D^+ meson production in pp collisions with the ALICE detector

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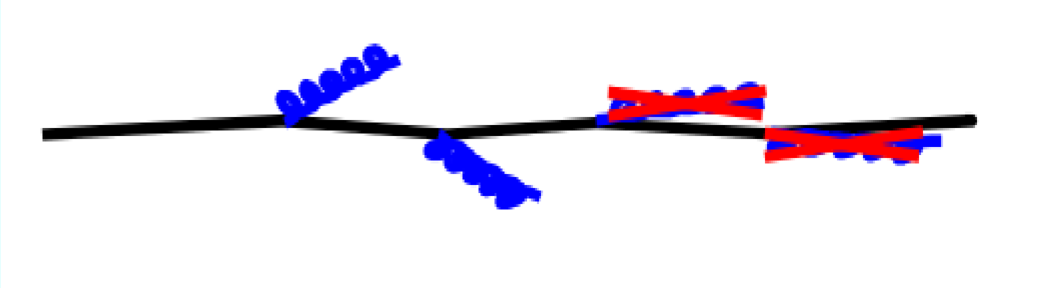
Heavy-flavour in heavy-ion collisions

- Due to their large masses, charm and bottom quarks are created in initial hard parton-parton scatterings
- Coming from the early stages of the heavy-ion collision, heavy-flavour quarks are therefore excellent probes of the hot and dense medium which is expected to form after the collision
- In particular, high p_t partons crossing the medium are expected to lose energy by the emissions of gluons according to

$$\Delta E \propto \alpha_s C_R \hat{q} L^2$$

where q is a transport coefficient, related to the medium characteristics, and C_R is the Casimir factor, which is 3 for gluons and 4/3 for quarks → gluon are expected to lose more energy in the medium

- Dead cone effect: gluon radiation is suppressed for $\theta < M_Q / E_Q$

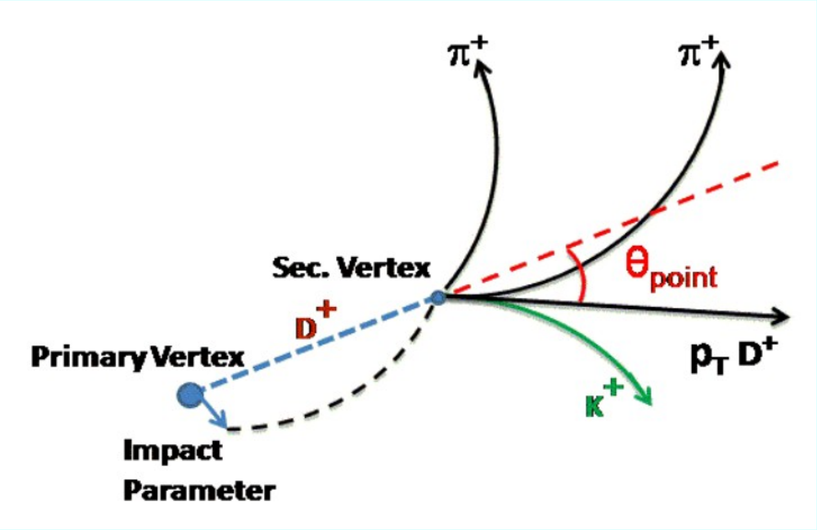


We expect to observe a suppression of high p_t hadrons: due to Casimir factor and dead cone effect, we expect light hadrons (mainly produced by gluons) to be more suppressed than c and b hadrons

Heavy-flavour in heavy-ion collisions

- To measure this effect, a comparison to hadron production in pp collision is needed
- The measurement of charm production in pp collisions is also of great interest per se, since it will provide a test of perturbative QCD predictions in a new energy domain
- ALICE can measure the production of various charmed mesons through different hadronic decay channels, e.g. $D^0 \rightarrow K^-\pi^+$ $D^+ \rightarrow K^-\pi^+\pi$, in the central barrel.
- I will present the D^+ p_t differential cross section obtained from the 2010 pp runs at a center of mass energy of 7 TeV in the rapidity range $|y|<0.5$

