Measurement of multiplicity–dependent Ξ_c^0 production via semileptonic decay channel in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE

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for the ALICE Collaboration

1. Introduction

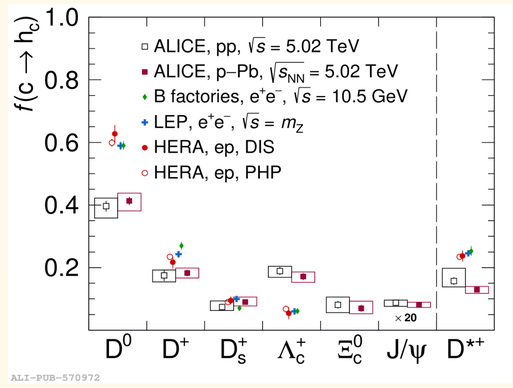
- **Describing heavy-flavor production**
  - Factorization approach:

$$\frac{d\sigma^{pp\to Hq}}{dp_T} = f_i(x_1, \mu_f^2) f_j(x_2, \mu_f^2) \times \frac{d\sigma^{ij\to q}}{dp_T}(x_1, x_2, \mu_f^2) \times D_{q\to Hq}\left(z_q = \frac{p_{Hq}}{p_q}, \mu_f^2\right)$$

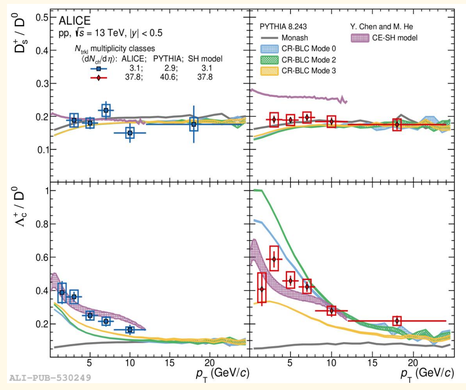
Parton distribution functions (PDFs) | Hard scattering cross section (via pQCD) | Fragmentation function (hadronization)

  - Fragmentation function (FF):
    a. Parameterized from e^+e^- and e^-p collisions
    b. Assumed to be universal and independent of collision systems
    c. Baryon-to-meson ratio provides significant insight

- **Questioning the universality of the FF**
  - Meson-to-meson ratio: consistent with e^+e^- and e^-p
  - Baryon-to-meson ratio:
    a. Significant p_T dependence in Λ_c^+, Ξ_c^0, and Ξ_c^+
    b. Significant enhancement compared to e^+e^- and e^-p
    c. Further information accessible via multiplicity classification



arXiv:2405.14571



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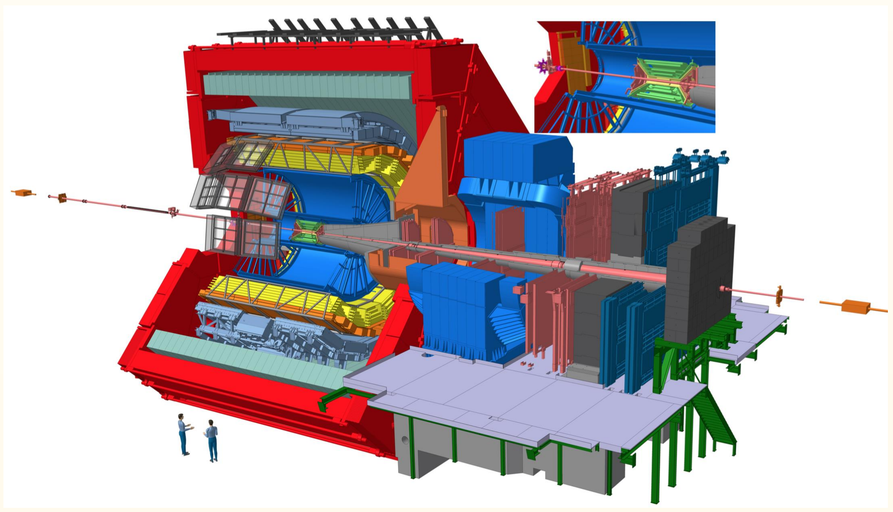
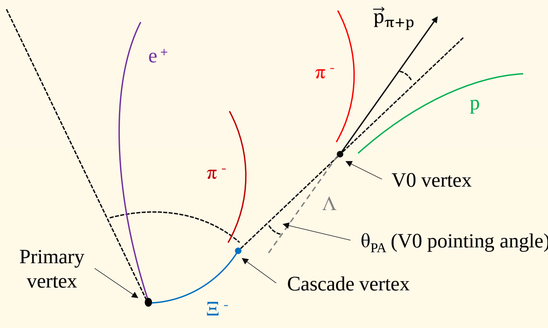
2. ALICE detector in Run 2



