ALICE vertexing performance and charm reconstruction

Xianbao Yuan (For the ALICE collaboration)
Key Laboratory of Quark & Lepton Physics (Huazhong Normal University), Ministry of Education, 430079, Wuhan, China
University and INFN, 35131, Padova, Italy

Ⅰ The ALICE experiment at LHC

ALICE (A Large Ion Collider Experiment):

- the LHC experiment mainly dedicated to heavy-ion collisions
- study proton-proton, lighter ions and proton-nucleus collisions also as reference for PbPb . pp collisions will allow to test pQCD in a new energy range.
- in the past two years, collected data from pp at 0.9, 2.76, 7 TeV and Pb-Pb at 2.76 TeV

Ⅱ Heavy flavor physics in heavy-ion collisions

1) Parton energy loss in dense QCD matter

- ✓ Radiative energy loss
- ✓ Collisional energy loss
- ✓ In-medium fragmentation

2) Nuclear Modification Factor: $R_{AA}(p_T) = \frac{d^2N_{AA}/dp_T dy}{N_{coll} * d^2N_{pp}/dp_T dy}$

- ✓ $R_{AA} \sim 1$ → A-A collisions are a simple superposition of Ncoll p-p collisions;
- ✓ Suppression has been observed at RHIC, see [1];
- ✓ We expect to measure the R_{AA} of D^0 with good precision, see [2].

Ⅲ ALICE detector

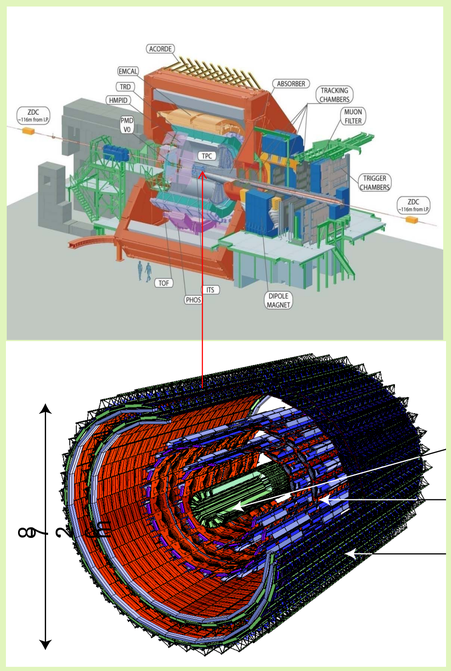
The main detectors for open charm reconstruction:

✓ Inner Tracking System (ITS) for:
- Precise tracking and vertexing
- Low p_t tracking
- Particle Identification(PID)

The 2198 ITS Si sensors were aligned using cosmic-ray tracks and pp collisions (JINST5 2010 P03003)

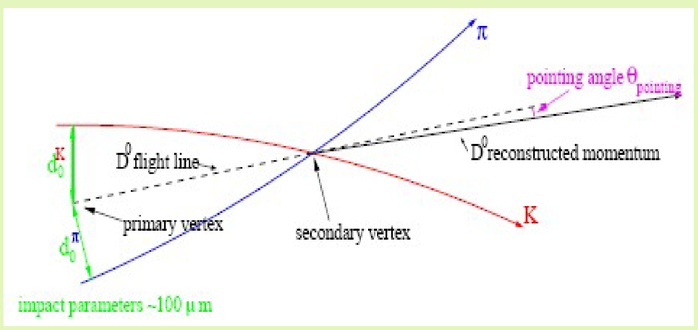
✓ Time Projection Chamber (TPC) for:
- Tracking
- Particle identification

✓ Time Of Flight (TOF) for :
- Particle identification



Inner Tracking System(ITS)

Ⅳ Impact parameter calculation



Schematic view of a $D^0 \to K^-\pi^+$ decay.

The impact parameter is defined as the distance of closest approach of the track trajectory to the primary vertex. It is a critical variable for the selection of charm meson. We focus here on the impact parameter projection in the bending plane, defined as d_0.

