Measurement of azimuthal correlations of D mesons with charged particles in pp collisions at $\sqrt{s} = 7$ TeV with ALICE at the LHC

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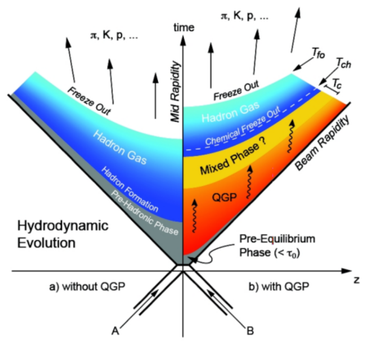
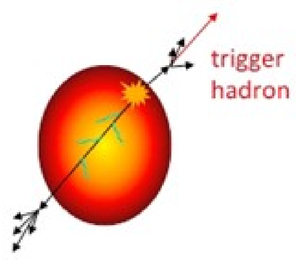
Motivation





- Heavy quarks (charm and beauty), having a large mass, are produced in hard-parton scatterings in the early stages of the collision.
- They experience the whole evolution of the Quark-Gluon Plasma, representing an important tool for its characterization.

The study of angular correlations between D mesons and charged particles in different collision systems allows us to:

pp collisions:

- ✓ Study the production mechanisms, fragmentation and hadronization of charm quark.
- ✓ Act as a reference for p-Pb and Pb-Pb systems.

p-Pb collisions:

- ✓ Investigate the cold nuclear matter effects on the charm jets.
- ✓ Search for long-range ridge-like structures in near- ($\Delta\varphi \approx 0$) and away-side ($\Delta\varphi \approx \pi$) regions ("double ridges") as observed in h-h correlations.

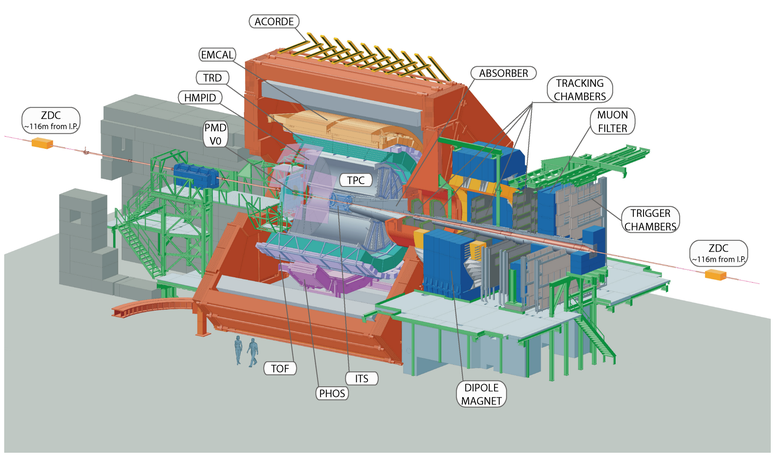
Pb-Pb collisions:

- ✓ Study the path-length dependence of heavy-quark energy loss.
- ✓ Disentangle the contributions from collisional and radiative energy loss mechanisms.
- ✓ Characterize the medium-induced modification of charm quark fragmentation and hadronization.

ALICE Detector

→ The main detectors used for the analysis, located in the central barrel, are:

- ITS (Inner Tracking System), for tracking and vertexing
- TPC (Time Projection Chamber), for particle tracking
- TOF (Time Of Flight), for particle identification



Analysis Method

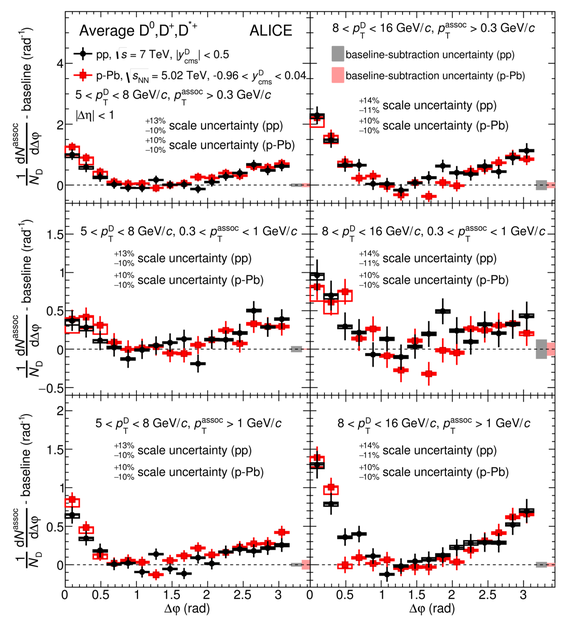
Signal extraction:

- D mesons and their charge conjugates are fully reconstructed at mid-rapidity from the hadronic decay channels:
  $D^0 \to K^-\pi^+$ (BR: 3.88±0.05%), $D^+ \to K^-\pi^+\pi^+$ (BR: 9.13±0.19%), $D^{*+} \to D^0\pi^+$ (BR: 67.7±0.5%)
- D-meson candidates are selected exploiting the displaced decay topology and particle identification on the daughter tracks.
- D-meson raw yields are extracted by fitting the invariant-mass distribution of the candidates.

