Non-prompt D^0-meson production in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE

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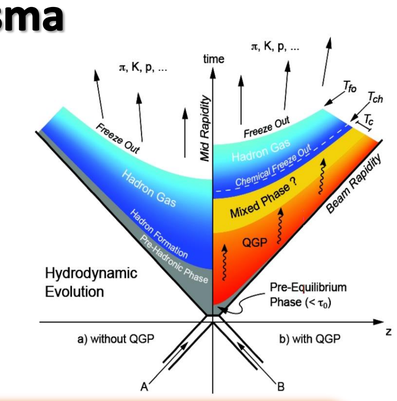
Heavy Flavours in the Quark-Gluon Plasma

- ✓ The heavy-flavor quarks (**charm, beauty**) are mainly produced in hard partonic scattering processes, in the early stage of system evolution after the collision
- ✓ Shorter formation time than the **QGP**, probing the full evolution of the quark-gluon matter by interacting with the medium constituents



Non-prompt D^0 meson production - indirect measurement in the beauty sector:

- ➢ Mass / color charge dependent energy loss
- ➢ Thermalization and collectivity

ALICE Detector

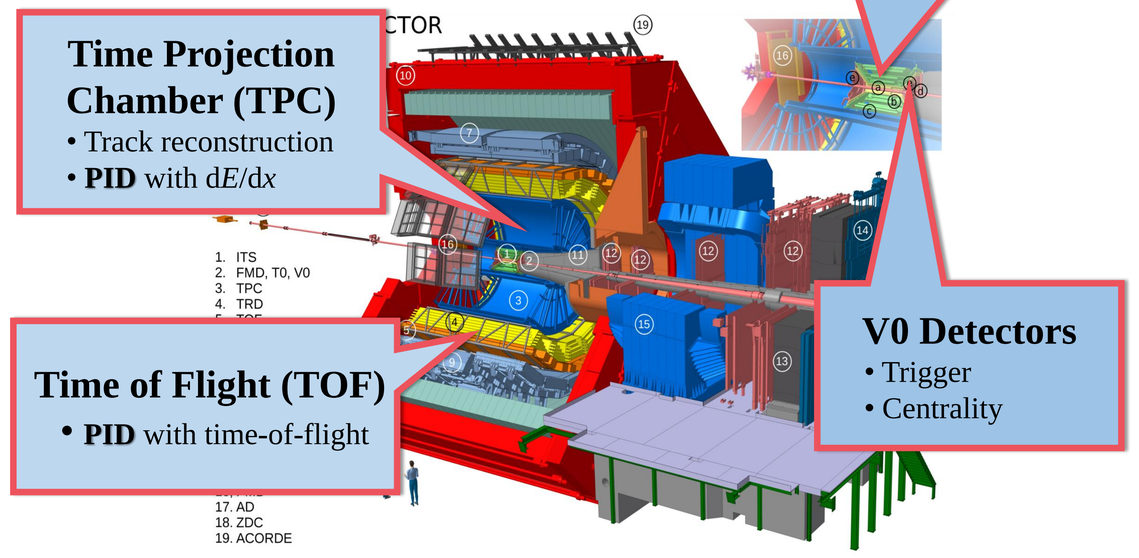
- ✓ Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV collected in 2018
- ✓ 92.5M events for 0-10%, 80.8M events for 30-50%

Inner Tracking System (ITS)
- Tracking
- Vertex reconstruction

Time Projection Chamber (TPC)
- Track reconstruction
- **PID** with d*E*/d*x*

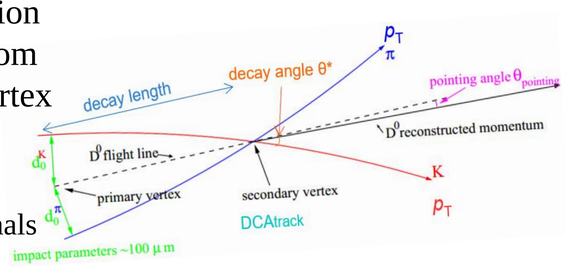
Time of Flight (TOF)
- **PID** with time-of-flight

