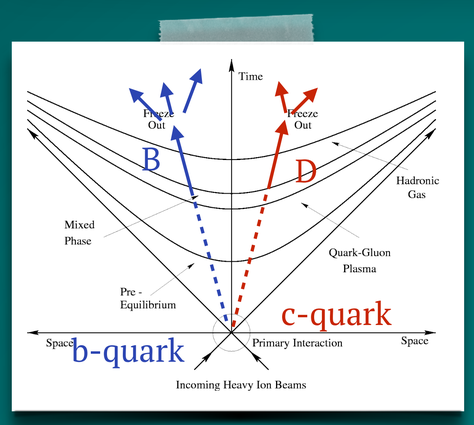
Measurement of D_s^+/D^+ as a function of transverse momentum and charged-particle multiplicity in pp, p-Pb and Pb-Pb collisions with ALICE

Fabrizio Grosa on behalf of the **ALICE** Collaboration
Politecnico and INFN Torino

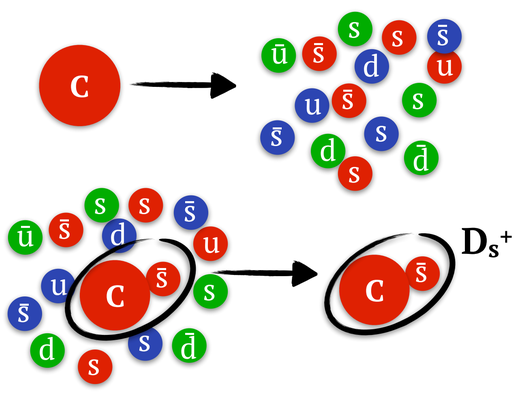
Physics Motivation



- The **Quark-Gluon Plasma** (QGP) is **created in ultra-relativistic Pb-Pb collisions** at the **LHC**
- **Heavy flavours** (i.e. c and b quarks) are mainly produced in **hard-scattering processes on time scales shorter than the QGP formation time**
- They **experience the full evolution of the QGP → interaction** with its **constituents**:
  (i) elastic (**collisional**) processes
  (ii) inelastic (**gluon radiation**) processes

- Measurement of heavy-flavour hadrons with **strange quark content** (i.e. D_s^+ mesons)
  → insight into the heavy-quark **hadronisation mechanism**
- Hadronisation via **coalescence** [1] + **enhanced production of strange quarks in the QGP** [2]
  → **relative abundance of D_s^+ with respect to non-strange D mesons** is expected to be **larger in heavy-ion collisions** compared to pp collisions

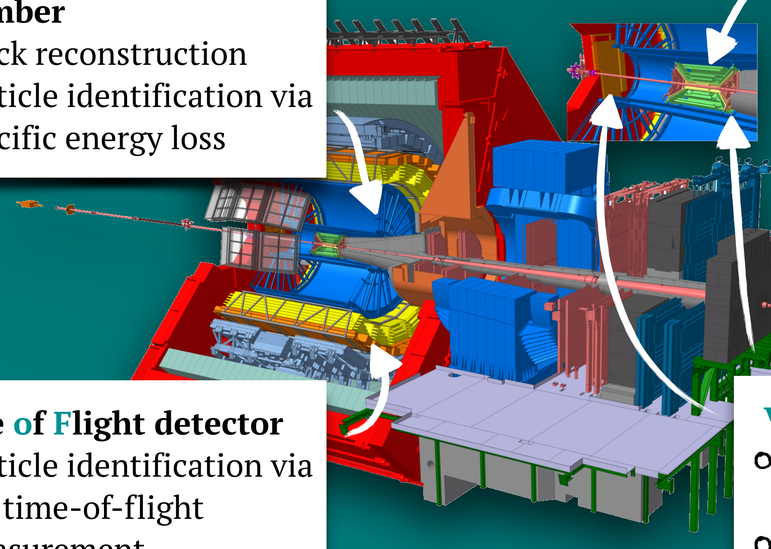
Charm-quark coalescence



- An **enhanced production of strange and multi-strange hadrons** was recently observed **in high-multiplicity pp and p-Pb collisions** in the light-flavour sector [3]: can we expect the same for the **heavy-quark sector**?

