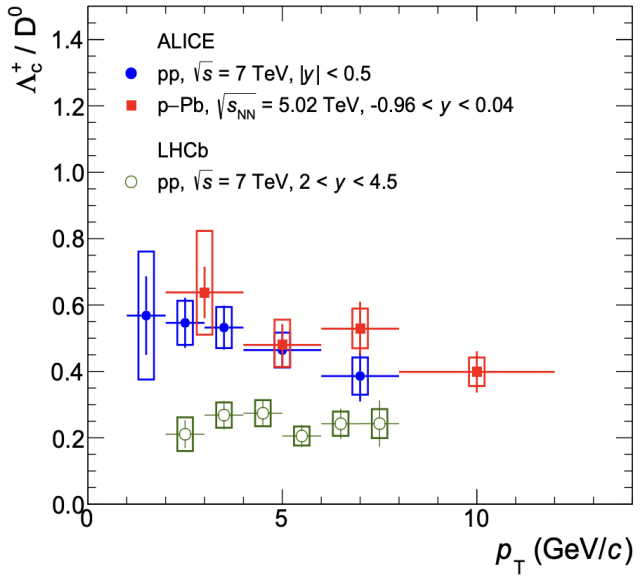
Study charm hadronization via Λ_c^+ production in pp and PbPb collisions with the CMS experiment

Motivation

- Heavy quarks are produced at the earliest stages of the collision
  - follow the whole evolution of the system
- Convenient for perturbative calculations
- Studying energy loss mechanism (different from light quarks)
- Hadronization process
  - $\Lambda_c^+(udc)$ sensitive to charm quark coalescence (baryon - meson ratio)

JHEP 04 (2018)108



ALICE and LHCb results different for Λ_c^+/D^0 in pp collisions (different rapidity range)

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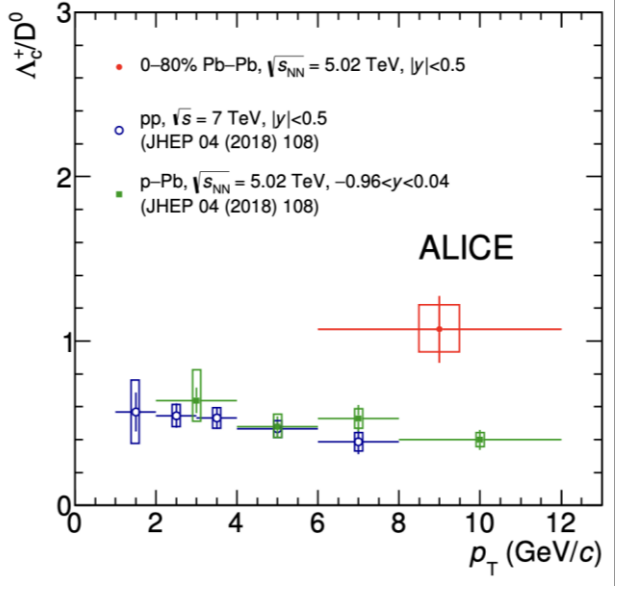