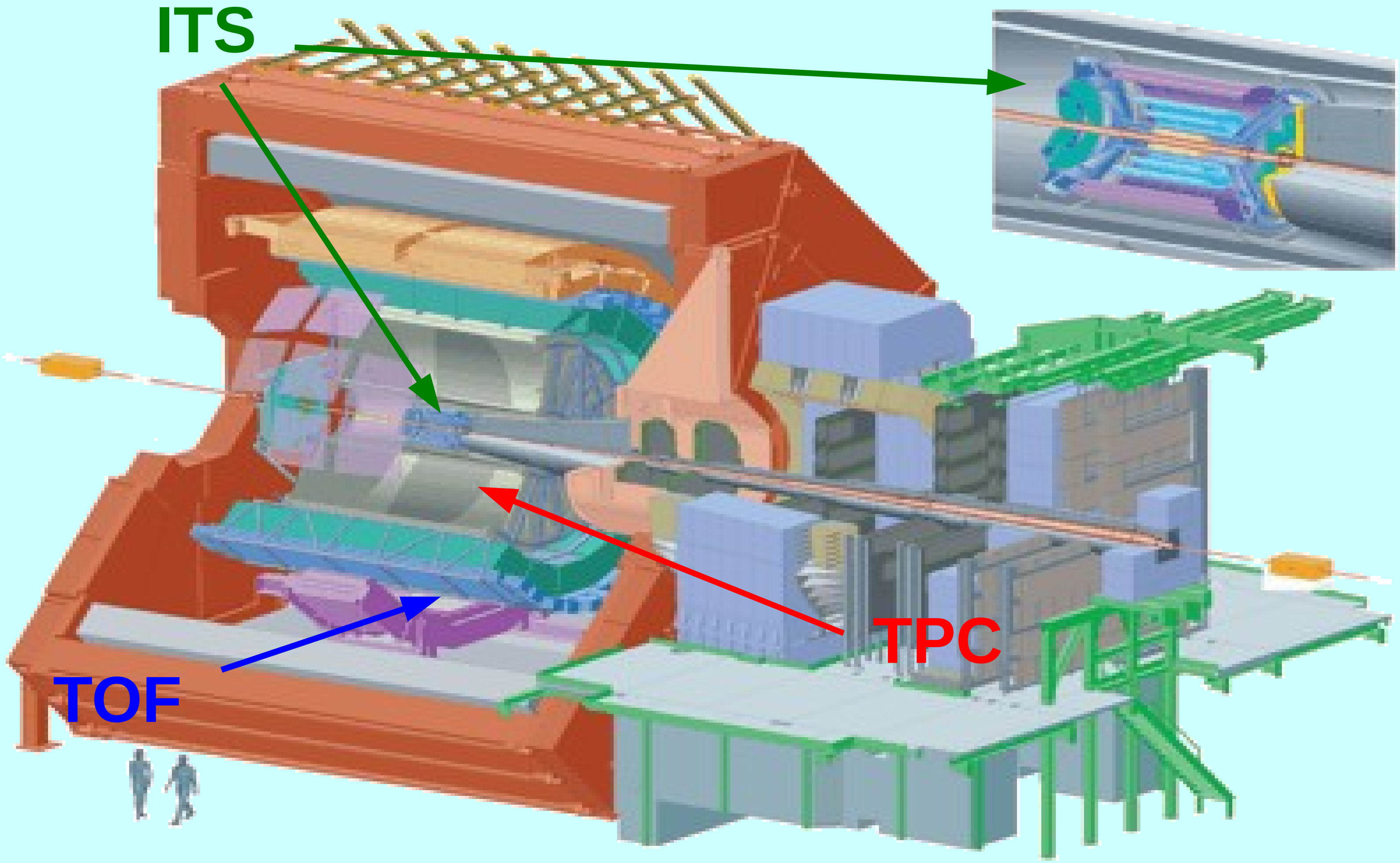
Decay topology for D^+ meson



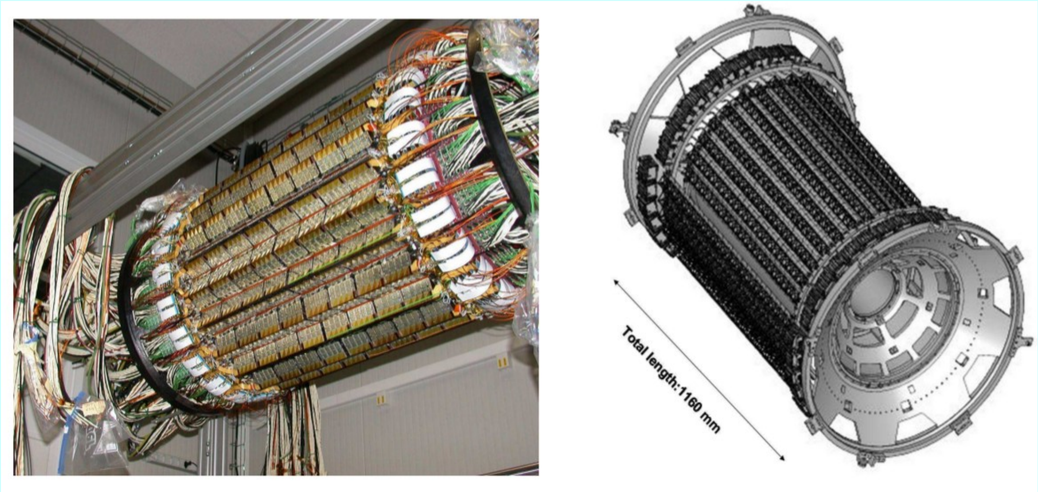
- Proper decay length ~ 311 µm
- 2 like sign pions, 1 opposite sign kaon
- Analysis based on the selection of triplets and fit to their invariant mass distribution

Selection stategy:

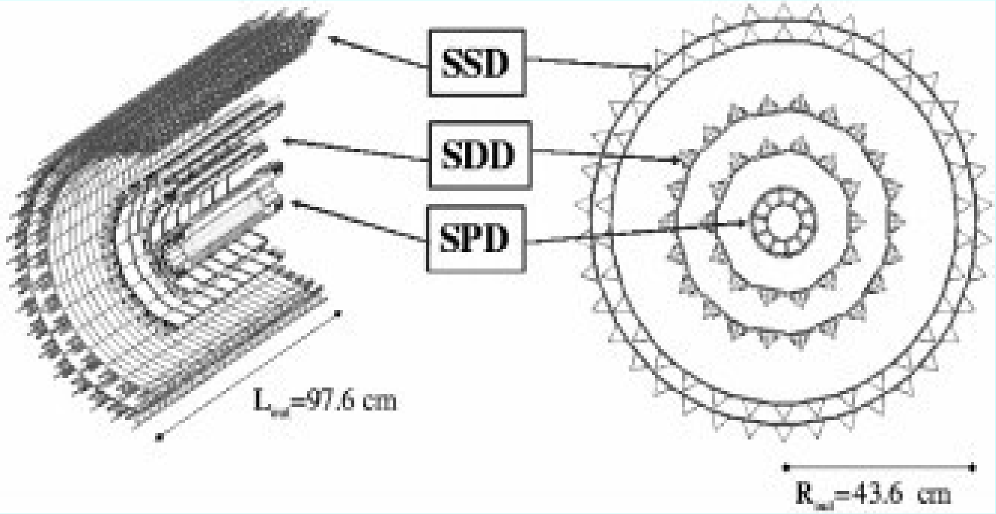
- Decay length (distance primary to secondary vertex) → good vertex reconstruction capabilities
- Dispersion of the daughter tracks around the secondary vertex → good impact parameter resolution
- Identification of the 3 daughters (2 like-sign pions + 1 opposite sign kaon) → particle identification


ITS
TPC
TOF

Inner Tracking System



- 6 layers of silicon detectors with radii between 3.9 cm and 43.0 cm
- High spatial resolution, which allows good resolution on vertex position and impact parameter distribution



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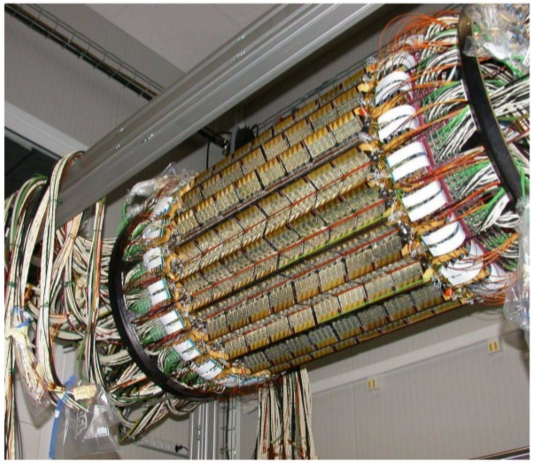

