A Large Ion Collider Experiment

Università degli Studi di Salerno

Studies of $\Lambda_c^+ \rightarrow pK^0_S$ in p-Pb collisions with ALICE at the LHC

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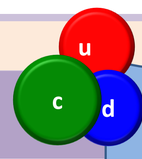
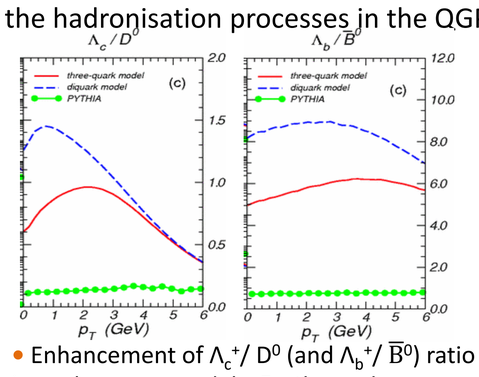
Introduction



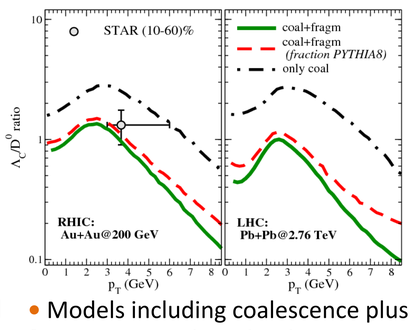
Λ_c^+ is the lightest charmed baryon:
Mass ~ 2286.46 MeV/c^2 [1]
$c\tau$ ~ 59.9 μm

Why to study Λ_c^+?

- **Charm** quarks are a sensitive probe of the **Quark-Gluon Plasma** (QGP), produced in ultra-relativistic heavy-ion collisions.
- Charmed-baryon production in Heavy-Ion (HI) collisions could give an insight into the hadronisation processes in the QGP.



- Enhancement of Λ_c^+ / D^0 (and $\Lambda_b^+ / \bar{B}^0$) ratio is predicted in coalescence models. Further enhancement is expected if light diquark states exist in the QGP [2].



- Models including coalescence plus fragmentation describe the measurement of the Λ_c^+ / D^0 ratio in Au-Au collisions by STAR [3].

- **Measurement in pp and p-Pb collisions:**
  - Investigate charm hadronisation and charm-baryon formation at LHC.
  - Crucial to understand the results in nucleus-nucleus collisions.
  - Important to set constraints to Cold Nuclear Matter effects, as well as to effects related to the possible formation of QGP in small systems, that can affect charm-hadron production.

- ALICE and CMS observed an enhancement of baryon/meson ratio at intermediate p_T in High-Multiplicity (HM) pp and p-Pb collisions [4].
  - Similar to what observed in HI collisions
  - mini-QGP, influence of colour reconnection on hadronisation?

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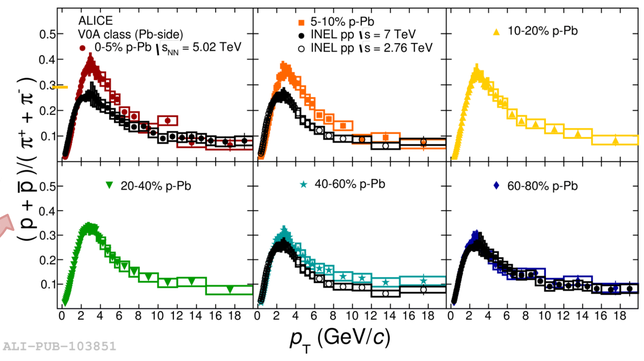
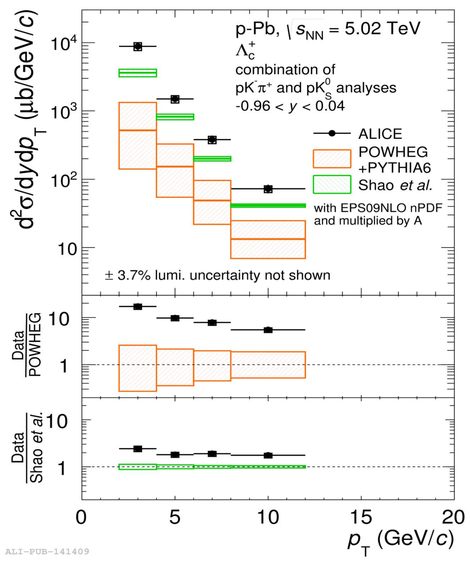
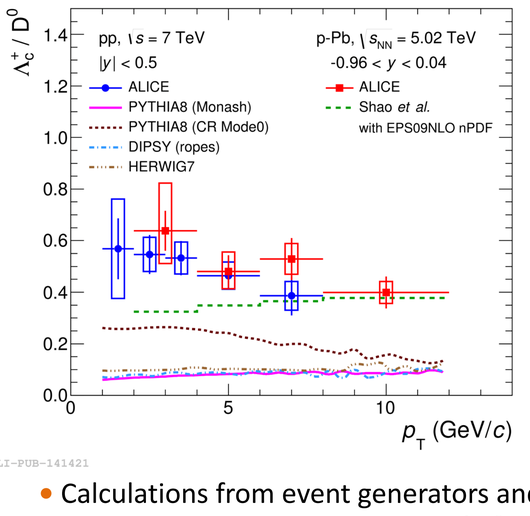


Results with Run -1 data

arXiv:1712.09581



- Lansberg and Shao[5] predictions and POWHEG [6] calculations significantly underestimate the cross section measured in p-Pb collisions.



