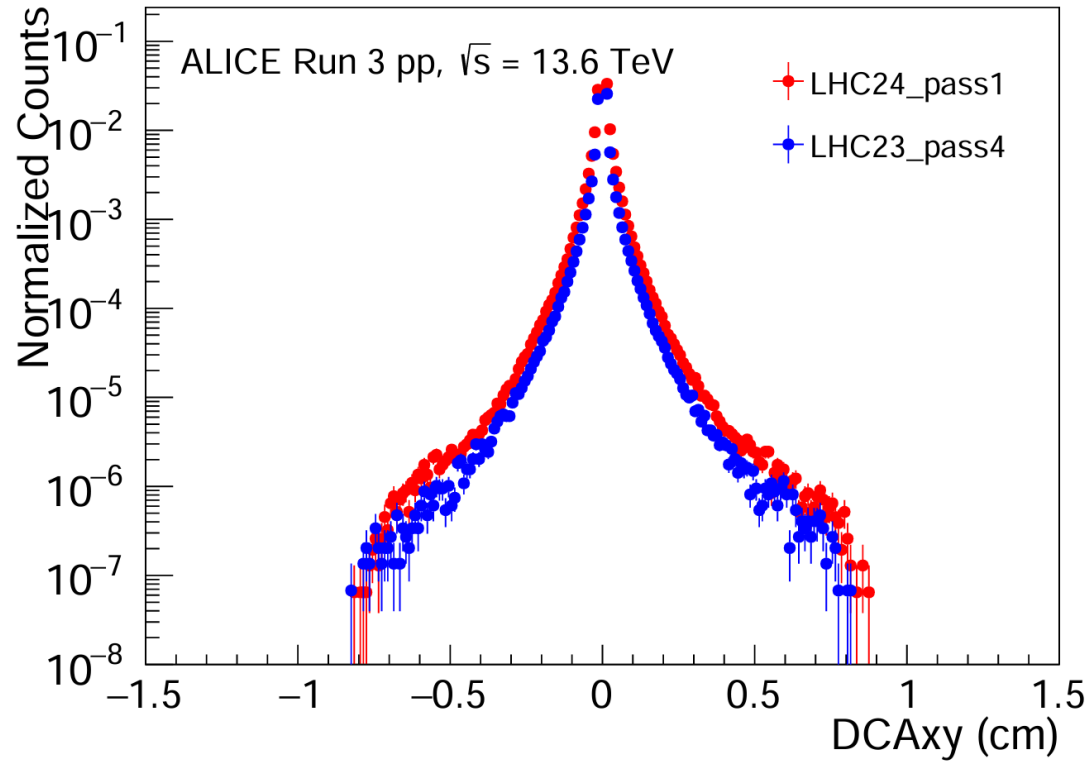
□ The ITSncs and ITSchi2 distributions are similar between 2 years.

TPC tracking



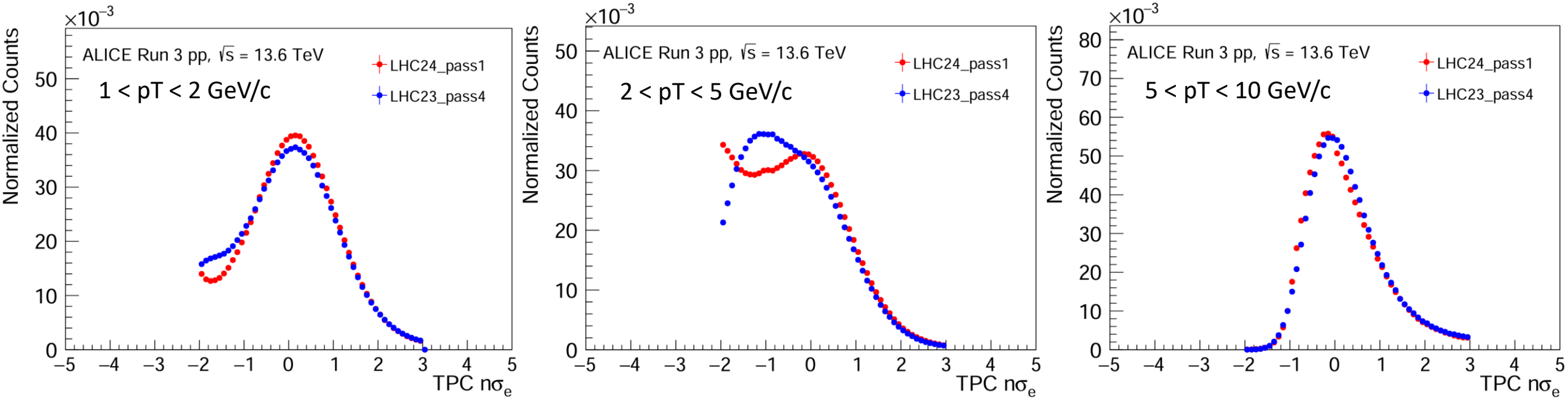
□ TPCncls and TPCchi2 are slight different.

