Performance studies of D^0-$\bar{D}^0$ azimuthal correlations in ALICE3

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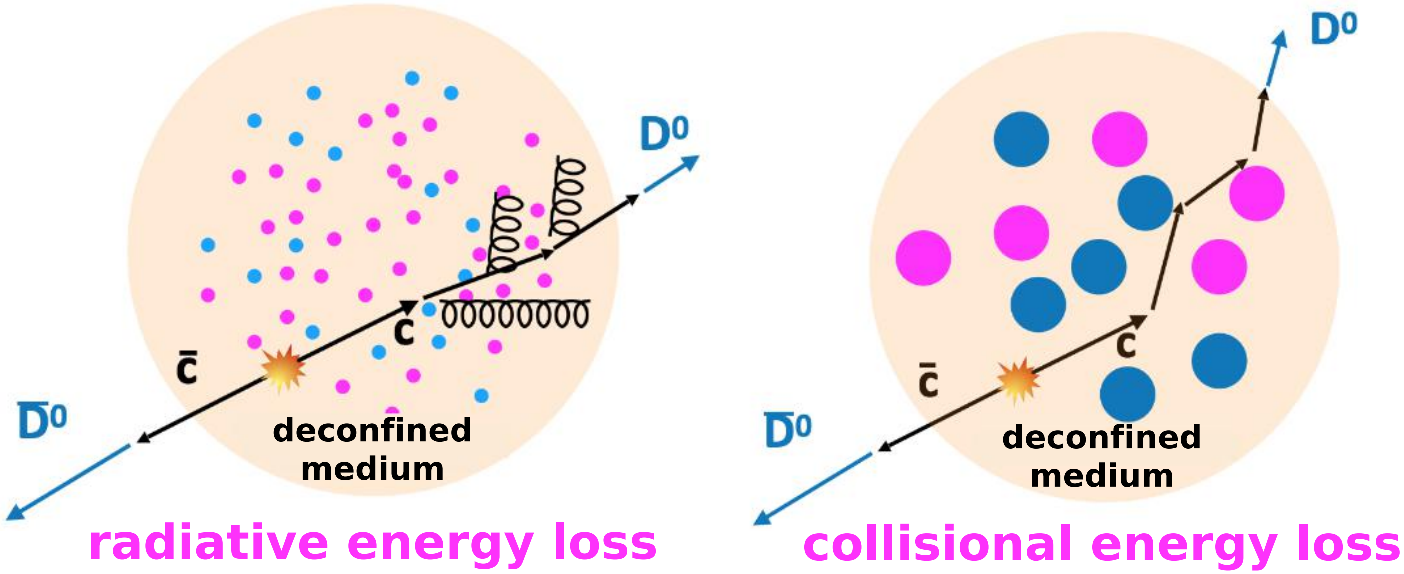
Physics motivation and goals

- Azimuthal correlations of D^0-$\bar{D}^0$ pairs provide
  - 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].



1.

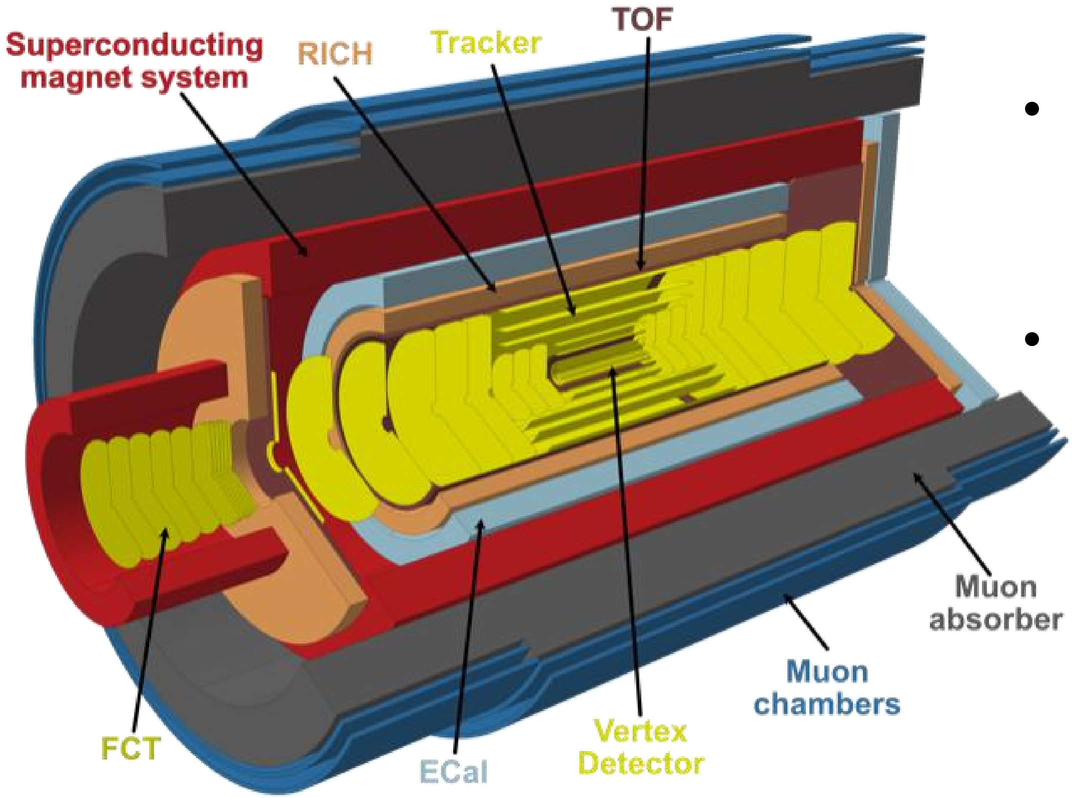
References:

[1] S. Acharya *et al.* EPJC 80 (2020) 979.

[2] S. Cao *et al.* Phys. Rev. C 99 (2019) 5, 054907.

The ALICE 3 detector

- **ALICE 3: 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 η range)
  - vertexing, tracking, hadron ID

2.

Reference:

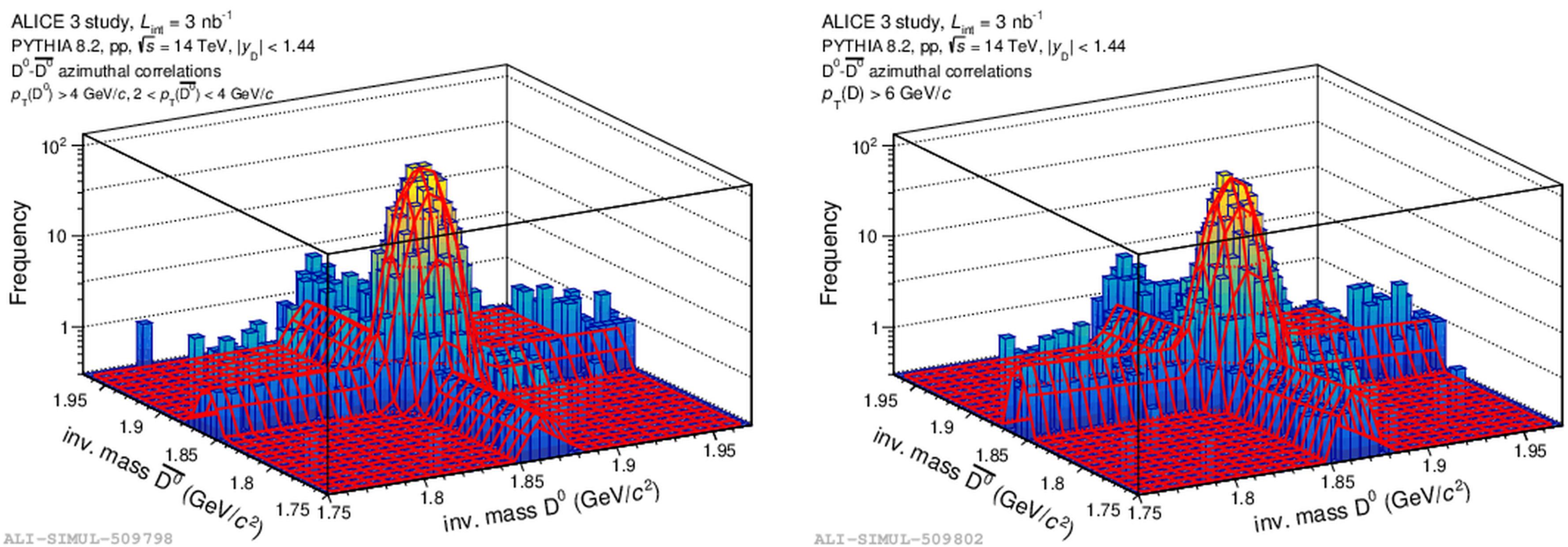
[3] D. Adamová *et al.* [arXiv:1902.01211 [physics.ins-det]].