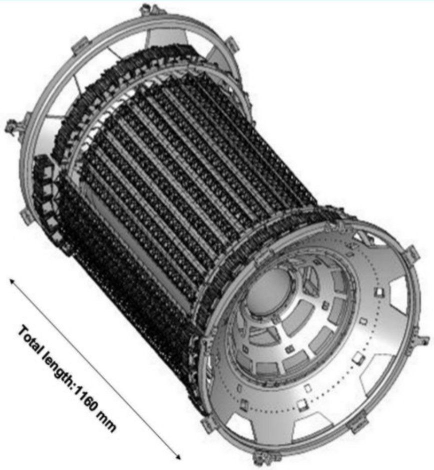

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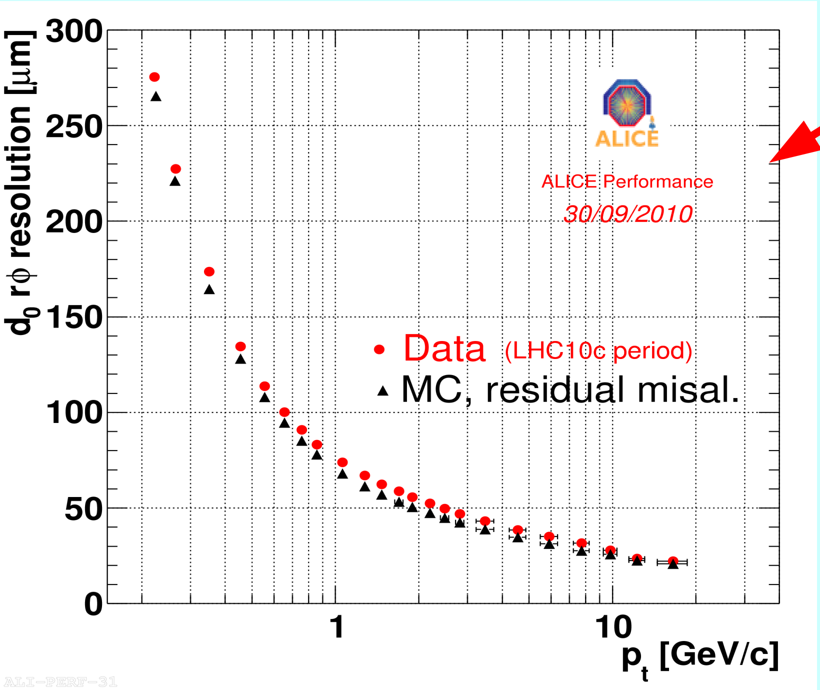
