Production of J/ψ in jets at mid-rapidity in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE

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Motivation

- Charm quarks can be used to probe the initial stage of pp collisions. Their production can be calculated according to pQCD

- Investigate the dominant sub-process in J/ψ production

- Understand the fragmentation mechanism of b- and c-jets by p_T fraction of J/ψ carried in jets - $z \equiv p_T^{J/\psi}/p_T^{jet}$

- Previous results from LHCb (published) and CMS (preliminary) differ from Pythia LO NRQCD predictions

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CMS-PAS-HIN-18-012
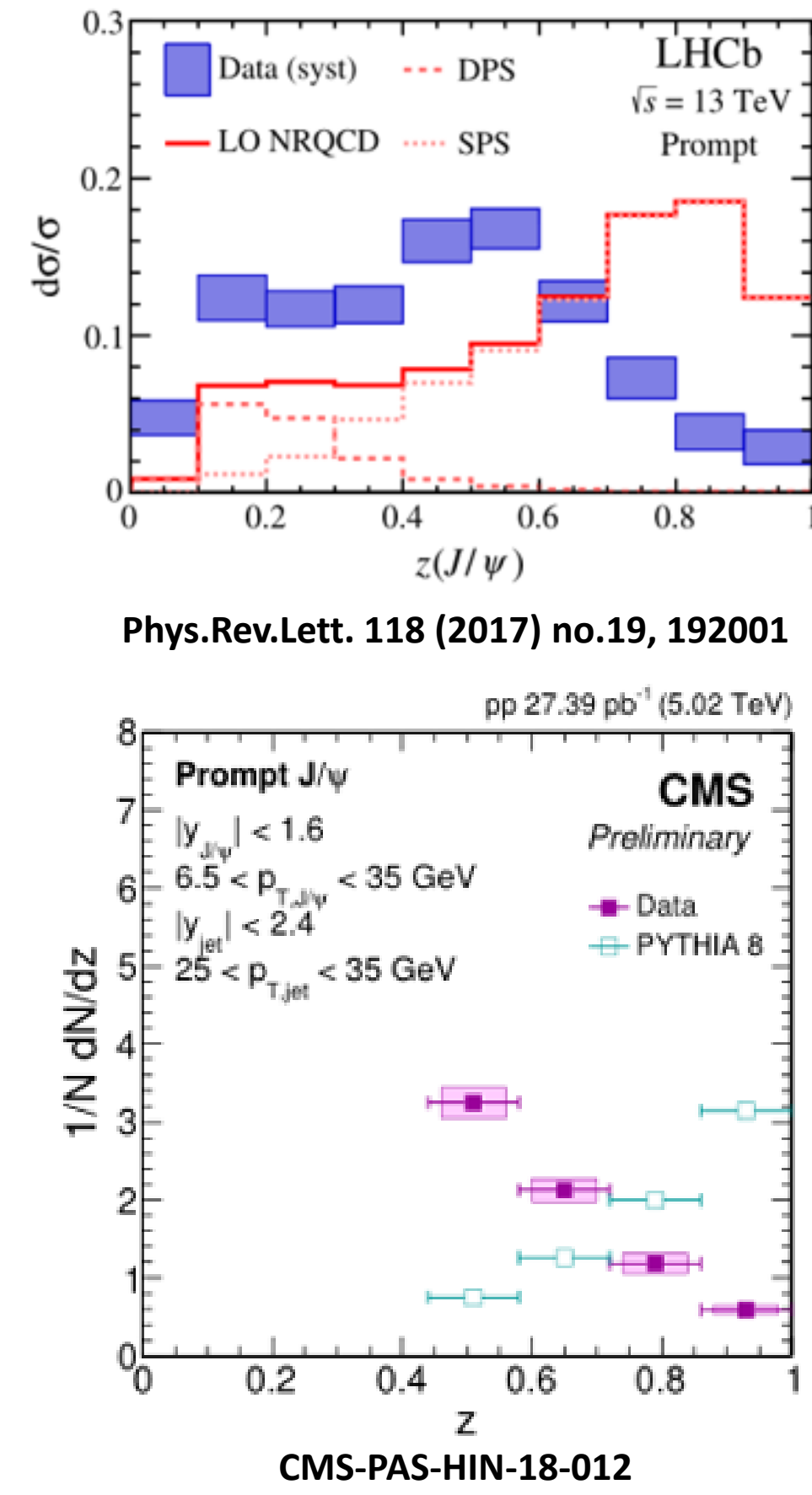
Analysis strategy