Time Projection Chamber
- Track reconstruction
- Particle identification via specific energy loss

Inner Tracking System
- Track reconstruction
- Reconstruction of primary and decay vertices



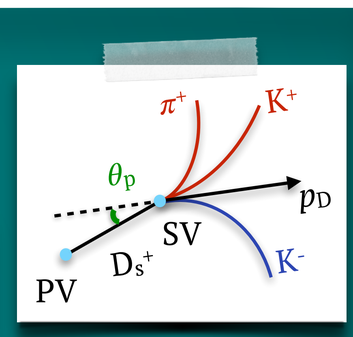
Time of Flight detector
- Particle identification via the time-of-flight measurement

V0 detectors
- Minimum Bias Trigger definition
- Centrality estimation

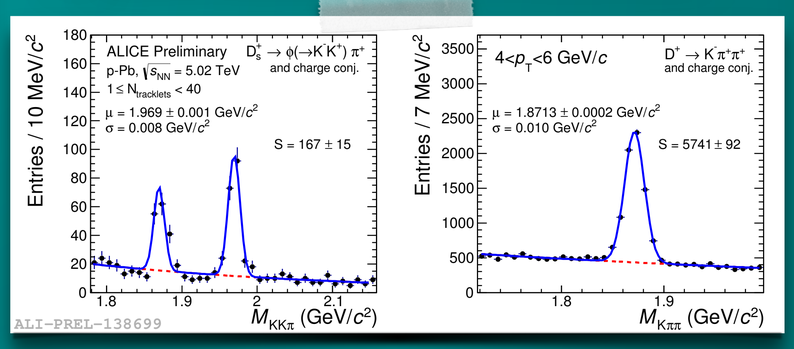
D-meson reconstruction

- D_s^+ and D^+ mesons are measured via their **hadronic decays** [4]:

$$D_s^+ \to \phi(\to K^+K^-)\pi^+,\ \mathrm{BR} = (2.27 \pm 0.08)\%,\ c\tau \simeq 150\ \mu\mathrm{m}$$
$$D^+ \to K^-\pi^+\pi^-,\ \mathrm{BR} = (9.46 \pm 0.24)\%,\ c\tau \simeq 312\ \mu\mathrm{m}$$

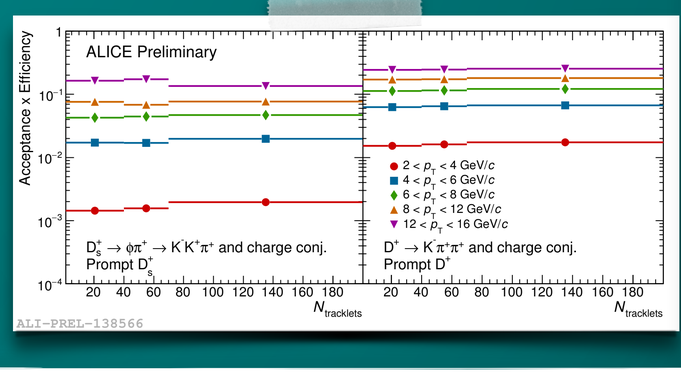


- **Secondary vertices displaced by a few hundred microns** from the primary vertex are reconstructed by **combining triplets of charged particles**
- Reduction of the combinatorial background achieved applying:
  (i) **geometrical selection** of displaced decay-vertex topology
  (ii) **particle identification** (PID) of decay tracks