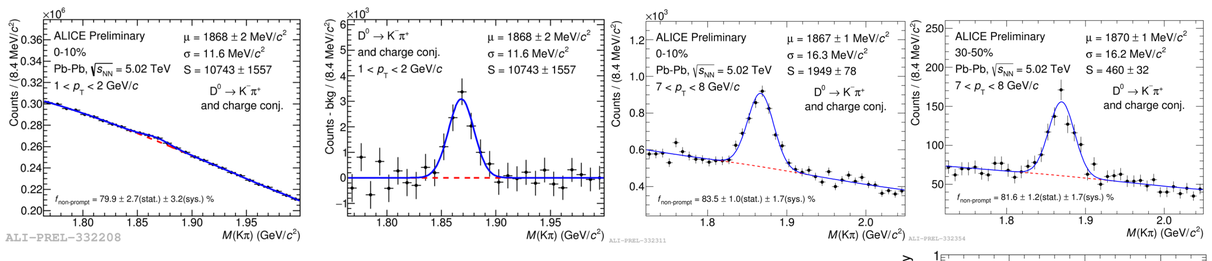
V0 Detectors
- Trigger
- Centrality



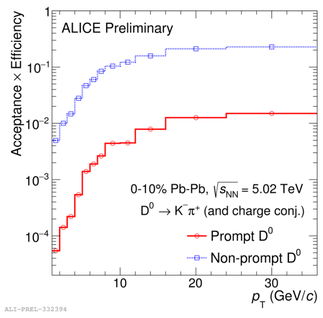
Signal extraction

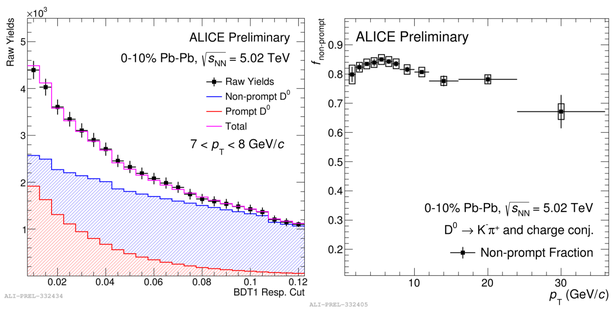
- ✓ Reconstruction of D^0 decay vertices around few hundreds μm displacement from primary vertex, by combining pairs of K/π tracks with correct electrical charge sign
  - ➢ Particle Identification (PID) on decay tracks
  - ➢ **Boosted Decision Trees (BDT)** -based decay topological selection
- ✓ **BDT** - A machine learning-based classification algorithm, utilizing geometrical variables from decay topology associated to the primary vertex and decay vertex, was applied in **2-steps** to:
  - ➢ Suppress combinatorial background
  - ➢ Disentangle non-prompt D^0 from inclusive signals





- ✓ Signal was extracted via an invariant mass analysis.
- ✓ Efficiency correction with Monte-Carlo simulation using HIJING [1] events enriched heavy quark pairs with PYTHIA [2] heavy-flavour tunes





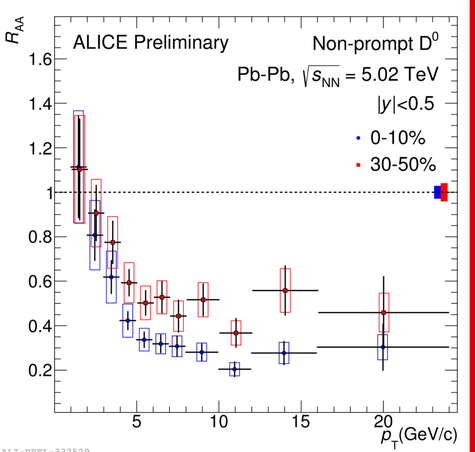
- ✓ Prompt D^0 contribution was subtracted exploiting a min-χ^2 approach with BDT cut-variation on the raw yield [3]
- ✓ **High purity** yields extracted: **~80%** for p_T < 24 GeV/*c*, **~65%** for p_T > 24 GeV/*c*