- Calculations from event generators and models [7-9] underpredict the Λ_c^+ / D^0 measurements in pp and p-Pb collisions.

ALICE detector

Inner Tracking System (ITS)

- Reconstruction of primary and secondary vertices.

Time Projection Chamber (TPC)

- Tracking
- Particle Identification (PID) of π, K and p with dE/dx measurements.

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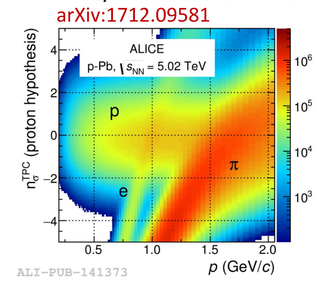
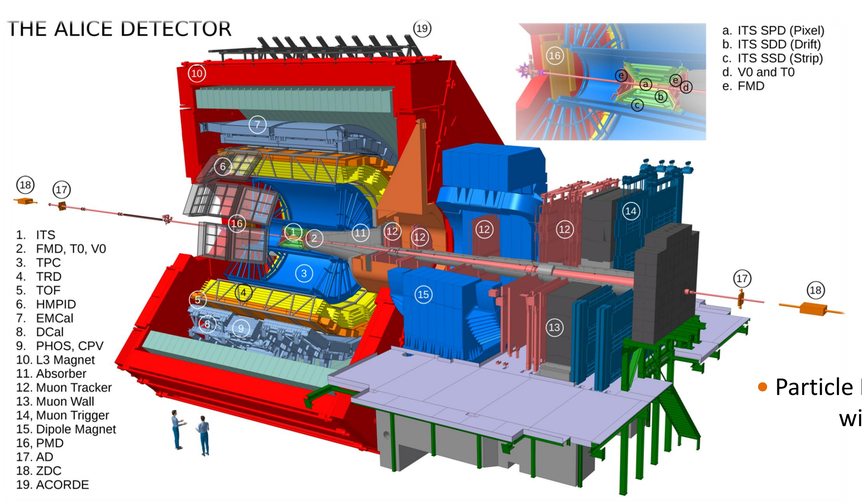
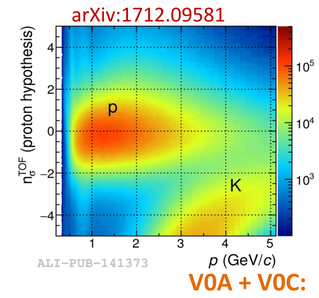




Time Of Flight (TOF)

- Particle Identification (PID) of π, K and p with time-of-flight measurements.

arXiv:1712.09581



V0A + V0C:

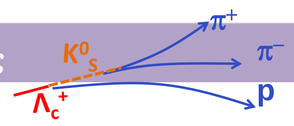
- Trigger and event centrality.

Data sample

- **Run I :** ~ 1.0 × 10^8 minimum–bias events analysed at $\sqrt{s_{NN}}$ = 5.02 TeV
- **Run II**: ~ 6.0 × 10^8 minimum–bias events analysed at $\sqrt{s_{NN}}$ = 5.02 TeV