- **Select** events with J/ψ → e$^+$e$^-$ candidates

  - Replace J/ψ daughters with the J/ψ track (3-momentum only)

  - Jet reconstructed using anti-k_T algorithm provided by FASTJET

  - Re-clustering J/ψ meson and charged tracks by R = 0.4 in $|\eta| < 0.5$

- **Store** tagged jet info

  - $M_{e^+e^-}$, $\tilde{L}_{xy}$, $p_T^{e^+e^-}$, p_T^{jet}, z

  - p_T range: [5, 35] GeV/c

  - z range: [0.0, 1.0]

- **Signal** extraction with invariant mass spectrum

- **Sideband** used for background estimation

- **Separate** prompt and non-prompt by cuts on pseudo-proper decay length - $\tilde{L}_{xy}$

- **Subtract** b-decay component in the prompt region

E/DCal high

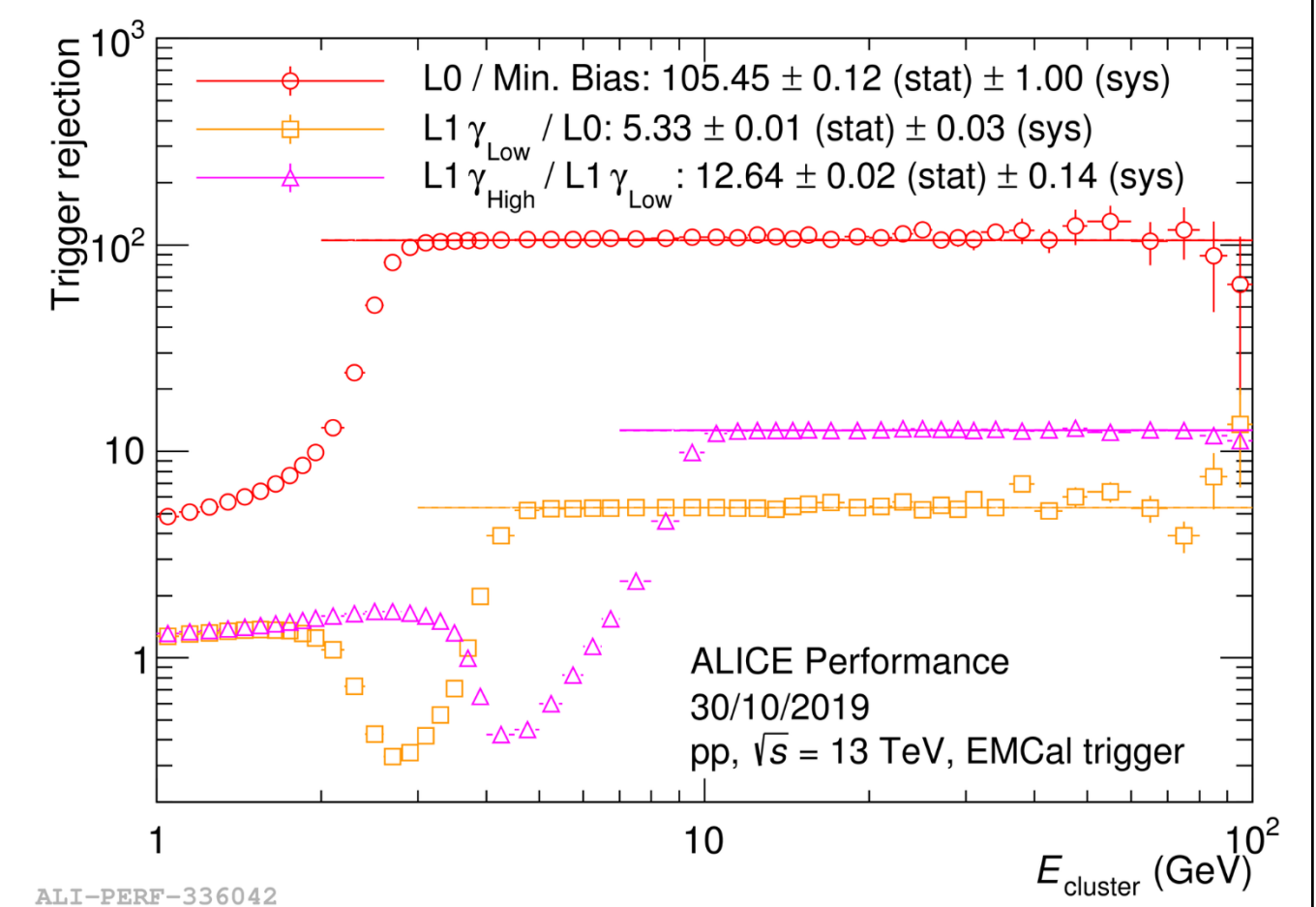**E/DCal low**

MB
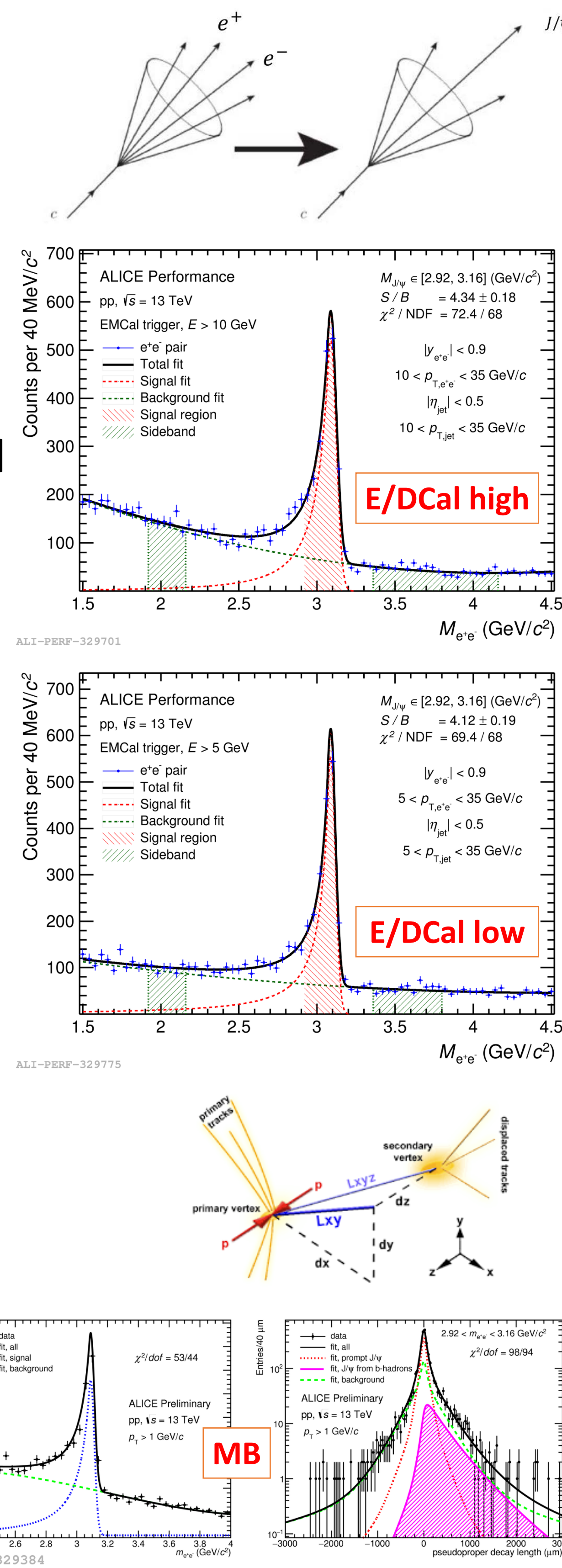
Detector response

- The migration across **z** and jet p_T bins due to the jet p_T resolution should be corrected with 2D unfolding.