Azimuthal correlation and Corrections:

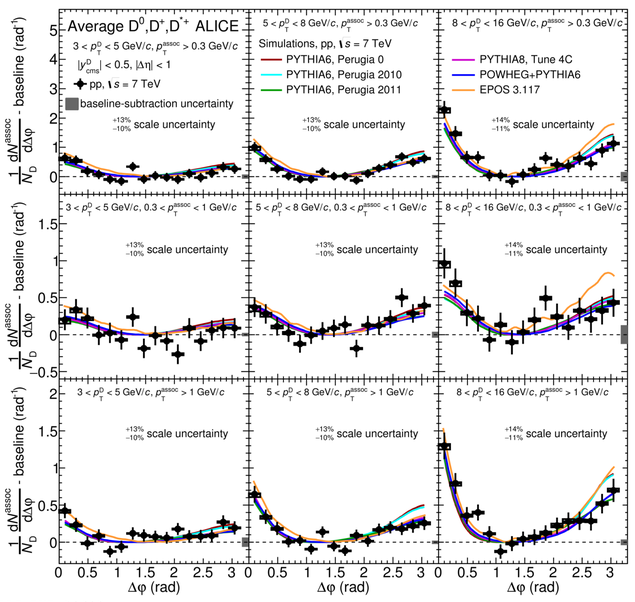
- Each selected D meson is correlated with charged tracks produced in the collision for $|\eta| < 0.8$ (excluding the daughter particles) both under the signal peak and in two sideband regions, to build ($\Delta\varphi$, $\Delta\eta$) correlation distributions.
- Effects due to limited detector acceptance and inhomogeneities are corrected via event-mixing technique.
- Background from combinatorial D-meson candidates is subtracted through sideband subtraction method.
- The distributions are corrected with D meson reconstruction and selection efficiency, and associated track reconstruction efficiency.
- The ($\Delta\varphi$, $\Delta\eta$) corrected distributions are projected onto $\Delta\varphi$, normalized by the number of trigger particles and multiplied by the fraction of primary particles in the sample (purity). The contribution of the correlations from D mesons originated from B-hadron decays was also subtracted.
- The average of the three D species and the fit with a double Gaussian (centered at $\Delta\varphi = 0$ and $\Delta\varphi = \pi$) plus a constant term (baseline) are performed to extract physical observables.

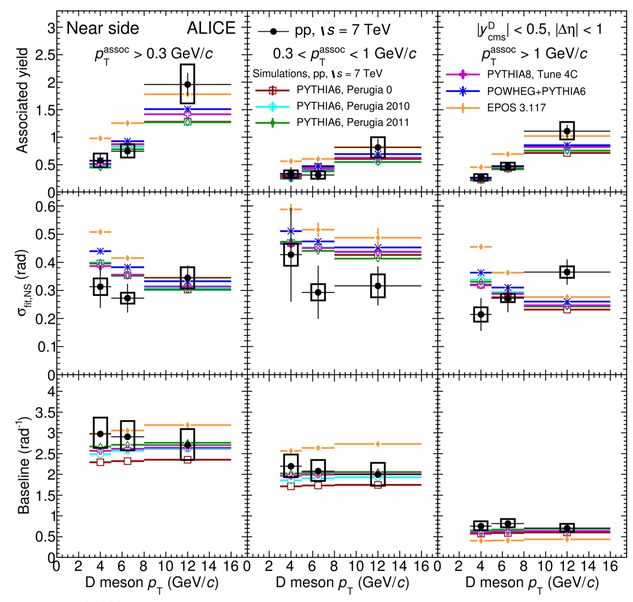
Correlation distributions



Comparison of azimuthal correlation distributions of D mesons with charged particles in pp collisions and p-Pb collisions after baseline subtraction, for different kinematic ranges [4].

Peak Properties and comparison with Monte Carlo





Left figure : Comparison of $\Delta\varphi$ correlation distributions in pp collisions and from Monte-Carlo simulations with different event generators, after the baseline subtraction [4].

Right figure : Comparison of near-side peak associated yield (top row), near-side peak width (middle row) and baseline (bottom row) values measured in pp collisions with the expectations from Monte-Carlo simulations with different event generators [4].

References

[1] Yu.L. Dokshitzer, D.E. Kharzeev, Phys. Lett. B 519 (2001) 199-206.
[2] R. Baier, Y. L. Dokshitzer, A. H. Mueller, S. Peigne, and D. Schiff, Nucl. Phys. B 484, (1997) 265.
[3] B. Abelev et al. (ALICE Collaboration), JHEP 01 (2012) 128.
[4] J. Adam et al. (ALICE Collaboration), Eur. Phys. J. C 77 (2017) 245.

Summary and Outlook

- ✓ The results of azimuthal correlations between D mesons and charged particles in pp collisions, extracted in different p_{T} intervals of trigger and associated charged particles, are presented.
- ✓ The measured distributions, as well as the properties of the correlation peaks, are in agreement with the predictions obtained from different MC event generators within uncertainties.
- ✓ The LHC Run3 data will allow us to perform this study with better precision and in different event multiplicity classes, due to the higher luminosity and the improved performance on the D-meson reconstruction.