$\Lambda_c$ studies in pp and p-Pb collisions with ALICE at the LHC

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Introduction

Why study $\Lambda_c$?
- Charm is a very sensitive probe of the Quark-Gluon Plasma (QGP), produced in ultra-relativistic heavy-ion collisions. Charm quarks produced in hard parton scattering processes in the early stages of the collision, traverse the QCD medium, interact with its constituents and experience the whole evolution of the medium.
- Together with charmed mesons, the measurement of $\Lambda_c$ in Pb-Pb collisions could give an insight into the hadronization mechanisms in the QGP, measuring the baryon over meson ratio in the heavy-quark sector [1].

$\Lambda_c$ in pp collisions
- Useful test for perturbative Quantum Chromo Dynamics (pQCD)
- Total cross section of charm production at the LHC with ALICE.

Baryon cross section needed in addition to the D-meson cross section.
- Existing $\Lambda_c$ measurements in pp collisions are in different energy [2] or kinematic regime [3].
- Reference for Pb-Pb collisions.

$\Lambda_c$ in p-Pb collisions
- Reference for Pb-Pb collisions.
- Study of cold nuclear matter effects not due to the QGP formation, such as modification of the Parton Distribution Functions (PDF), $k_t$ broadening or energy loss.
- Total cross section of charm production at the LHC with ALICE.

ALICE detectors essential for this analysis

Time Of Flight (TOF)
- Particle identification (PID) of $\pi$, $K$, $p$ with time-of-flight measurements.

Time Projection Chamber (TPC)
- Tracking
- Particle identification (PID) of $\pi$, $K$, $p$ with dE/dx measurements.

Reconstruction of $\Lambda_c \rightarrow pK^n\$ candidates building
- $K^n_1$ candidates selected from pairs of opposite charge tracks forming a vertex displaced from the interaction vertex.
- Cuts applied: high-quality single tracks cuts, DCA between tracks, radius of fiducial volume, cosine of $\theta^{*}$ pointing angle.
- Proton candidates selected according to track selection and PID, combined with selected $K^n_1$ to build $\Lambda_c$ candidates.

Particle Identification (PID)
- PID is essential to identify protons.
- Detector used: TOF and TPC.
- Used approach: number of sigma cuts and combined PID.
- Using PID the background is suppressed by a factor 20!

Signal extraction, after further selection:
- Standard topological cuts on variables offering good S/B separation.
- Cut on multivariate discriminator (BDT) [4].

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

$K^0_S$ candidates building
- $K^0_S$ candidates selected from pairs of opposite charge tracks forming a vertex displaced from the interaction vertex.
- Cuts applied: high-quality single tracks cuts, DCA between tracks, radius of fiducial volume, cosine of $\theta^{*}$ pointing angle.
- Proton candidates selected according to track selection and PID, combined with selected $K^0_S$ to build $\Lambda_c$ candidates.

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In both analyses:
- $\Lambda_c$ is reconstructed in a wide momentum range.
- A good agreement with Monte Carlo expectations is observed.

The analyses are ongoing
- Beauty feed-down fraction estimated with two methods, using measured yield and expected $\Lambda_b$ from theoretical calculations (FONLL predictions) [5].
- Efficiency and acceptance corrections estimated using Monte Carlo simulations.
- Systematic studies.
- Cross-checks between the measurements in the different decay channels.

Final target:
- First measurement of $\Lambda_c$ cross sections in pp and p-Pb collisions at mid rapidity at the LHC energies with ALICE.

- $\Lambda_c$ is the lightest open charm baryon:
  - Mass = 2286.4 MeV/$c^2$
  - $\Delta R = 59.9 \mu m$

References

Data sample:
- $pp$: 3.0 x 10^{6} minimum bias events analysed at $\sqrt{s} = 7$ TeV.
- $p-Pb$: 1.0 x 10^{6} minimum bias events analysed at $\sqrt{s} = 5.02$ TeV.