- The jet finding procedure was performed on detector and generator level separate-ly. Then the jets can be matched with the tagged J/ψ inside.

- Generate 4D matrix for jet p_T and z of J/ψ from b-hadron decay.

ALICE at LHC
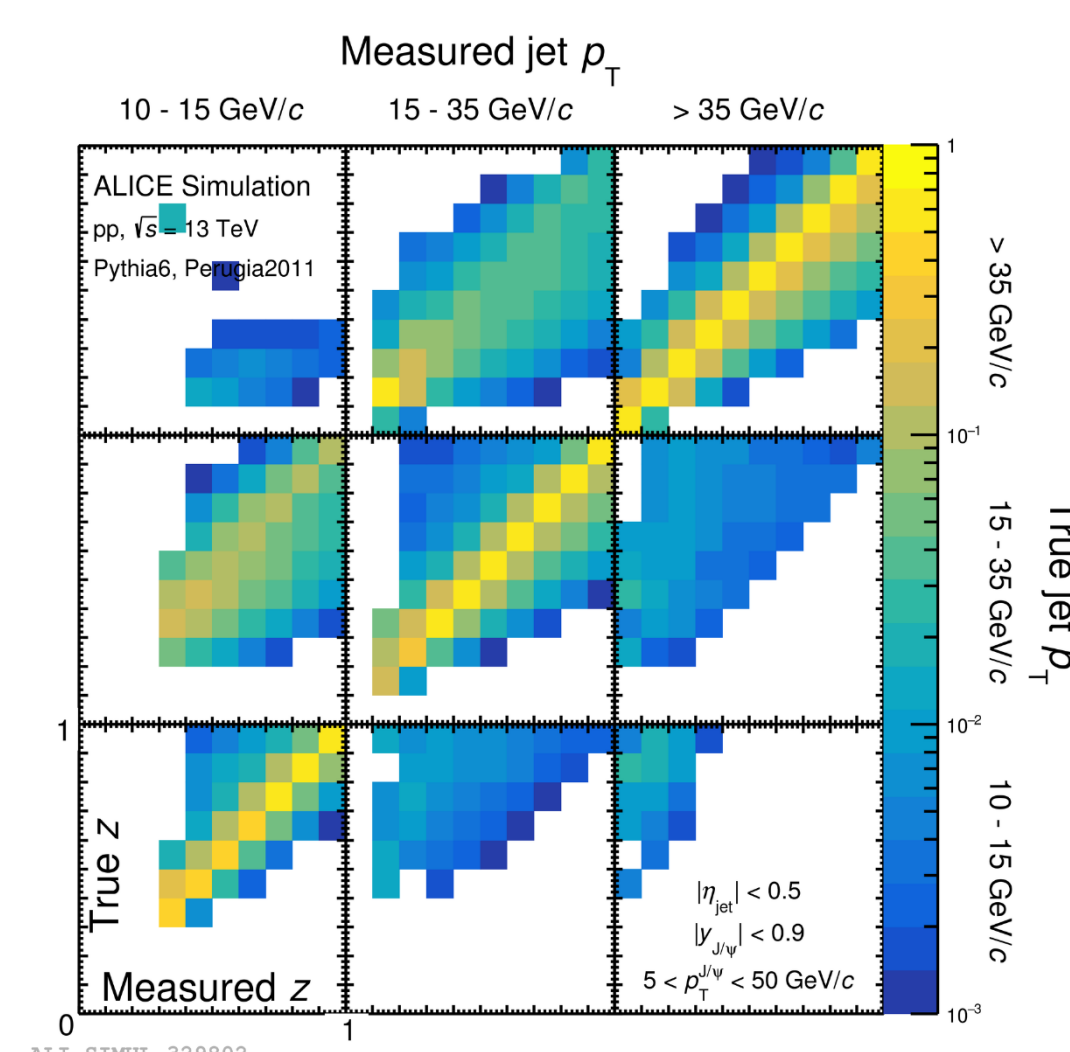
V0   **EMCal DCal**
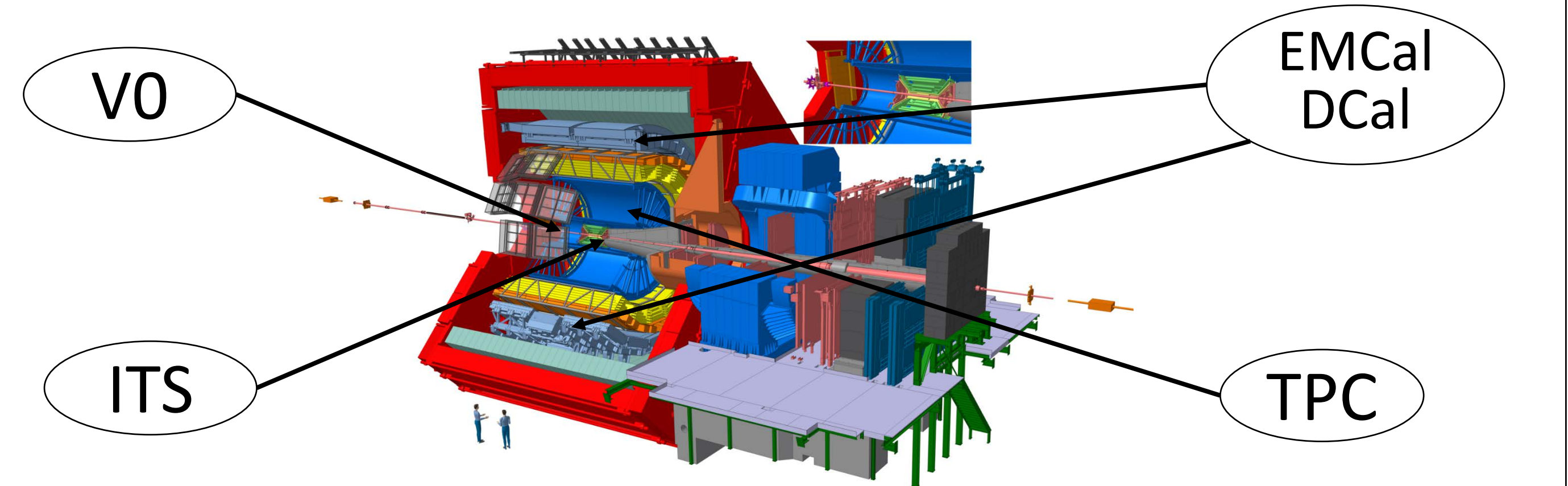
ITS   **TPC**