- **ALICE subsystems relevant to this analysis**
  - TPC (Time Projection Chamber): tracking, PID† via dE/dx
  - ITS (Inner Tracking System): tracking and vertexing
  - TOF (Time of Flight): PID via time-of-flight measurement
  - V0: triggering, centrality

†Particle identification

3. $\Xi_c^0 \to e\Xi\nu$ measurement

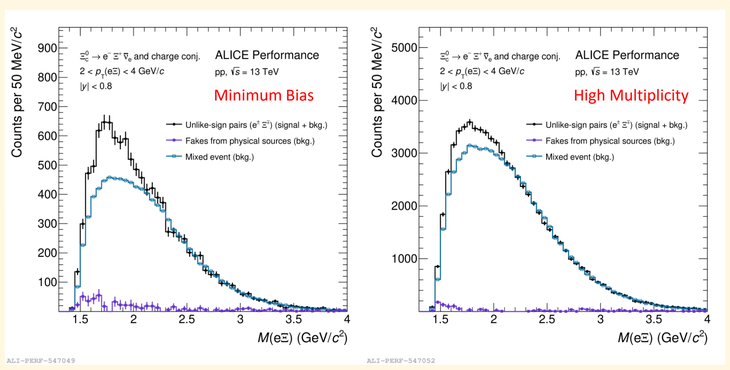


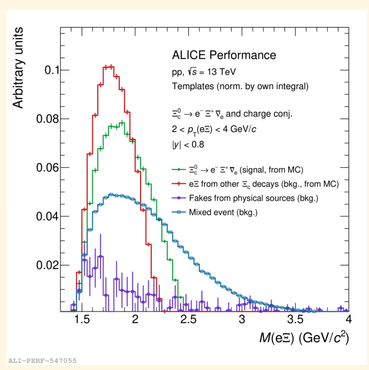
Ongoing ALICE $\Xi_c^0 \to e\Xi$ analysis		
Collision system	pp	
√s (TeV)	13	
Trigger	HM	MB
Multiplicity (%, via V0M)	0-0.1	0.1-30 / 30-100
L_{int}	~32 nb^{-1} (MB)	
Observable	Ξ_c^0/D^0	

- **Target channel and analysis strategy**
  - Target: $\Xi_c^0 \to e^+\Xi^-\nu_e \to e^+(\pi^-\Lambda)\nu_e \to e^+(\pi^-(p\,\pi^-))\nu_e$ and its charge conjugate
  - Analysis strategy:
    a. Collect electrons and Ξ candidates
    b. Offline selection:
      b-1. Multiplicity classification
      b-2. Build eΞ pairs by using collected e and Ξ candidates
    c. Signal extraction via "template fit"
    d. Follow-up corrections:
      d-1. Unfolding: convert eΞ $p_T \to \Xi_c^0$ p_T, recover momentum of missing ν
      d-2. Acc. × ε, subtracting feed-down Ξ_c^0 from b-hadron...
    e. Extract physical observables: prompt per-event yield, Ξ_c^0/D^0

4. Analysis

- **Procedure**
  - Define signal and background (BG)
    a. Signal: eΞ pairs from $\Xi_c^0 \to e\Xi\nu$
    b. Total BG = Combinatorial BG + 4-body BG
      b-1. Combinatorial BG: from uncorrelated decay products
      b-2. 4-body BG: correlated eΞ pairs from decay modes other than $\Xi_c^0 \to e\Xi\nu$
  - Obtain templates for signal extraction
    a. Signal: using MC
    b. Combinatorial BG: data-driven approach by using like-sign pairs
    c. 4-body BG: using MC
  - Final signal extraction:
    perform template fit onto unlike-sign eΞ pair distribution





5. Outlook

- **$\Xi_c^0 \to e\Xi\nu$ analysis with ALICE**
  - Branching fraction ($\Xi_c^0 \to e\Xi\nu$ / $\Xi_c^0 \to \Xi\pi$) is updated:
    1.38 ± 0.14 (stat) ± 0.22 (syst) (PRL127, 272001) →
    0.816 ± 0.094 (stat) ± 0.121 (syst) (this analysis)
  - Analysis finalized, publication is in preparation