DCA distribution



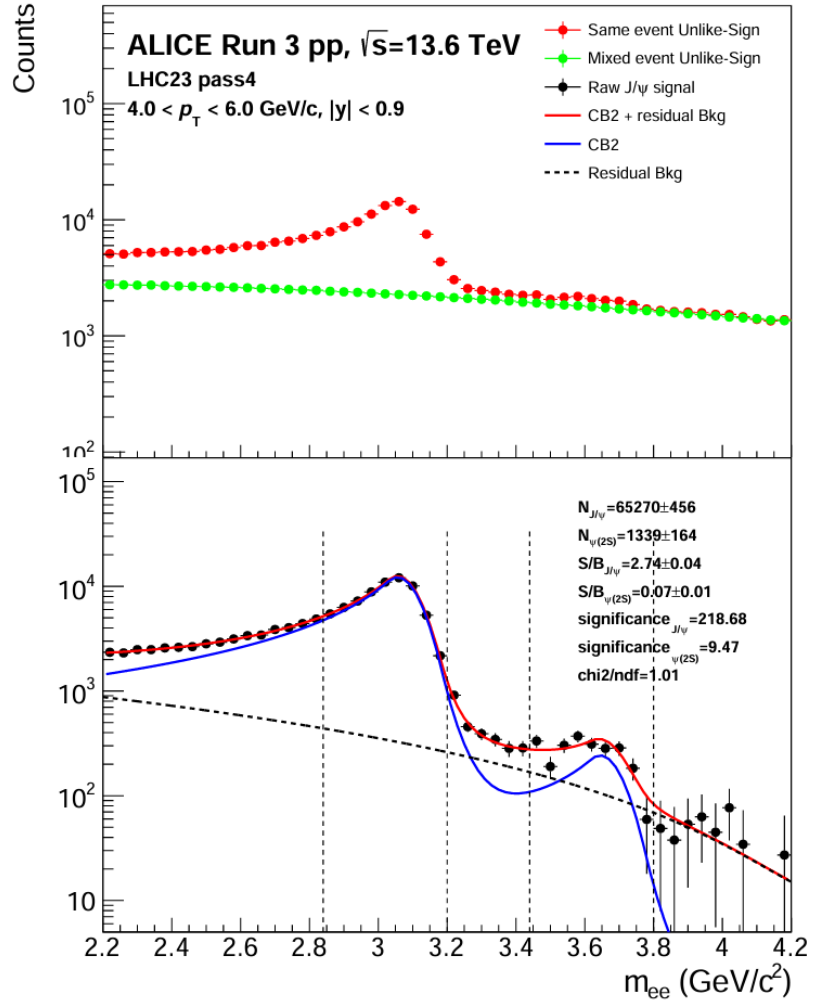
□ The width of the DCA distributions are different.

