

# Performance studies of $D^0$ - $\bar{D}^0$ azimuthal correlations in ALICE 3

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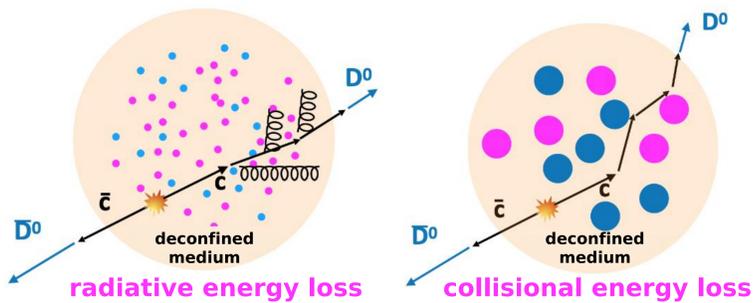
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ALICE

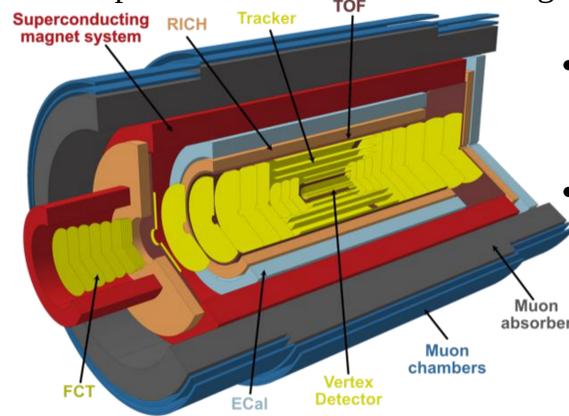
## Physics motivation and goals

- High-purity selection of D mesons with ALICE 3 allows to measure azimuthal correlations of  $D^0$ - $\bar{D}^0$  pairs with high precision
  - a direct access to charm production mechanisms in pp collisions [1].
  - a **direct measure of momentum broadening** by the QGP in Pb-Pb collisions, sensitive to the nature of the **energy loss mechanism**, as well as **the degree of charm thermalization in the QGP** at low  $p_T$  [2].



## The ALICE 3 detector

- ALICE 3 is a next-generation heavy-ion experiment for LHC Run 5 [3].**
- Compact all-silicon tracker with high-resolution vertex detector.



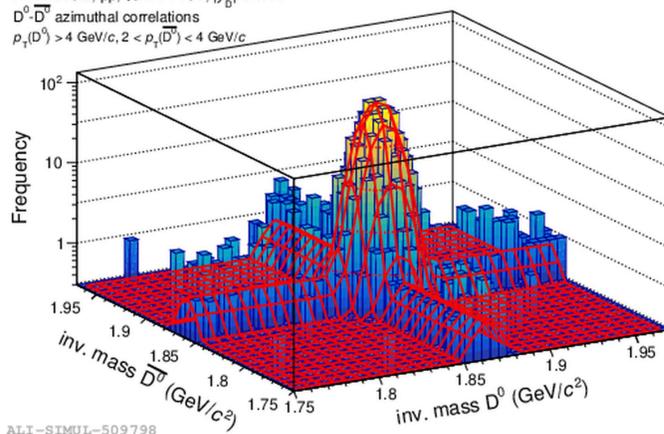
- Particle identification over a large acceptance.
- Heavy-flavour hadrons** ( $p_T \rightarrow 0$ , wide  $\eta$  range)
  - vertexing, tracking, hadron ID

## Evaluation of signal correlation template - pp collisions

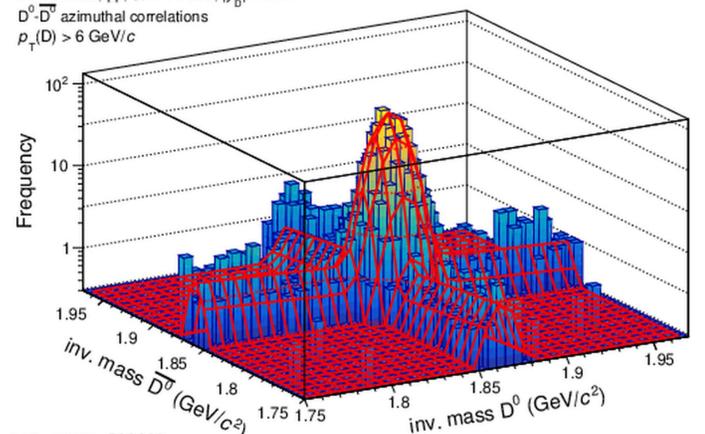
### 2-dimensional invariant mass distribution of $D^0$ and $\bar{D}^0$ pairs at $|\eta_{\text{daug}}| < 1.44$

- 2D mass fits to subtract combinatorial background for  $D^0$ - $\bar{D}^0$  pairs.
- Signal + background for single D mesons from PYTHIA 8.2 events. Pair distributions generated from independent 1D distributions.
- Statistics matched to the expected significance.