ALICE reported larger Λ_c^+/D^0 ratio in PbPb than in pp and pPb collisions

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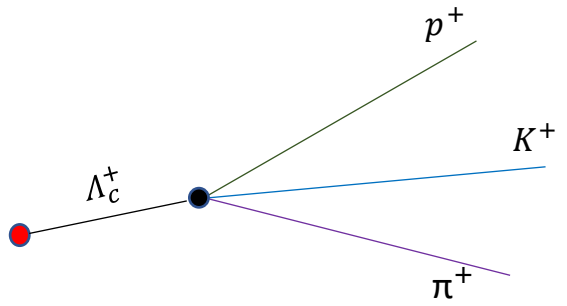
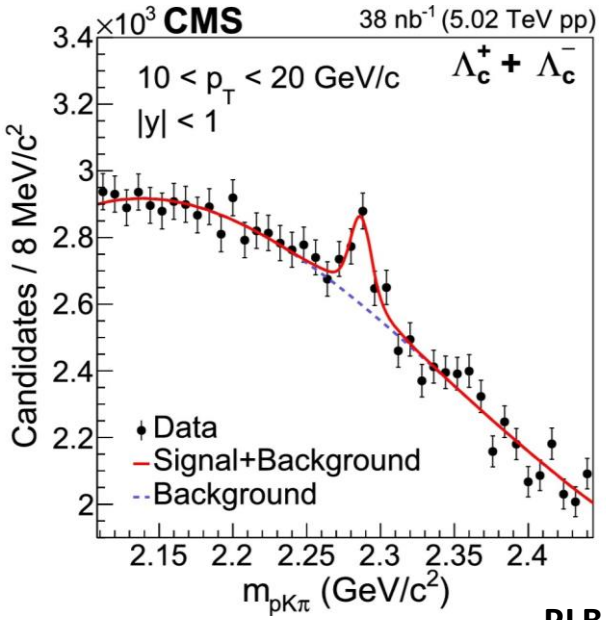
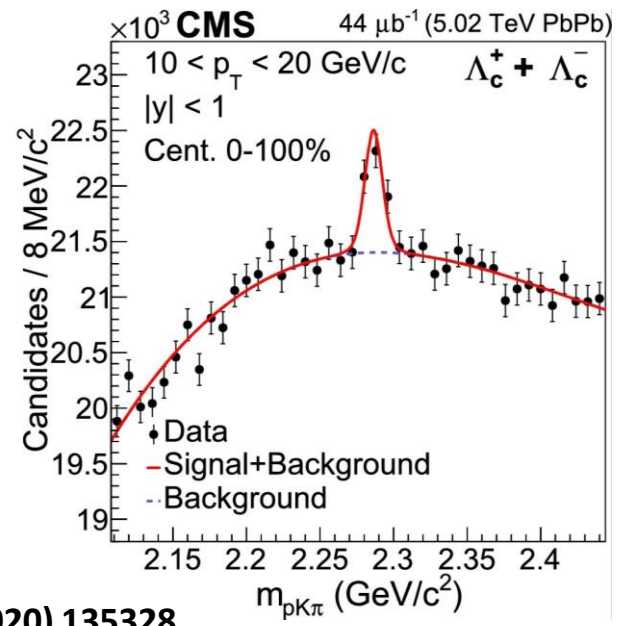
on behalf of the CMS Collaboration for Quark Matter 2022, Krakow, Poland

Λ_c^+ Reconstruction

- Data from 2015 Run:
  - PbPb: 300M Minimum bias events
  - pp: 2B Minimum bias events
- Λ_c^+ reconstruction:
  - $\Lambda_c^+ \rightarrow p^+K^-\pi^+$ (Branching ratio = 6.23%)
- No particle identification
  - All possible combinations of three charged tracks in an event are considered
- Λ_c^+ is measured inclusively
  - Both prompt and non-prompt components







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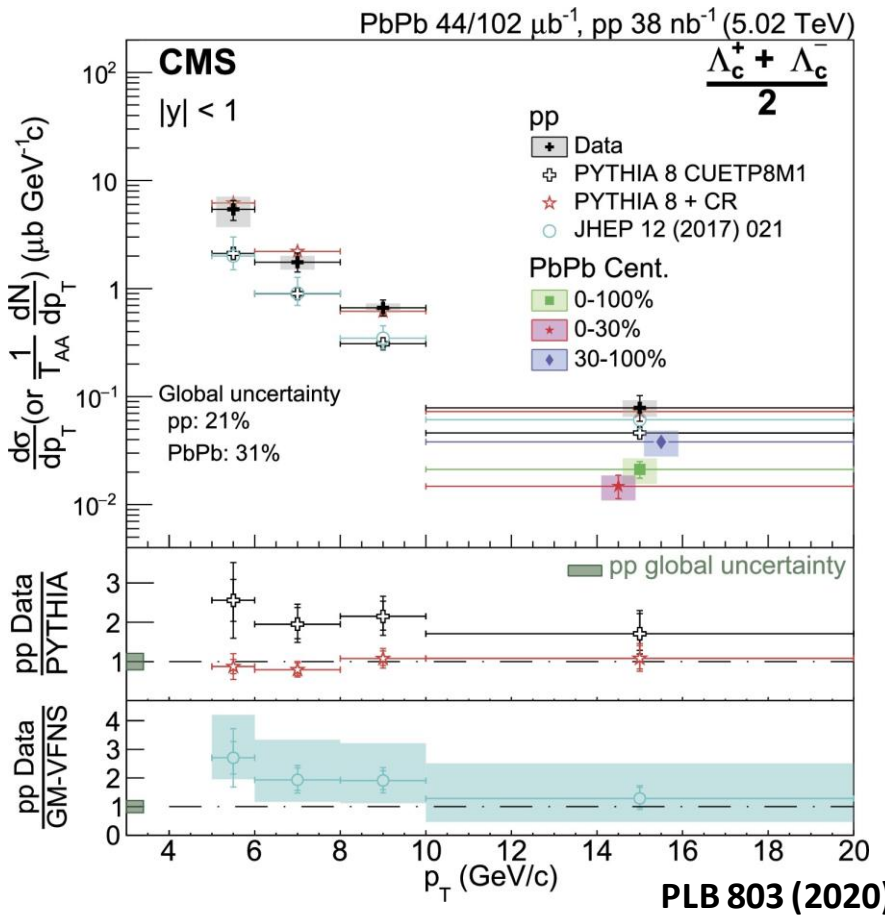
Signal function → Double Gaussian