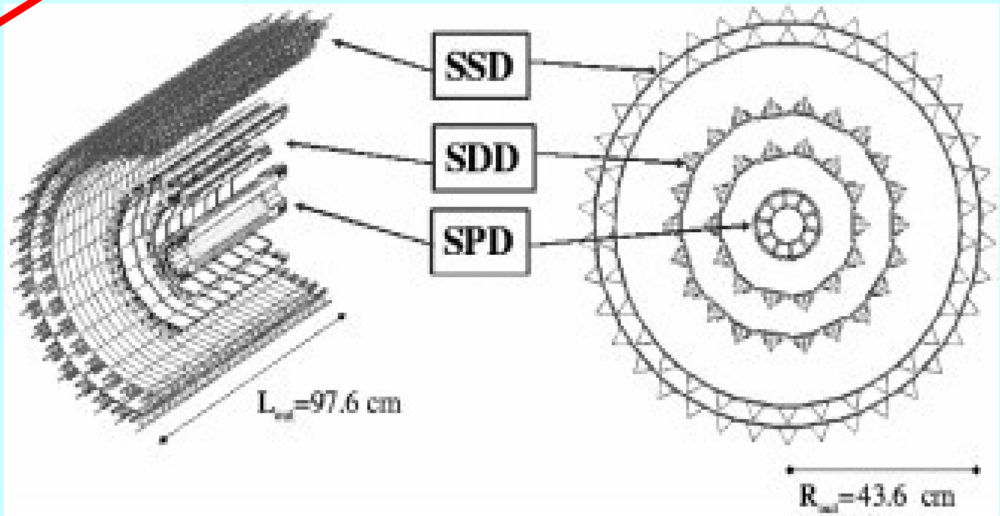
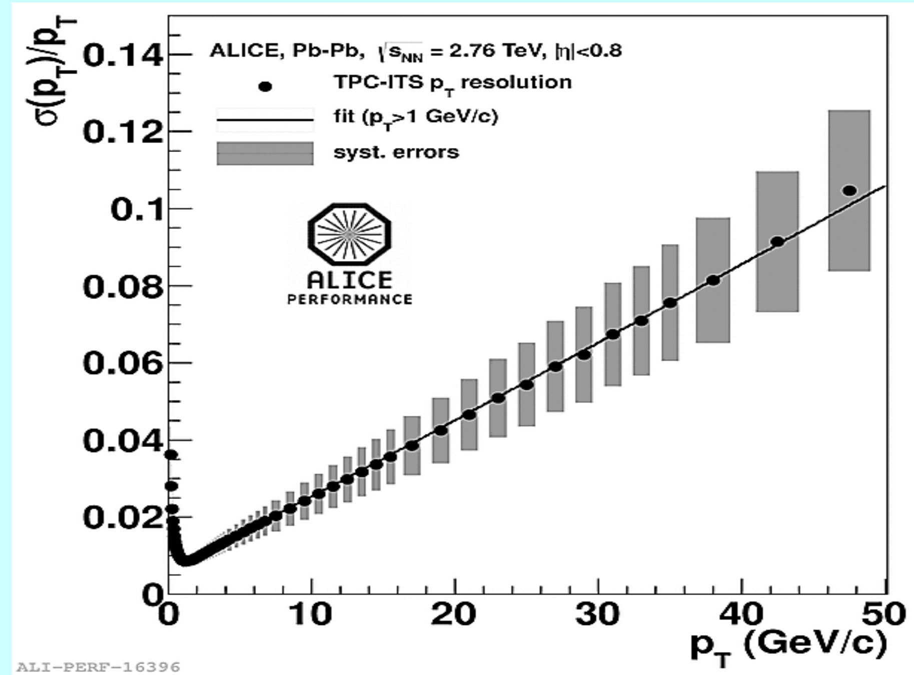
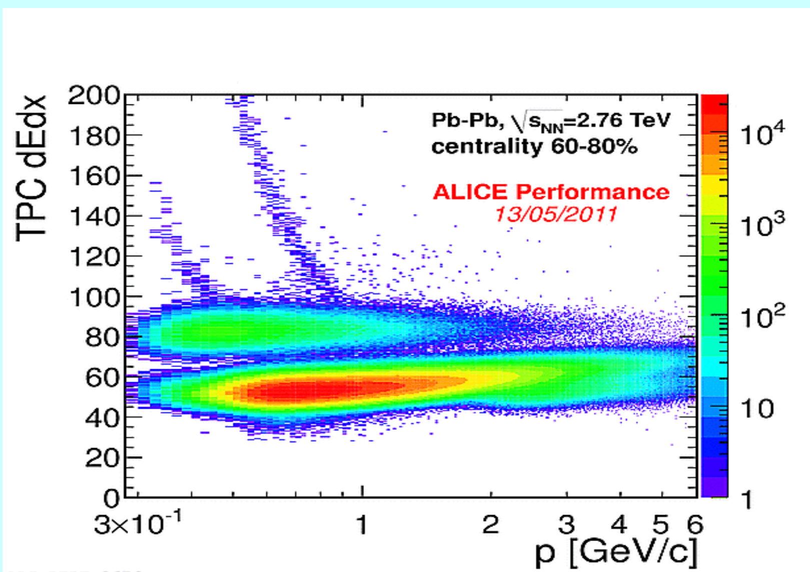