ALICE 3 study,  $L_{\text{int}} = 3 \text{ nb}^{-1}$   
PYTHIA 8.2, pp,  $\sqrt{s} = 14 \text{ TeV}$ ,  $|\eta_D| < 1.44$   
 $D^0$ - $\bar{D}^0$  azimuthal correlations  
 $p_T(D^0) > 4 \text{ GeV}/c$ ,  $2 < p_T(\bar{D}^0) < 4 \text{ GeV}/c$



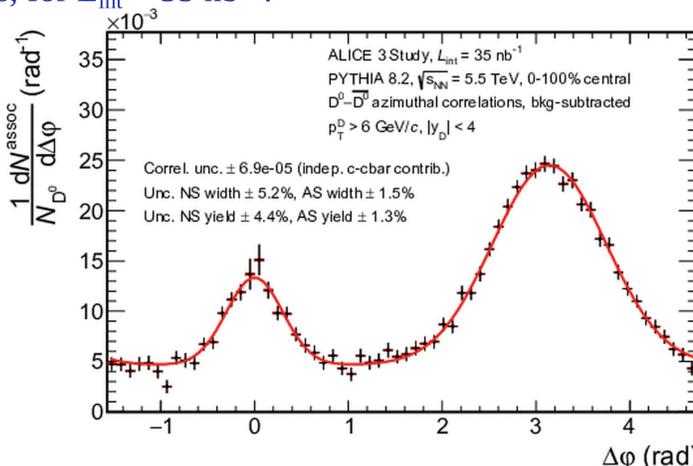
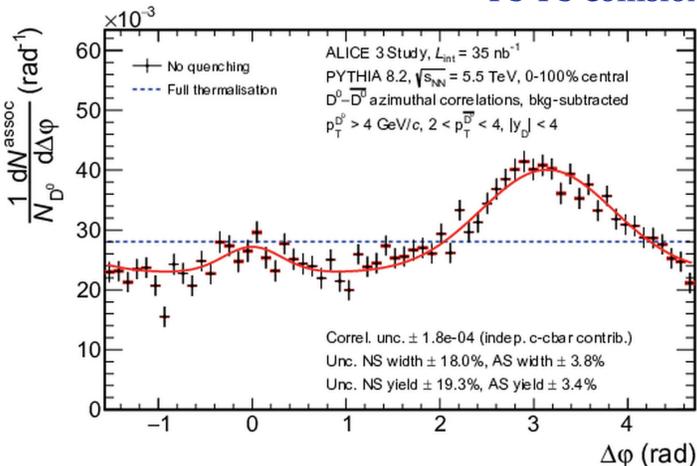
ALICE 3 study,  $L_{\text{int}} = 3 \text{ nb}^{-1}$   
PYTHIA 8.2, pp,  $\sqrt{s} = 14 \text{ TeV}$ ,  $|\eta_D| < 1.44$   
 $D^0$ - $\bar{D}^0$  azimuthal correlations  
 $p_T(D) > 6 \text{ GeV}/c$



$$F(M_{D^0}, M_{\bar{D}^0}) = N_{SS} f_S^{D^0}(M_{D^0}) f_S^{\bar{D}^0}(M_{\bar{D}^0}) + N_{SB} f_S^{D^0}(M_{D^0}) f_B^{\bar{D}^0}(M_{\bar{D}^0}) \\ + N_{BS} f_B^{D^0}(M_{D^0}) f_S^{\bar{D}^0}(M_{\bar{D}^0}) + N_{BB} f_B^{D^0}(M_{D^0}) f_B^{\bar{D}^0}(M_{\bar{D}^0})$$

## Expected performance in azimuthal correlations - Pb-Pb collisions

Expected performance for azimuthal correlation distributions of  $D^0$  and  $\bar{D}^0$  in  $|\eta| < 4$ , in 0-100% Pb-Pb collisions, for  $L_{\text{int}} = 35 \text{ nb}^{-1}$ .



- Calculation of estimated  $D^0$ - $\bar{D}^0$  pairs in Pb-Pb collisions for  $35 \text{ nb}^{-1}$  luminosity.
- Includes background subtraction and weights to account for  $D^0$ - $\bar{D}^0$  reconstruction and selection efficiencies. Normalization to the number of trigger  $D^0$  mesons.

## Conclusions

- Precise identification of  $D^0$ - $\bar{D}^0$  pairs with a high background rejection can be expected.
- Correlation patterns in PbPb collisions will be detailed enough to assess **the effects of transport broadening and thermalisation**, using pp collisions as a reference.

### References:

- [1] S. Acharya et al. EPJC 80 (2020) 979.
- [2] S. Cao et al. Phys. Rev. C 99 (2019) 5, 054907.
- [3] D. Adamová et al. [arXiv:1902.01211 [physics.ins-det]].