Combinatorial Background → 3rd order Chebyshev polⁿ function

Results: p_T Spectra



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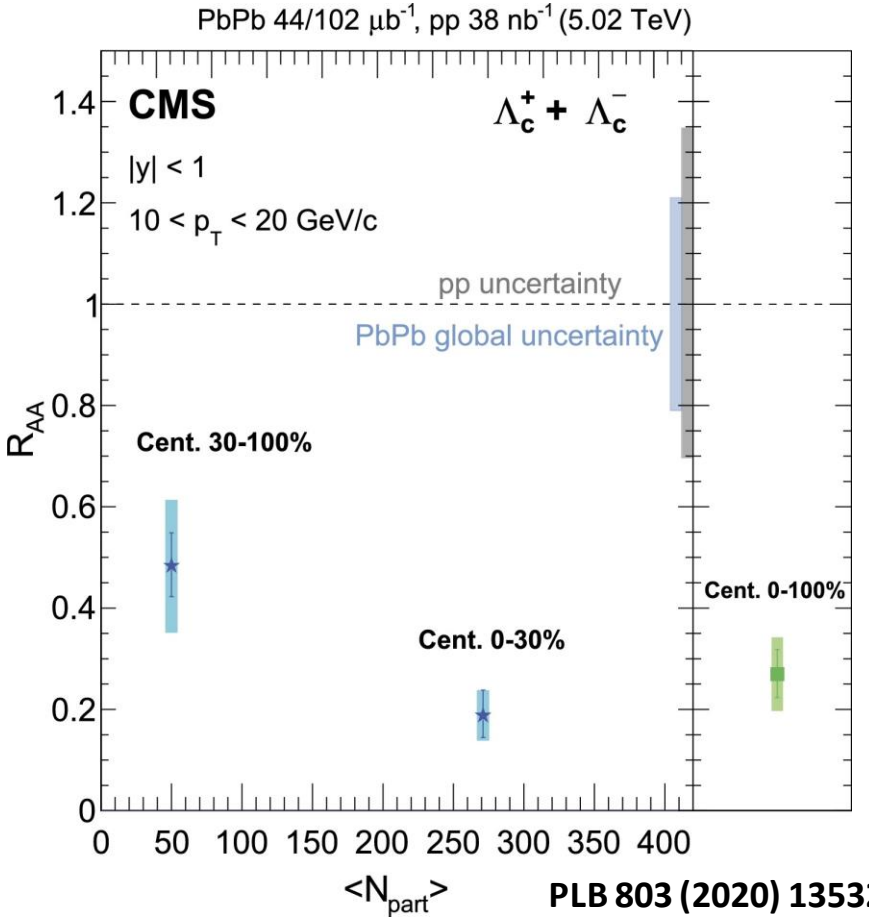
- PYTHIA8 systematically below data
- PYTHIA8+CR2 consistent with pp data
- GM-VFNS systematically below data for p_T<10 GeV/c