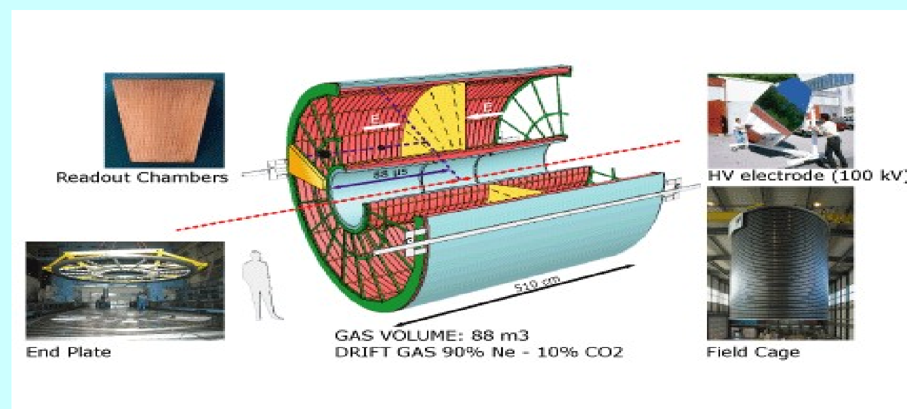


Time Projection Chamber

- Position resolution ~ 1 mm in both transverse plane and z direction
- P_t resolution ~1% at p_t=5GeV/c
- dE/dx resolution ~5%