- **Detectors**
  - V0 & EMCal for trigger
  - ITS & TPC for tracking
  - TPC & EMCal for electron PID
- **Acceptance**
  - TPC   : $|\eta| < 0.9$, $\Delta\varphi = 360°$
  - EMCal: $|\eta| < 0.7$, $\Delta\varphi = 107°$
  - DCal   : $|\eta| < 0.7$, $\Delta\varphi = 7°$
    + $0.22 < |\eta| < 0.7$, $\Delta\varphi = 60°$
- **Datasets**
  - pp, $\sqrt{s}$ = 13 TeV, with EMCal triggered events in 2016 - 2018
  - E_{th} (high) = 9 GeV, $\mathcal{L}_{int.}$ = 16 pb^{-1}
  - E_{th} (low) = 4 GeV, $\mathcal{L}_{int.}$ = 1.5 pb^{-1}

J/ψ efficiency

- PYTHIA6 MB events + J/ψ
  - using PHOTOS to handle J/ψ decay
  - prompt with realistic p_T shape + flat in range 6-50 GeV/c
  - non-prompt according to PYTHIA6 b$\bar{b}$ process.
- Reconstruction $A \times \varepsilon$:
  - detector acceptance
  - trigger efficiency
  - selection efficiency
- Strong dependence on J/ψ p_T due to the trigger (onset) and electron PID (decrease)
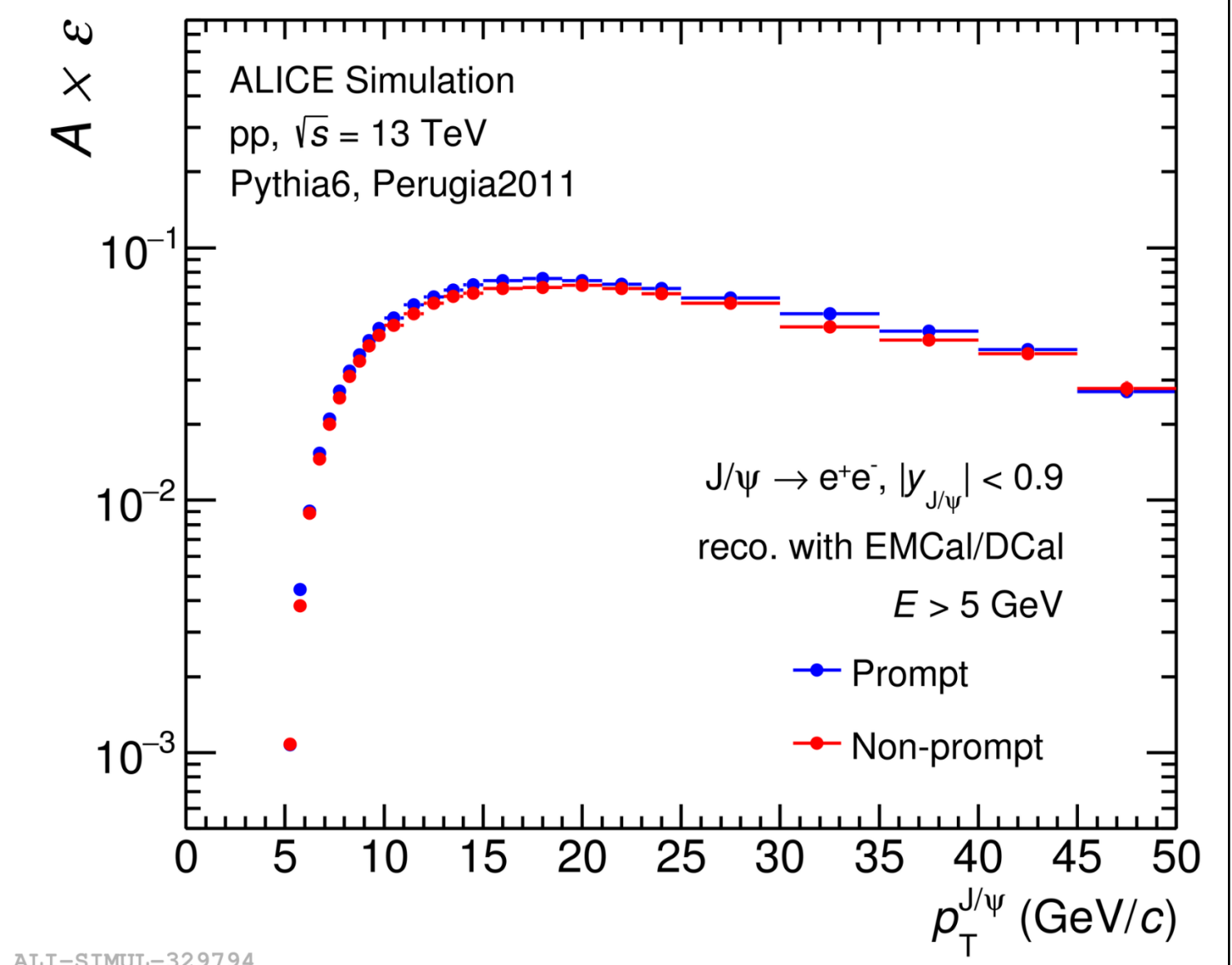
Outlook

- The J/ψ produced in jets at mid-rapidity have been measured in the range of $5 < p_T < 35$ GeV/c in pp collisions at $\sqrt{s}$ = 13 TeV with the ALICE detector.

- For the next step, we will study the impact of kinematic cuts on final fragmentation functions.

Reference

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2. LHCb Collaboration, Phys.Rev.Lett. 118 (2017) no.19, 192001
3. Kang, Zhong-Bo, et al. Phys.Rev.Lett. 119 (2017) no.3, 032001
4. Bain, Reggie, et al. Phys.Rev.Lett. 119 (2017) no.3, 032002
5. CMS Collaboration, CMS-PAS-HIN-18-012