Factor-6 increase in statistics compared to Run 1

Reconstruction of decay $\Lambda_c^+ \rightarrow pK^0_S$

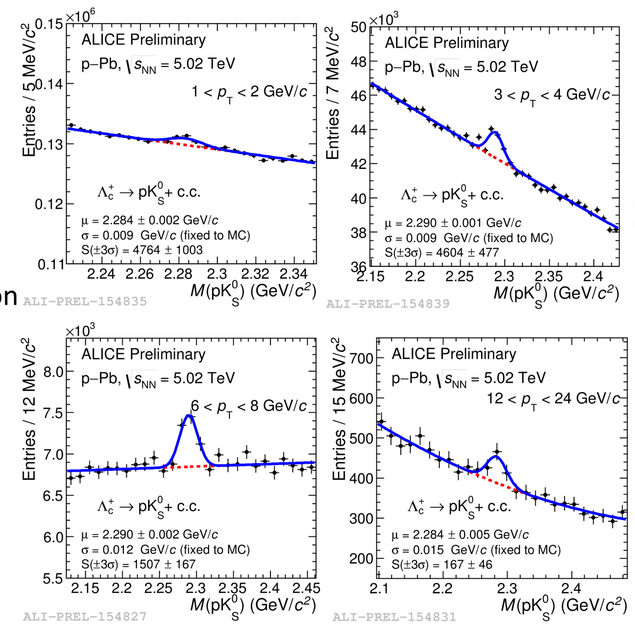


Building pK^0_S candidates

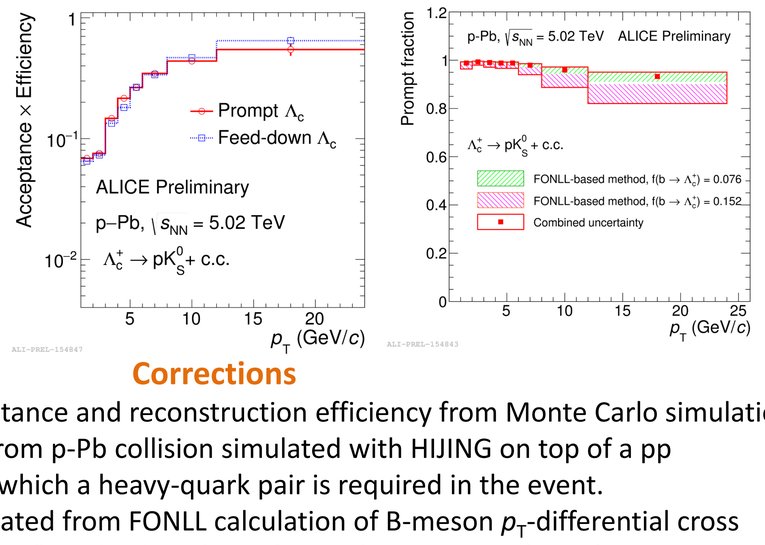
- **K^0_S candidates** selected from pairs of opposite charge tracks forming a vertex displaced from the interaction vertex.
- **Selections applied**: high-quality track selection, Distance of Closest Approach (DCA) between tracks, cosine of K^0_S pointing angle.
- **Proton candidates** identified with track and PID selection are combined with K^0_S to build Λ_c^+-baryon candidates.

Particle Identification (PID)

- Detector used: TOF and TPC.
- Used approach:
  Selection based on a cut on the number of sigma and on the combined PID probability.



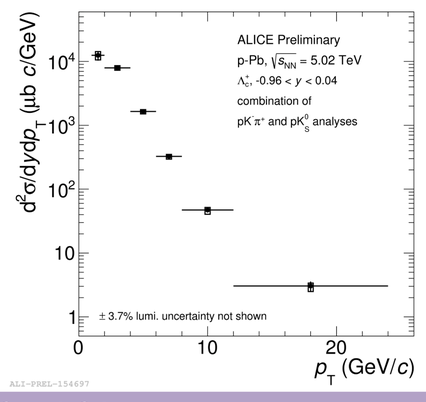
- Λ_c^+ is reconstructed in the transverse momentum interval 1 < p_T < 24 GeV/c
- **2 new p_T bins (1-2 and 12-24 GeV/c) and more p_T-differential measurements with respect to Run-1 data.**

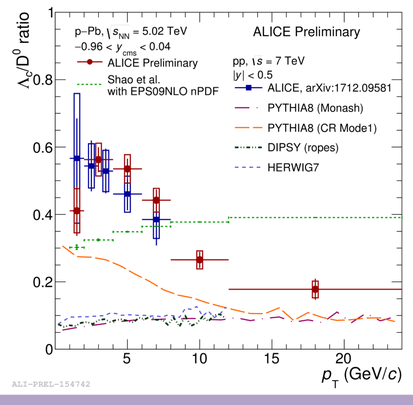


Corrections

- Corrections for detector acceptance and reconstruction efficiency from Monte Carlo simulations performed by adding an event from p-Pb collision simulated with HIJING on top of a pp event simulated with PYTHIA in which a heavy-quark pair is required in the event.
- Feed-down contribution estimated from FONLL calculation of B-meson p_T-differential cross section, b → Λ_b branching fraction from [11], and simulating the Λ_b -> Λ_c X decay kinematics with the EvtGen package [12].

Results with Run -2 data





- Run-2 results compatible within uncertainties with Run-1 ones.
- With Run-2 data: reduced statistical and systematic uncertainties + extended p_T range.
- Cross section measurement extended at **lower and higher p_T bins** with respect to Run-1 results.
- Indication of a decreasing trend of Λ_c^+ / D^0 ratio from p_T = 4 GeV/c to p_T = 24 GeV/c.
- See also ***posters by C. Hills (ID 269), J. Wilkinson (ID 37) and Y. Watanabe (ID 132).***
- **Ongoing measurement on large-size data samples in pp collisions at $\sqrt{s}$ = 5 and 13 TeV.**

References

[1] C. Patrignani *et al.* (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
[2] Y. Oh et al., PRC 79, 044905 (2009)
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[6] GM-VFNS: Eur. Phys. J. C41, 199 (2005)
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[10] M. Cacciari et al., JHEP10 137 (2012)
[11] L. Gladilin, Eur. Phys. J. C75 no. 1, 19 (2015)
[12] D. J. Lange, Nucl. Instrum. Meth. A462, 152–155 (2001)