PID performance



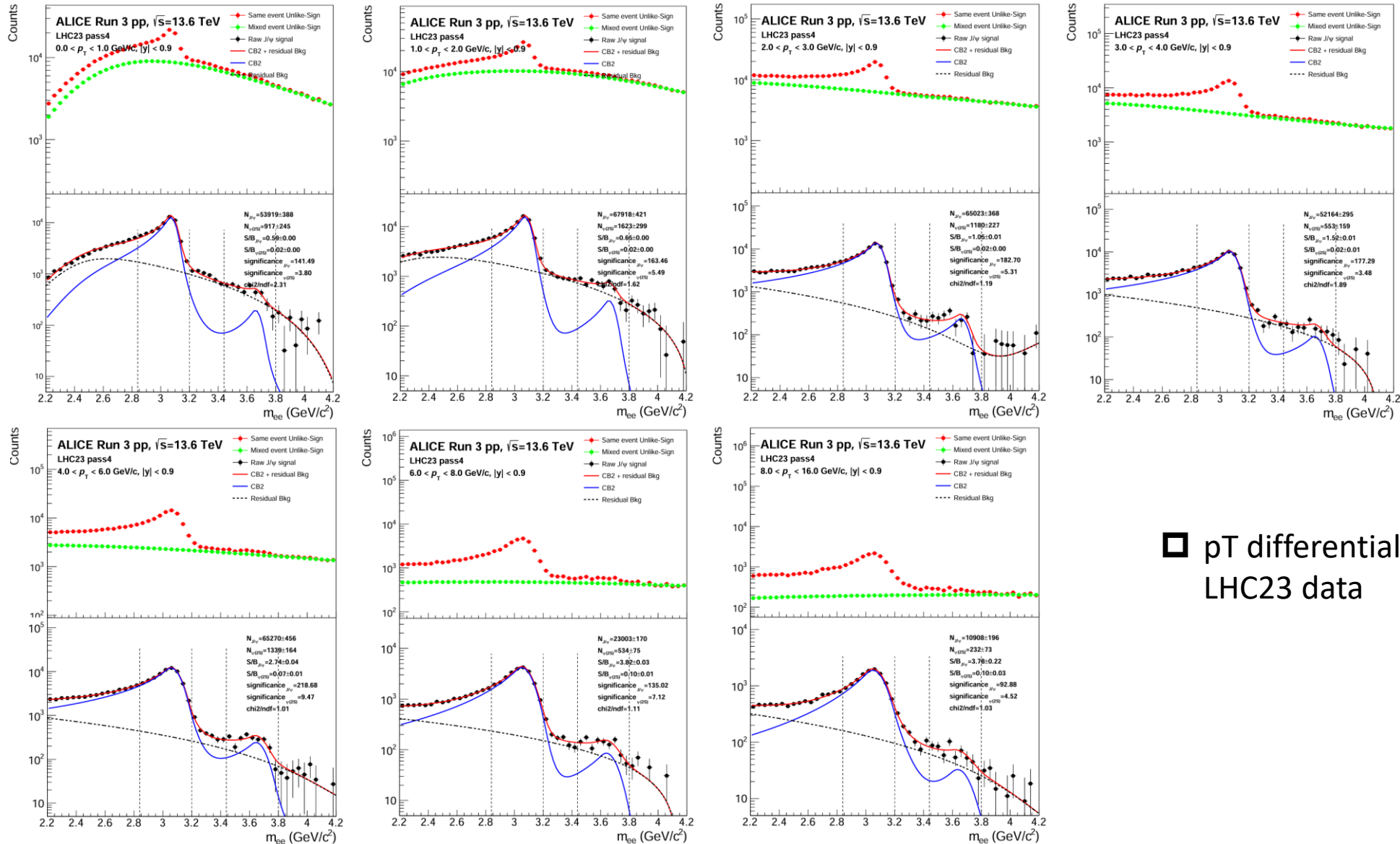
□ The TPCn σ_e distributions are similar in low and high p $_T$, but different in middle p $_T$.