Evaluation of signal correlation template - pp collisions

- 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.

$$\begin{aligned} F(M_{\mathrm{D}^0}, M_{\overline{\mathrm{D}}^0}) &= N_{\mathrm{SS}} f_{\mathrm{S}}^{\mathrm{D}^0}(M_{\mathrm{D}^0}) f_{\mathrm{S}}^{\overline{\mathrm{D}}^0}(M_{\overline{\mathrm{D}}^0}) + N_{\mathrm{SB}} f_{\mathrm{S}}^{\mathrm{D}^0}(M_{\mathrm{D}^0}) f_{\mathrm{B}}^{\overline{\mathrm{D}}^0}(M_{\overline{\mathrm{D}}^0}) \\ &+ N_{\mathrm{BS}} f_{\mathrm{B}}^{\mathrm{D}^0}(M_{\mathrm{D}^0}) f_{\mathrm{S}}^{\overline{\mathrm{D}}^0}(M_{\overline{\mathrm{D}}^0}) + N_{\mathrm{BB}} f_{\mathrm{B}}^{\mathrm{D}^0}(M_{\mathrm{D}^0}) f_{\mathrm{B}}^{\overline{\mathrm{D}}^0}(M_{\overline{\mathrm{D}}^0}) \end{aligned}$$

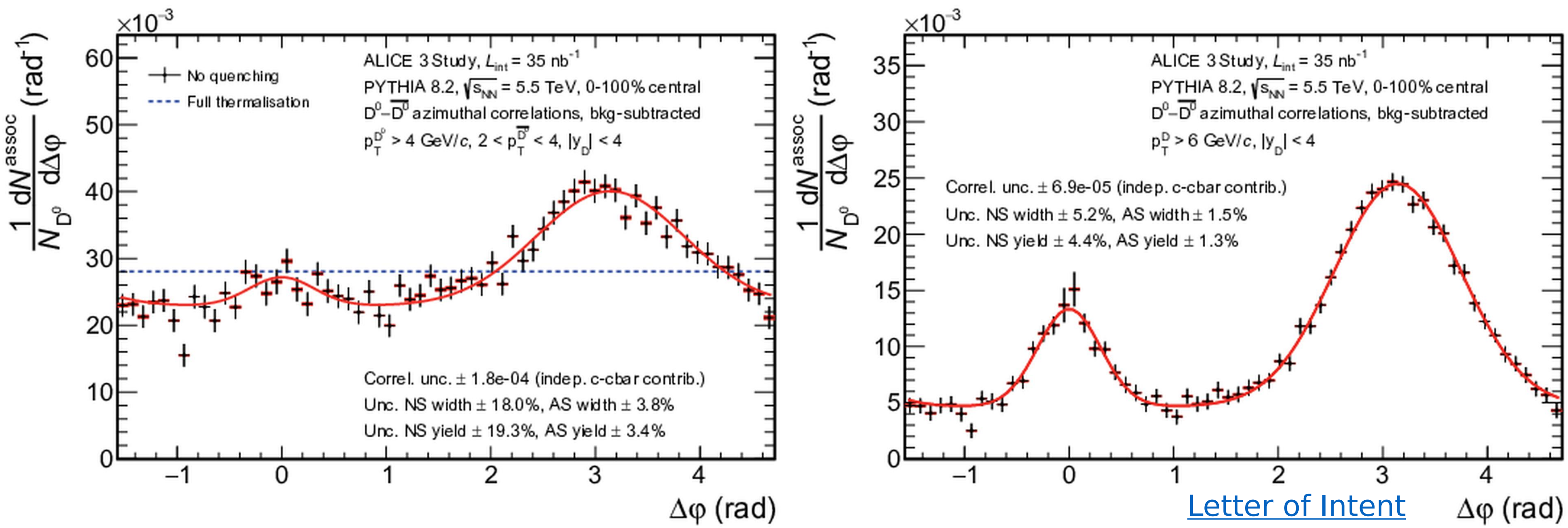
- Precise identification of D^0-$\bar{D}^0$ pairs with a high background rejection can be expected.



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

Expected performance in azimuthal correlations - Pb-Pb collisions

- Calculation of estimated D^0-$\bar{D}^0$ pairs in Pb-Pb collisions for 35 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.
- Correlation patterns in Pb-Pb collisions will be detailed enough to assess **the effects of transport broadening and thermalisation**, using pp collisions as a reference.



Letter of Intent

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