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- Indication of Λ_c^+ suppression in PbPb collision
- Λ_c^+ suppression is larger for central events

Results: Λ_c^+ / D^0 ratio

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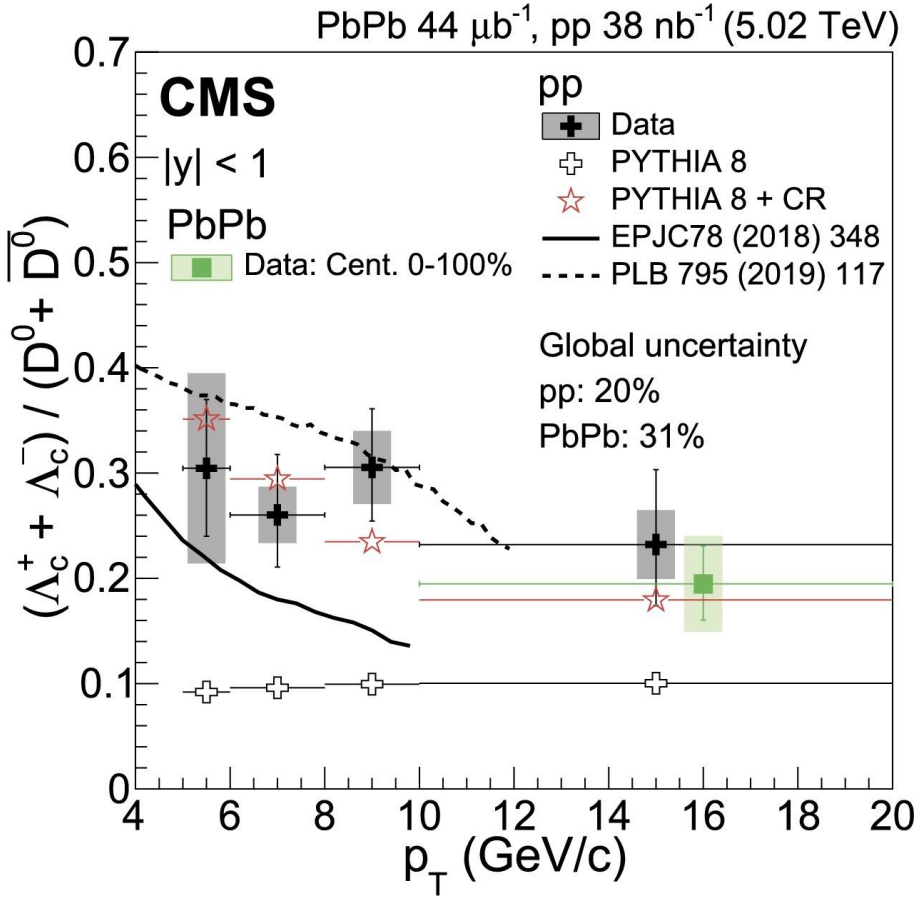

- Similarity between pp & PbPb results suggest that there is no significant coalescence of Λ_c^+ ($10 < p_T < 20$ GeV/c)
- No significant p_T dependence is observed
- PYTHIA8 underestimates the pp data
- PYTHIA8 + Color Reconnection Mode 2 (CR2) resembles the pp data
- Solid line (Catania) predicts stronger p_T dependence
  - Coalescence + fragmentation
  - Updated calculation (PLB821(2021)136622) describes the data well
- Dashed line (TAMU) is reasonable explanation of data for $p_T < 10$ GeV/c
  - Includes charmed baryon states beyond PDG.

Outlook

- Production of Λ_c^+ measured in pp & PbPb collisions
- Suppression of Λ_c^+ consistent with D^0 results in PbPb
- No significant coalescence of Λ_c^+ observed for $10 < p_T < 20$ GeV/c
- Λ_c^+ in pp described well by PYTHIA 8 + CR (mode 2)
- Possible additional constraints to theoretical models
- New analysis ongoing with increased statistics
  - ~ 13 times more PbPb data
  - ~ 6 times more pp data
- In the new analysis, we can obtain p_T-differential measurements in PbPb collisions and R_{AA} vs p_T results.

  Also, we obtained signal in lower p_T region for pp collisions.