Ⅴ Measurement of the impact parameter resolution

Main components of impact parameter distribution

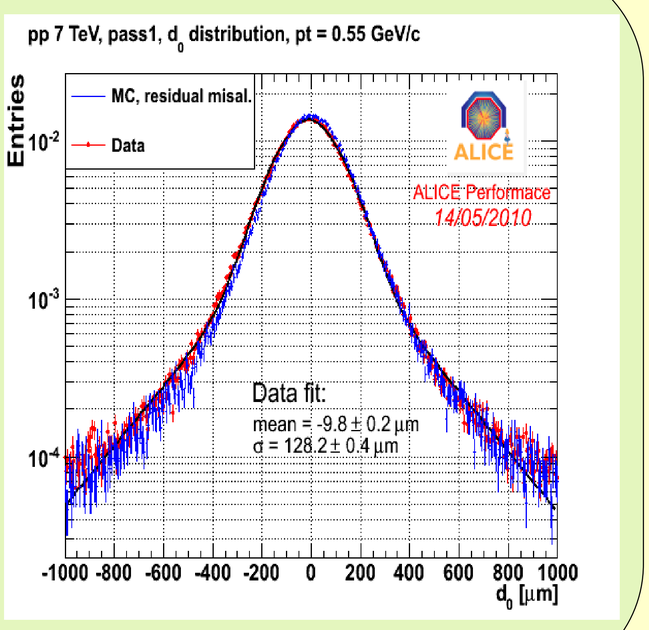
- ✓ primary particle: gaussian shape
- ✓ secondary particle: exponential shape. the main contribution to secondary pa-rticles is from strangeness decays

Fitting function:

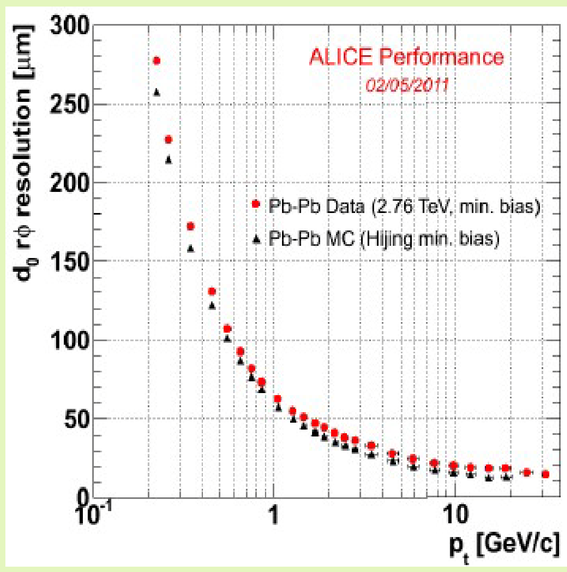
$$K*\frac{1}{\sqrt{2\pi}\sigma}*e^{-\frac{(x-\mu)^2}{2\sigma^2}}+(1-K)*\frac{1}{2\lambda}*e^{-\frac{(X-\mu)^2}{2\lambda}} \quad (0\le K\le 1)$$

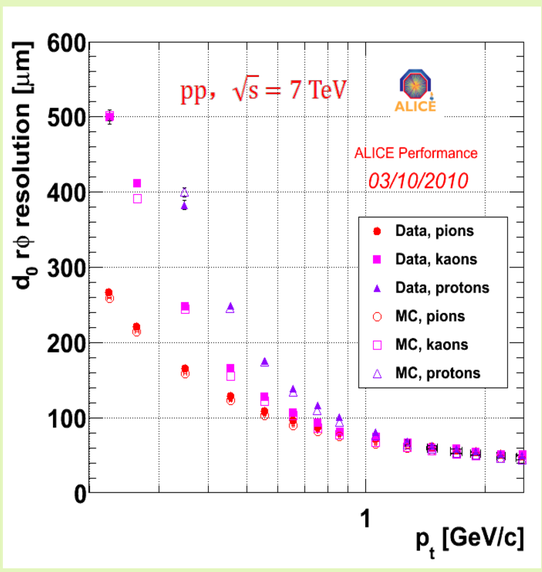
Fit range: $3\sigma_1$

Here σ_1 is the variance of the fit of the whole impact parameter distribution with a single Gaussian function. We obtain the impact parameter resolution σ, using the above fitting function for the whole distribution in $3\sigma_1$.



