Measurements of $D^{*+}$-meson production in Pb–Pb and pp collisions with ALICE at the LHC

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Physics motivation

Heavy quarks, charm and beauty, are primarily produced in hard scattering processes in the early stages of the collision. They are considered as excellent probes to study the Quark-Gluon Plasma (QGP) produced in high-energy heavy-ion (A–A) collisions.

- Energy loss in the medium via gluon radiation and elastic collisions.
- Dependent on path length, colour charge and parton mass.
- Quantification of the effect via the nuclear modification factor ($R_{AA}$).

$$R_{AA} = \frac{1}{(T_{AA})} \frac{d\sigma_{AA}}{d\eta} \left|_{\sqrt{s}=\sqrt{s_{NN}}} \right. \frac{d\sigma_{pp}}{d\eta}$$

($T_{AA}$) is the average nuclear overlap function (Glauber model).

- pp collisions represent the needed reference for A–A collisions and a powerful tool to test NLO pQCD calculations.

$D^{*+}$-meson acceptance and efficiency correction are obtained via Monte Carlo simulations.

Feed-down (from B) correction based upon FONLL calculations.

Systematic uncertainties via the open boxes and the statistical uncertainties via the bars.

Event selection and reconstruction

- A suppression of the $D^{*+}$ yield is observed for $p_T > 3$ GeV/c.
- The distribution of the mass difference after selection cuts is shown in Fig. 4.

Reconstruction & raw yield extraction

- Reconstruction in the hadronic decay channel: $D^{*+} \to D^{0}\pi^+ \to K^-\pi^+\pi^+$.
- Branching fractions of $67.7 \pm 0.5\%$ and $3.88 \pm 0.05\%$, respectively.
- The analysis strategy is based on:
  - a precise tracking (Inner Tracking System (ITS), combined with Time Projection Chamber (TPC)),
  - reconstruction of the $D^0$ decay secondary vertex (ITS) and then combined with a soft pion,
  - particle identification (TPC via specific energy loss and Time-Of-Flight (TOF)),
  - Pb-Pb: determination of the centrality of the collision (V0).

- An invariant mass analysis on the mass difference $M(K^+\pi^-\pi^+)$ in $M(K^+\pi^-)$ is done in order to extract the raw yield.

Data samples

- Pb-Pb $p_T > 2.76$ TeV:
  - 2011 data sample: $L_{int} = 21.3 \pm 0.7$ nb$^{-1}$ for the 0-10% centrality class and $L_{int} = 5.8 \pm 0.2$ nb$^{-1}$ for the 10-20% centrality class.
  - 2010 data sample: $L_{int} = 2.2 \pm 0.1$ nb$^{-1}$ for the 50-80% centrality class.

Proton-proton collisions at $\sqrt{s} = 13$ TeV

- First prospects for the current ongoing pp collisions at 13 TeV are shown.
- The distribution of the mass difference after selection cuts is shown in Fig. 4.

References