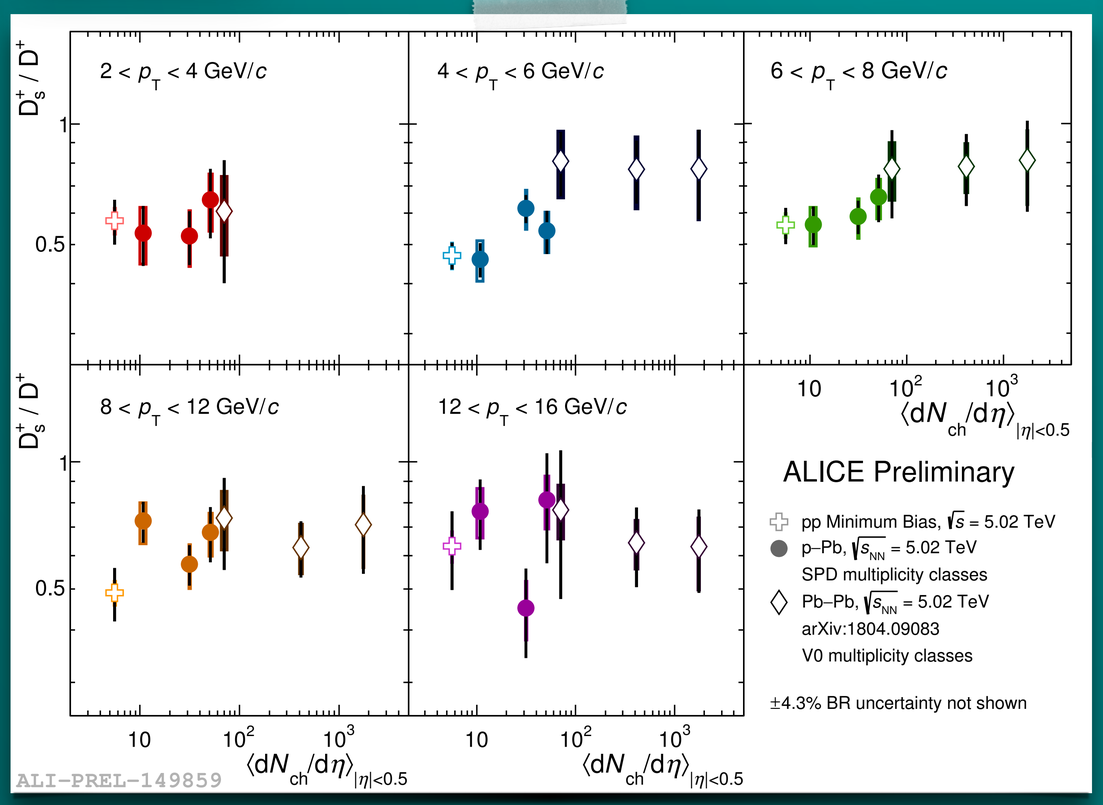


- The raw signal is extracted via a **binned fit of the invariant-mass distributions** (Gaussian function for the signal and exponential function for the background)

- **Efficiency correction** from Monte Carlo simulations using **HIJING** [5] (**PYTHIA** [6]) p-Pb or Pb-Pb (pp) events **enriched** with PYTHIA **$c\bar{c}$ and $b\bar{b}$ pairs**
- **Beauty feed-down subtraction** based on **FONLL** [7] calculations



Results

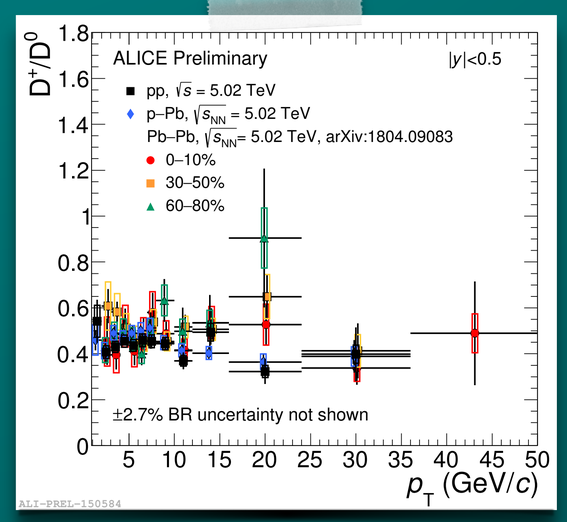


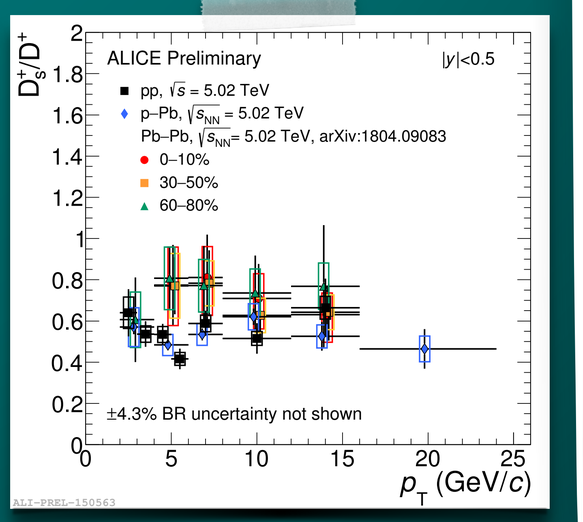
- The **yield ratios of different non-strange D-meson species** (e.g. D^+/D^0) **are similar in pp, p-Pb and Pb-Pb collisions** for different centrality classes
- The **D_s^+/D^+ yield ratio is larger in Pb-Pb collisions with respect to pp collisions**, although the measurements are compatible within about one standard deviation
- The **D_s^+/D^+ yield ratio is similar in different centrality classes** in **Pb-Pb collisions**
- **No significant difference** is observed for the **D_s^+/D^+ yield ratio in p-Pb collisions** for different multiplicity intervals **with respect to pp collisions**

Pb-Pb [8]

p-Pb [9]

pp [10]





References

[1] S. Plumari, V. Minissale, S. K. Das, V. Greco, Eur. Phys. J. C 78 (2018) 348
[2] I. Kuznetsova, J. Rafelski, Eur. Phys. J. C 51 (2007) 113
[3] ALICE Collaboration, Nature Physics 13 (2017) 535–539
[4] PDG, Chin. Phys. C40 (2016) 100001
[5] X. Wang, M. Gyulassy, Phys. Rev. D 44 (1991) 3501
[6] T. Sjöstrand, S. Mrenna, P. Skands, JHEP 0605 (2006) 026
[7] M. Cacciari, M. Greco, P. Nason, JHEP 9805 (1998) 007
[8] ALICE Collaboration, arXiv:1804.09083
[9] ALICE Collaboration, ALICE-PUBLIC-2017-008
[10] ALICE Collaboration, ALICE-PUBLIC-2018-006