Nuclear Modification Factor R_{AA}

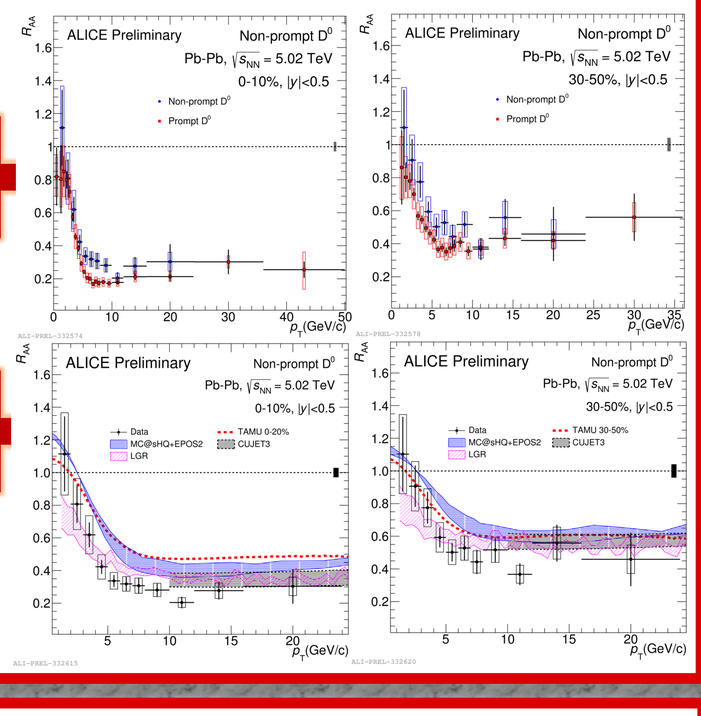
- ✓ Non-prompt D^0 R_{AA} measurement for 0-10% and 30-50%, in 1 < p_T < 24 GeV/*c*

$$R_{AA} = \frac{1}{\langle T_{AA} \rangle} \frac{dN_{AA}/dp_T}{d\sigma_{pp}/dp_T}$$

- ➢ $\langle T_{AA} \rangle$: Average nuclear overlap function, proportional to the number of binary nucleon-nucleon collision
- ➢ $d\sigma_{pp}/dp_T$: Non-prompt D^0 production cross-section measured in pp collisions at 5.02 TeV

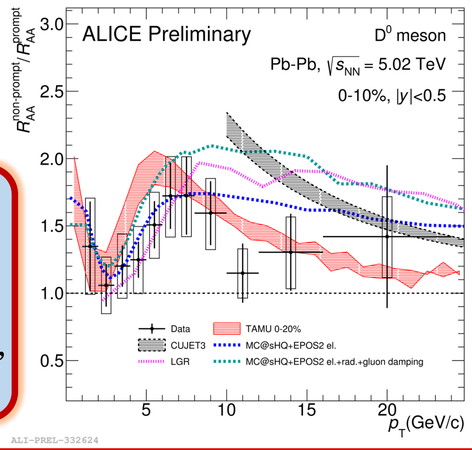


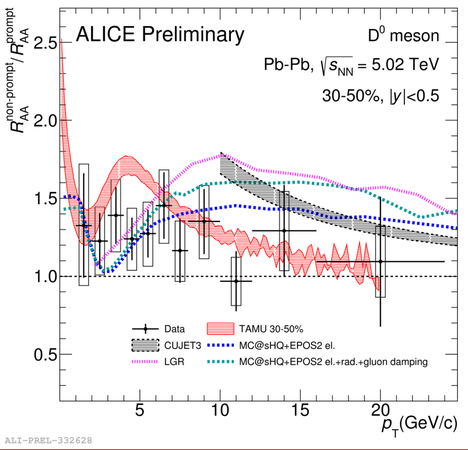
- ✓ R_{AA} provides information about the **energy loss** [4-5] in the QGP
  - ➢ Suppression in production observed for p_T > 2 GeV/*c*
  - ➢ Less suppression in semi-central (30-50%) than that in central (0-10%)
- ✓ Hint of less suppression for non-prompt than prompt D^0
  - ➢ Lower energy loss for beauty than charm
- ✓ Transport model with collisional energy loss [6-8] can describe the data within uncertainty for p_T < 10 GeV/*c*
- ✓ Models based on pQCD [9] provide good estimation for p_T > 10 GeV/*c*



R_{AA} Ratio

- ✓ R_{AA} ratio of non-prompt over prompt D^0
- ✓ Hint of a bump in mid-p_T region for central (0-10%)
  - ➢ Different kinematic
  - ➢ Different energy loss due to the mass dependence
- ✓ No evidence for the same bump in semi-central (30-50%), over the measured p_T range





- ✓ The model predictions match data within uncertainties both for central and semi-central
- ✓ Smaller amplitude for semi-central than central, by model predictions

References

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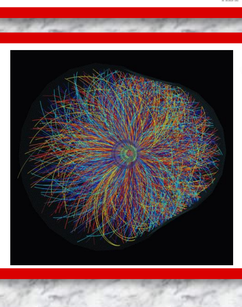

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