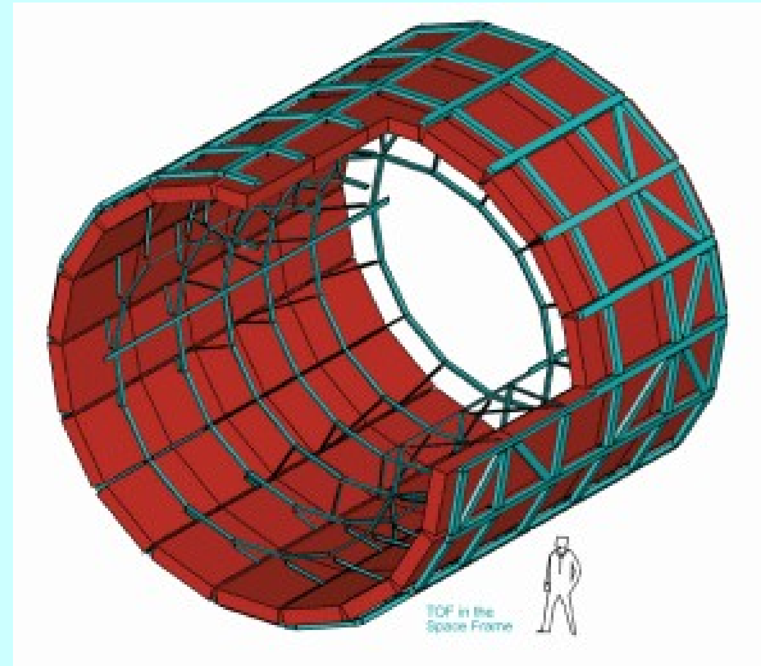


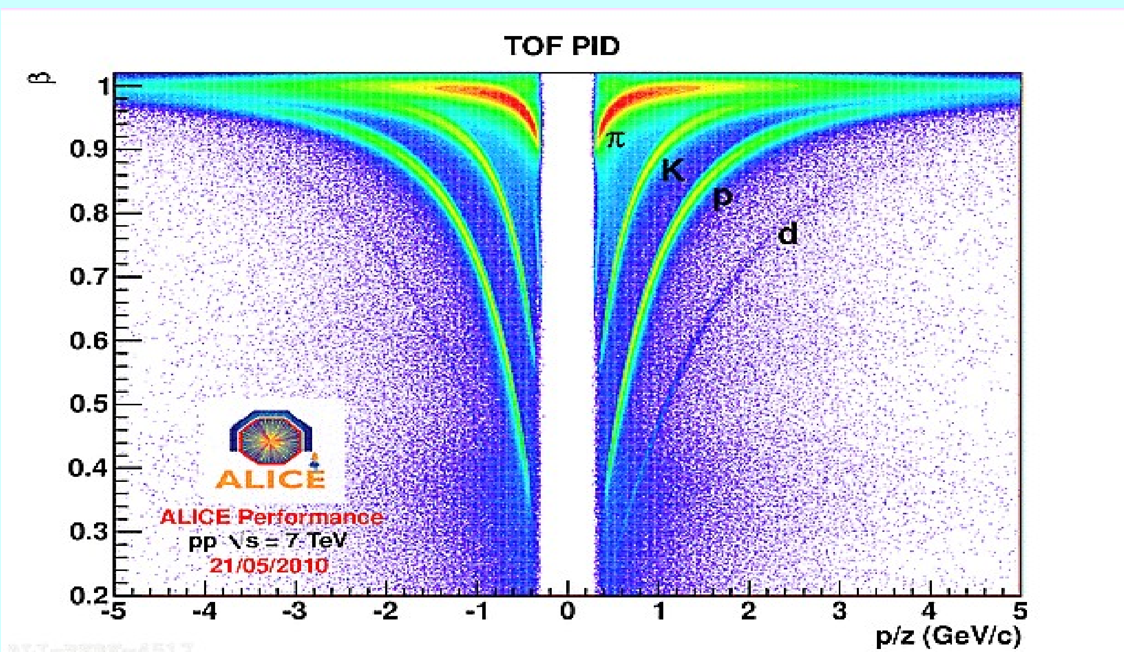




Time of Flight

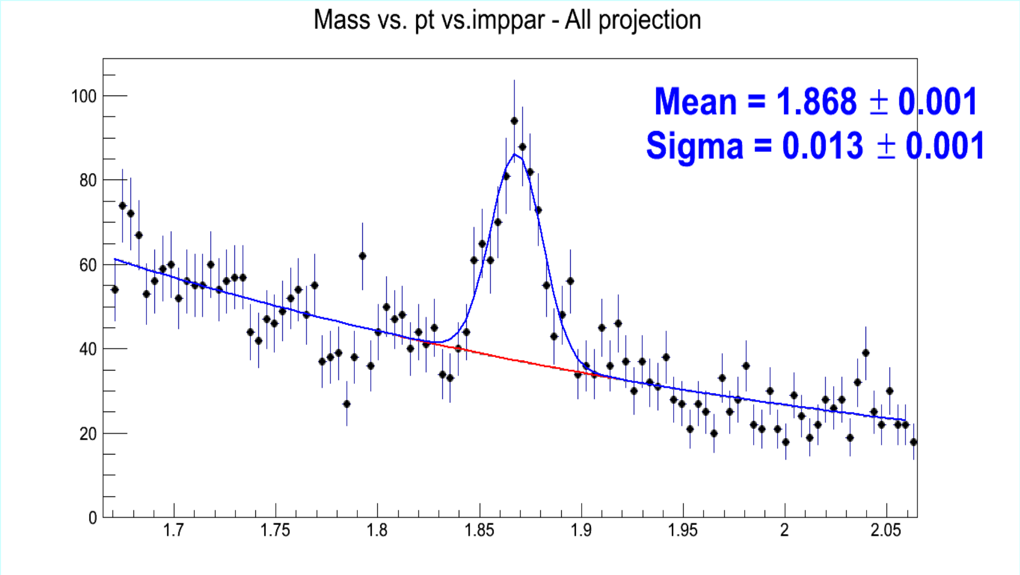
- Multi-gap Resistive Plate Chambers (MRPCs)
- Intrinsic time resolution better than 100 ps



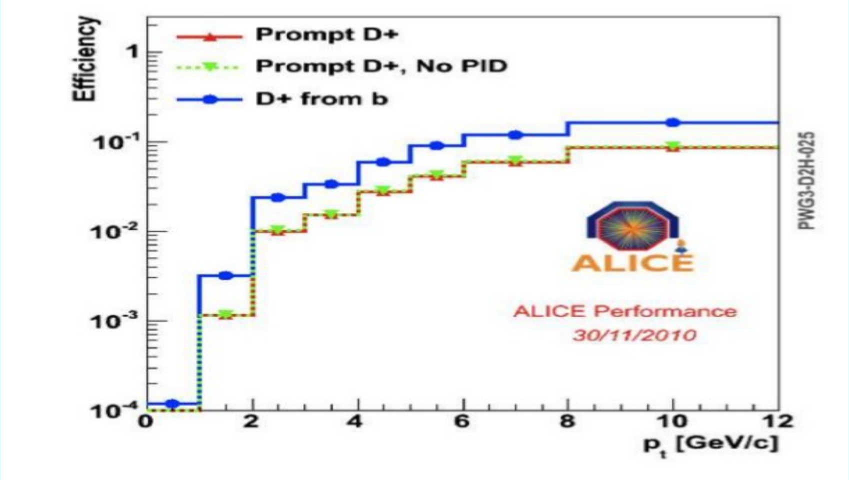


Raw yield extraction

- Apply the topological and PID selections to get the invariant mass histograms in the different p_t bins
- Fit to the invariant distribution to get the total amount of signal
- Fit function contains a gaussian term to describe the signal and an expontial term for background



