**Heavy quarks: physics motivation**

- Heavy quarks are produced in hard scattering processes in the initial stages of the collisions → they are an excellent probe to study the medium created in heavy-ion collisions.
- They lose energy via: gluon radiation and elastic collisions in the medium
- Colou-charge and mass-dependent energy loss → $\Delta E_g > \Delta E_{el} > \Delta E_{med}$[1]
- To quantify D-meson production we evaluate the nuclear modification factor:
  
  $$R_{AA} = \frac{dN_{AA}/dpt}{(T_{AA}) d\sigma_{pp}/dpt}$$

  where $(T_{AA})$ is the average nuclear overlap function from the Glauber model.

**The ALICE experiment**

**D+ $\rightarrow K^-\pi^+\pi^+$ reconstruction**

D+ fully reconstructed through their hadronic decays (B.R. $\sim 9.1\%$) displaced by few hundred $\mu$m from the primary vertex.

Require excellent capabilities in:
- Vertex reconstruction to separate primary and secondary vertices
- Tracking for the impact parameter and $p_T$ resolution
- Particle identification to reduce the huge combinatorial background

**PID approach:** $3\sigma$ compatibility cut between measured signals in TOF and TPC and expected values for the particle species

**Analysis strategy:** optimization of topological cuts, in particular distance between primary and secondary vertices

**References**


**Summary**

- D-meson production suppressed by a factor of 3 in $p_T \sim 10$ GeV/c in Pb-Pb semi-central collisions.
- $R_{AA}$ is compatible for all three D-meson species over the full $p_T$ range.
- Several theoretical models can reproduce D-meson $R_{AA}$ reasonably well.
- D-meson suppression increases going from peripheral to central collisions.
- Similar suppression observed for D mesons and charged pions.
- Indication of a difference in suppression of D mesons and non-prompt $J/\Psi$ (measured by CMS [4]) as expected from theoretical models including mass-dependent energy loss.

**Systematic uncertainties**

- Efficiency: Correction factor obtained from MC simulations to take into account the acceptance of the detector, the tracking efficiency and the selection cut applied.
- B feed-down subtraction: Contribution of $D^+$ mesons from B decay evaluated from FONLL prediction [2]. Hypothesis on non-prompt, $R_{AA} \sim 2R_{AA}$ prompt, systematic uncertainty evaluated varying the hypothesis in the range $1 < R_{AA}(\text{non-prompt})/R_{AA}(\text{prompt}) < 3$

- Yield extraction: variation of fit range, background function (polynomial) and signal extraction technique (bin counting after background subtraction or fit integral).
- Topological selection: analysis repeated with different values for topological cuts.
- Tracking efficiency: different track selection criteria.
- PID efficiency: analysis repeated without PID.
- Normalization uncertainty on pp reference and $T_{AA}$.

**Corrections**

- Efficiency:
  - Correction factor obtained from MC simulations to take into account the acceptance of the detector, the tracking efficiency and the selection cut applied.
- B feed-down subtraction:
  - Contribution of $D^+$ mesons from B decay evaluated from FONLL prediction [2]. Hypothesis on non-prompt, $R_{AA} \sim 2R_{AA}$ prompt, systematic uncertainty evaluated varying the hypothesis in the range $1 < R_{AA}(\text{non-prompt})/R_{AA}(\text{prompt}) < 3$

- Yield extraction:
  - Variation of fit range, background function (polynomial) and signal extraction technique (bin counting after background subtraction or fit integral).
- Topological selection:
  - Analysis repeated with different values for topological cuts.
- Tracking efficiency:
  - Different track selection criteria.
- PID efficiency:
  - Analysis repeated without PID.
- MC $p_T$ shape:
  - Efficiency evaluated using different D-meson $p_T$ distributions.
- Normalization uncertainty on pp reference and $T_{AA}$.