Signal extraction



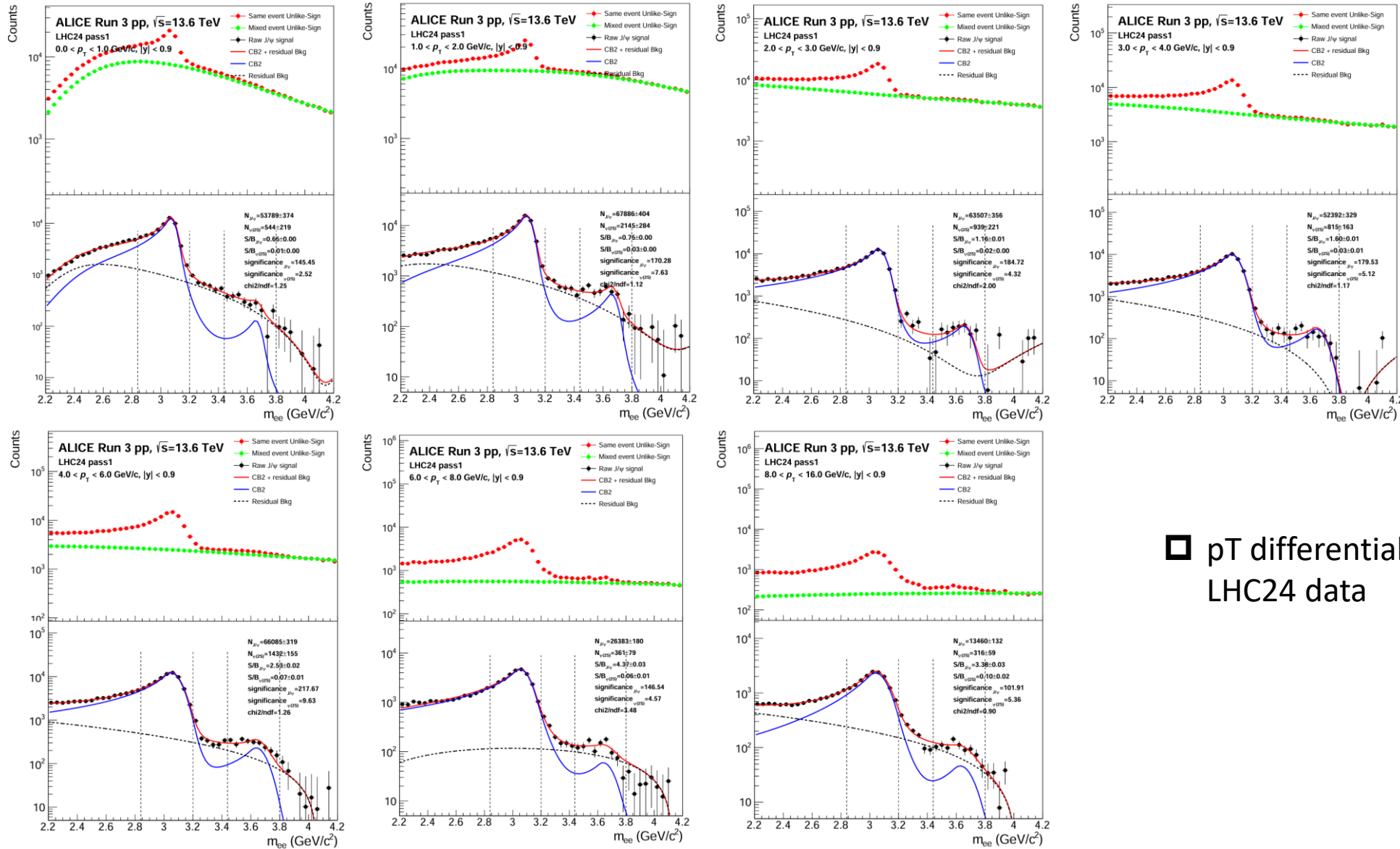
- The **mix event** is used for subtract the combinational background.
 - Scaled by the side band.
- Use **pol2** function to estimate the residual background.
- The signal are described by two **Crystal Ball functions**.
 - The sigma and tail parameters are assumed to be the same between the two signals.
 - $mean_{J\psi} + 0.589 \text{ GeV}/c^2 = mean_{\psi 2S}$