Efficiency/Acceptance correction



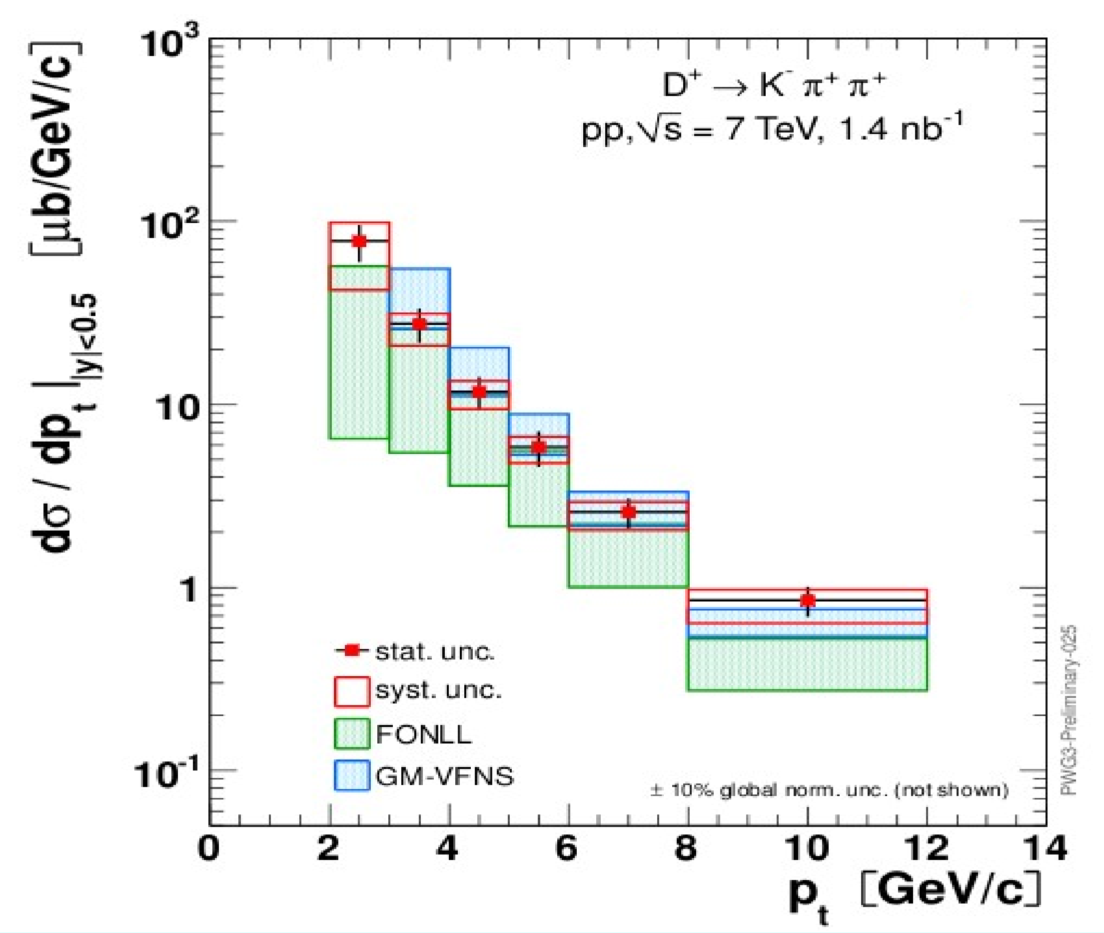
- Same analysis performed on Monte Carlo Simulations
- PYTHIA with Perugia-0 tuning for event generation
- Geant3 transport code

Further corrections

- Subtract the fraction of D^+ coming from B mesons decay: this fraction is estimated by using the beauty production cross section predicted by FONLL calculation together with the efficiency for secondary D mesons given by the detector simulation
- Extract the differential cross section

$$\left.\frac{d\sigma^{D^+}}{dp_t}\right|_{|y|<0.5} = \frac{1}{2}\frac{1}{2\,y_{acc}\,\Delta p_t}\frac{\left.f_{prompt}\cdot N^{D^\pm\ raw}(p_t)\right|_{|y|<y_{acc}}}{\epsilon_{prompt}\cdot BR\cdot L_{int}}$$

Results



- Results are compared to two theoretical predictions, namely FONLL and GM-VFNS
- Cross section on the upper edge of theory predictions
- Same situation was found at Tevatron and RICH