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

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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].
**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 \(\eta\) range)
    - vertexing, tracking, hadron ID

Reference:
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.

\[
F(M_{D^0}, M_{\bar{D}^0}) = N_{SS} f_{S}^{D^0}(M_{D^0}) f_{S}^{\bar{D}^0}(M_{\bar{D}^0}) + N_{SB} f_{S}^{D^0}(M_{D^0}) f_{B}^{\bar{D}^0}(M_{\bar{D}^0}) \\
+ N_{BS} f_{B}^{D^0}(M_{D^0}) f_{S}^{\bar{D}^0}(M_{\bar{D}^0}) + N_{BB} f_{B}^{D^0}(M_{D^0}) f_{B}^{\bar{D}^0}(M_{\bar{D}^0})
\]

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 $|\eta_{\text{daug}}| < 1.44$
- 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.

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

Letter of Intent