Signal extraction



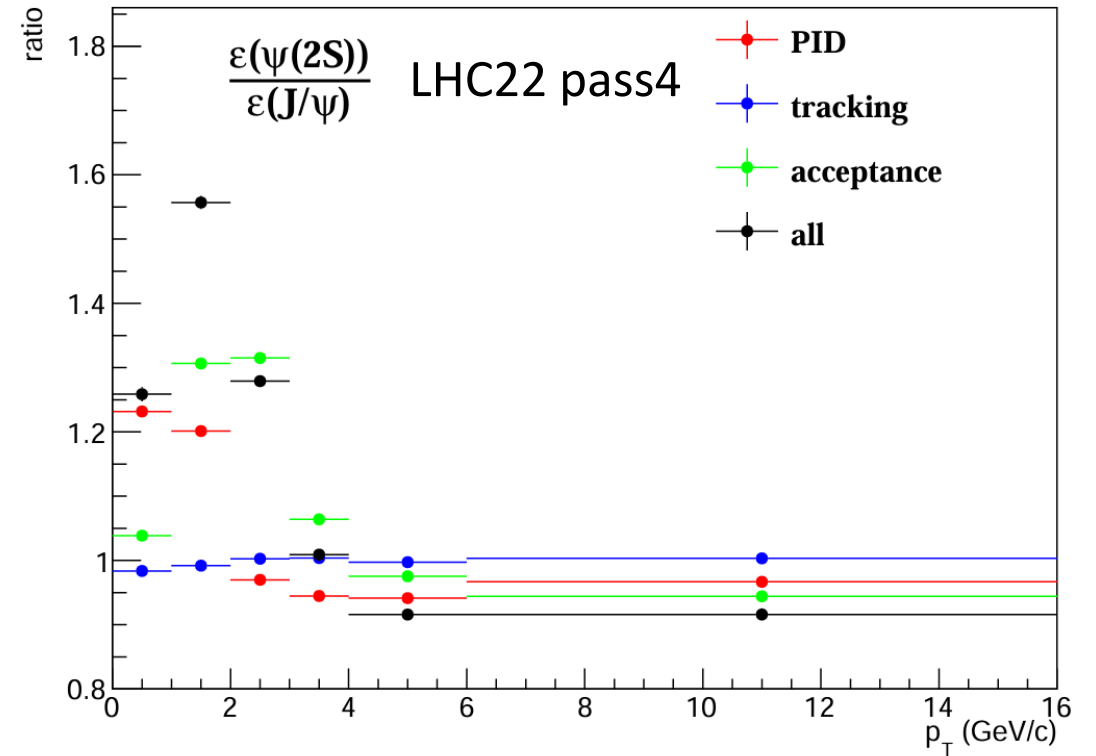
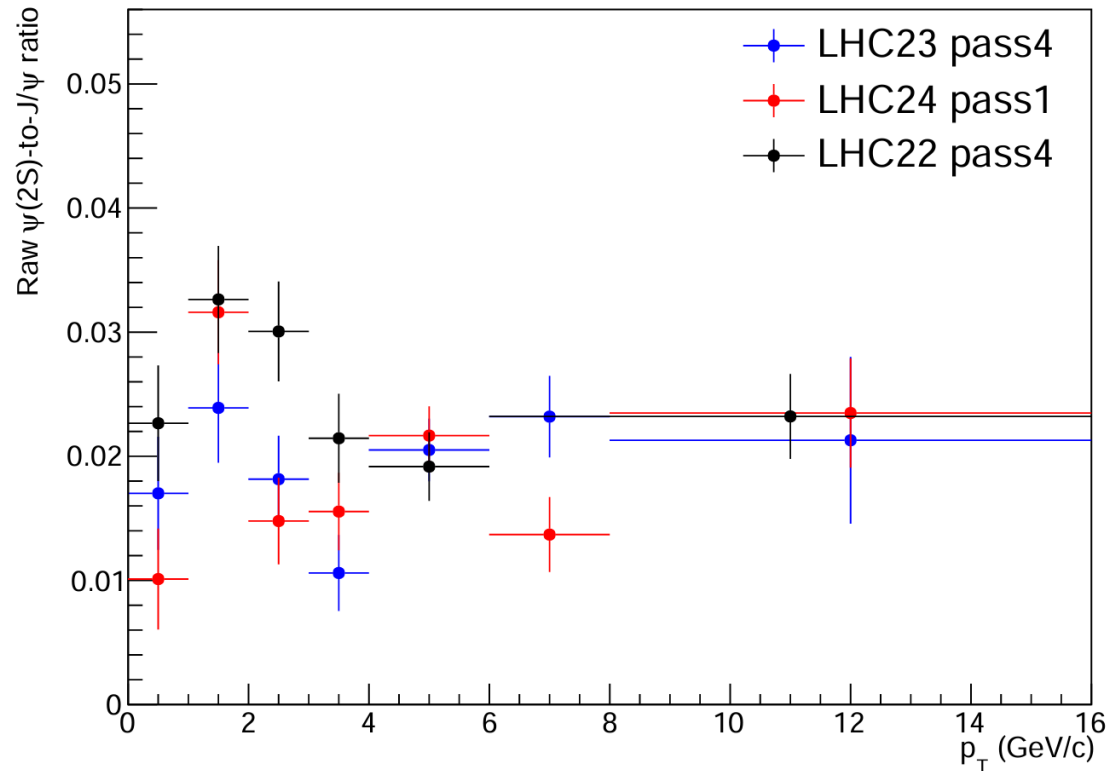
□ p_T differential signal extraction for LHC23 data

Signal extraction



□ p_T differential signal extraction for LHC24 data

Raw $\psi(2S)$ -to- J/ψ ratio



- ❑ The raw ratio are consistent within uncertainties for the two years, and are similar with the previous LHC22 pass4 result.
- ❑ More statistics from LHC24 and LHC22 pass7 data will be added soon.
- ❑ The efficiency calculation is ongoing.

Summary

- ❑ The LHC23 pass4 skimmed and LHC24aj pass1 skimmed data are compared.
 - Slight different in tracking variables and different for PID performance in middle pT.

- ❑ The ratio of raw counts of $\psi(2S)$ and $J\psi$ are measured.
 - The ratio are consistent within uncertainty.

- ❑ Outlook:
 - Finish the efficiency correction using data-driven method.
 - Combine the results of LHC22 pass7, LHC23 pass4, LHC24 pass1 data.