Ⅵ Impact parameter resolution vs p_t





- ➢ MC simulations give an impact parameter resolution very close to data
- ➢ Multiple scattering: dominates the resolution at lower p_t's.
- ➢ Expected mass dependence of the impact parameter resolution at lower p_t's (see right panel), again well reproduced by the simulation - here the combined PID to identify the particles has been used

Ⅶ Multiple scattering effect on resolutions

According to Molière angle distribution width:

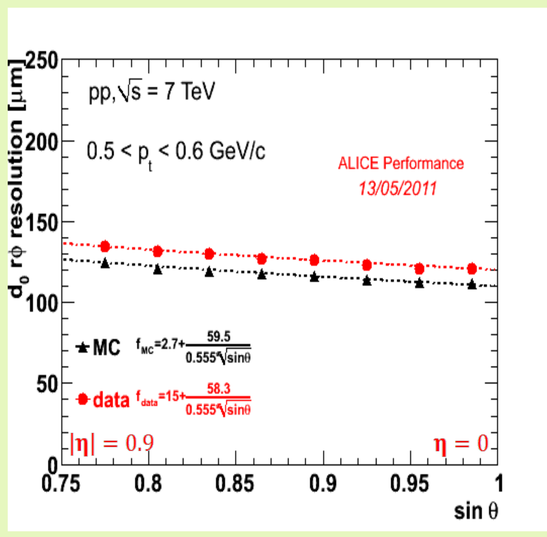
$$\theta_0 = \frac{13.6MeV}{\beta cp} z\sqrt{x/x_0}[1+0.038\ln(x/x_0)]$$

$$\sigma_{d0(r\phi)} \propto 1/pt(\sin\theta)^{1/2} \xleftarrow[pt = p\sin\theta]{L = L_0/\sin\theta} \sigma_{d0} \propto \frac{13.6MeV}{\beta cp} L\sqrt{L/L_0}$$

$$\sigma_{d_0}(r\phi) = A + \frac{B}{p_t\sqrt{\sin(\theta)}} \longrightarrow f_{fun} = A + \frac{B}{p_t * \sqrt{\sin\theta}} \longrightarrow$$

(θ is the polar angle, L the length travelled by the particle in the material)

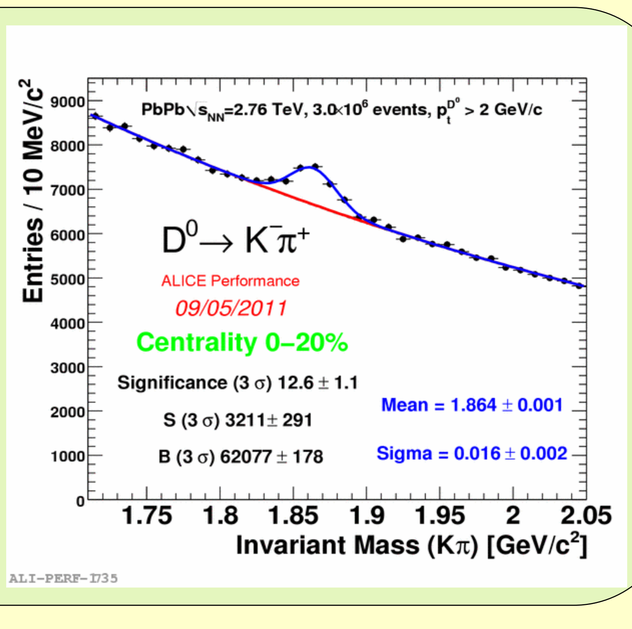
the lower sin(θ), the more multiple scattering the particle suffered. The difference between the MC and real data come from the primary vertex resolution.



Ⅷ Reconstruction of $D^0 \to k^-\pi^+$

Main selections for reconstruction:

- ✓ displaced secondary vertex requ--iring two displaced tracks and good pointing of D^0 momentum to primary vertex.
- ✓ TPC and TOF information for c--ombined particle identification.



Ⅸ Conclusion

- ✓ The ALICE detector performs very well. The impact parameter resolution is well described by MC.
- ✓ ALICE has been analyzing pp and PbPb collisions. One of the main goal is the measurement of R_{AA}.
- ✓ First results on charm reconstruction in pp and PbPb collisions are shown here. These results are preliminary to R_{AA} analysis.

References:

[1] B.I. Abelev et al. arXive:0805.0364.
[2] ALICE collaboration. J. Phys. G: Nucl. Part. Phys. 32 1295.