Open charm production using the $D^{*+} \rightarrow D^0 \pi^+$ decay in ALICE

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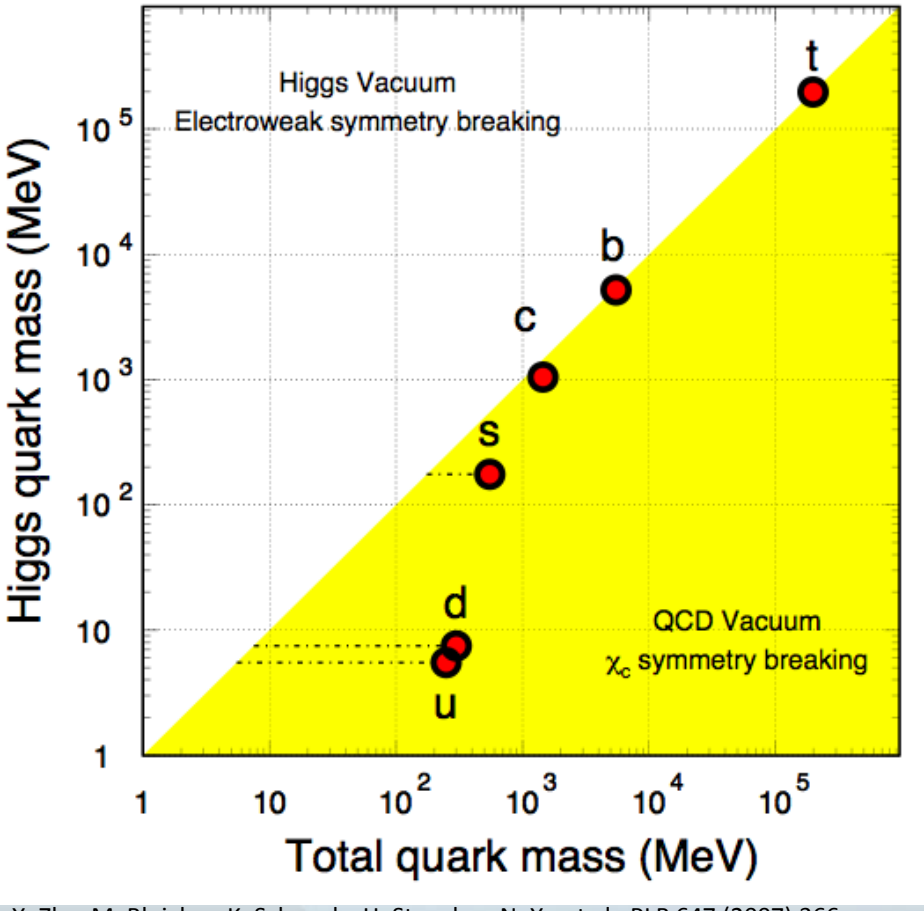
Heavy Flavour Quarks



X. Zhu, M. Bleicher, K. Schweda, H. Stoecker, N. Xu et al., PLB 647 (2007) 366.

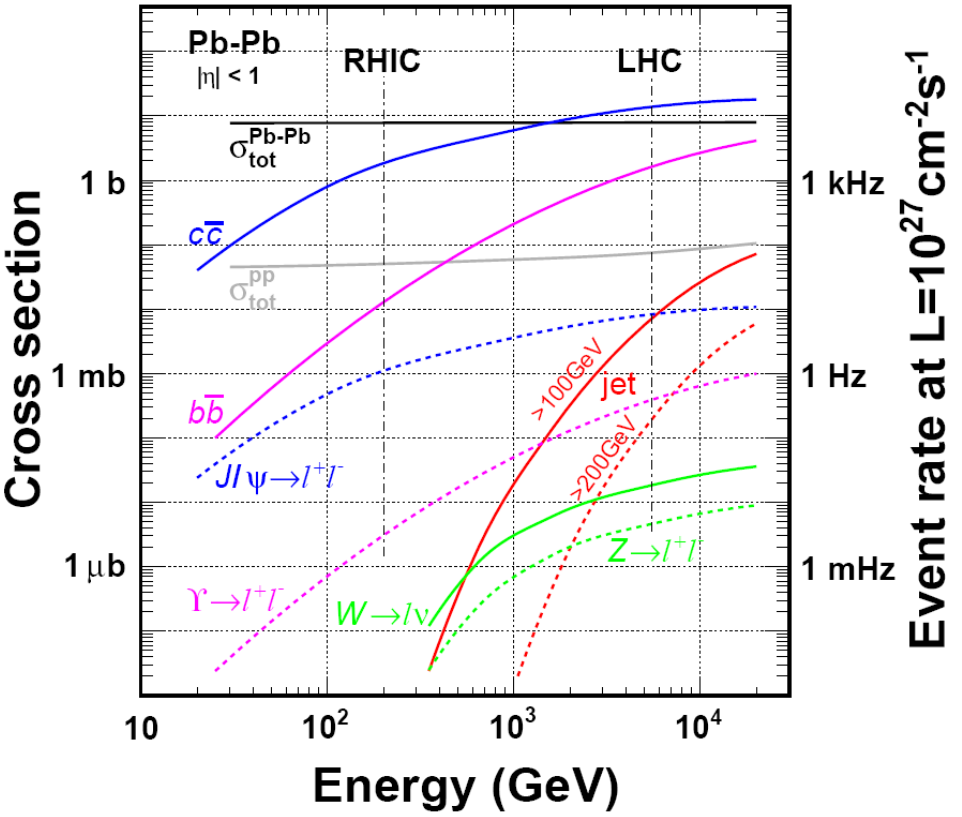
- As beauty and top quarks, charm quark has heavy mass composition
- In QGP where the chiral symmetry is restored, charm quark remains heavy
- Charm is a good probe for the medium

The measurement of charm cross section allows:

- Test of pQCD
- Probe parton distributions
- Baseline for J/ψ enhancement in Pb + Pb[1]

[1] P. Braun-Munzinger and J. Stachel, Nature 448(2007)302

Expectations for LHC



Cross-sections of interesting probes expected to increase relative to RHIC by factors

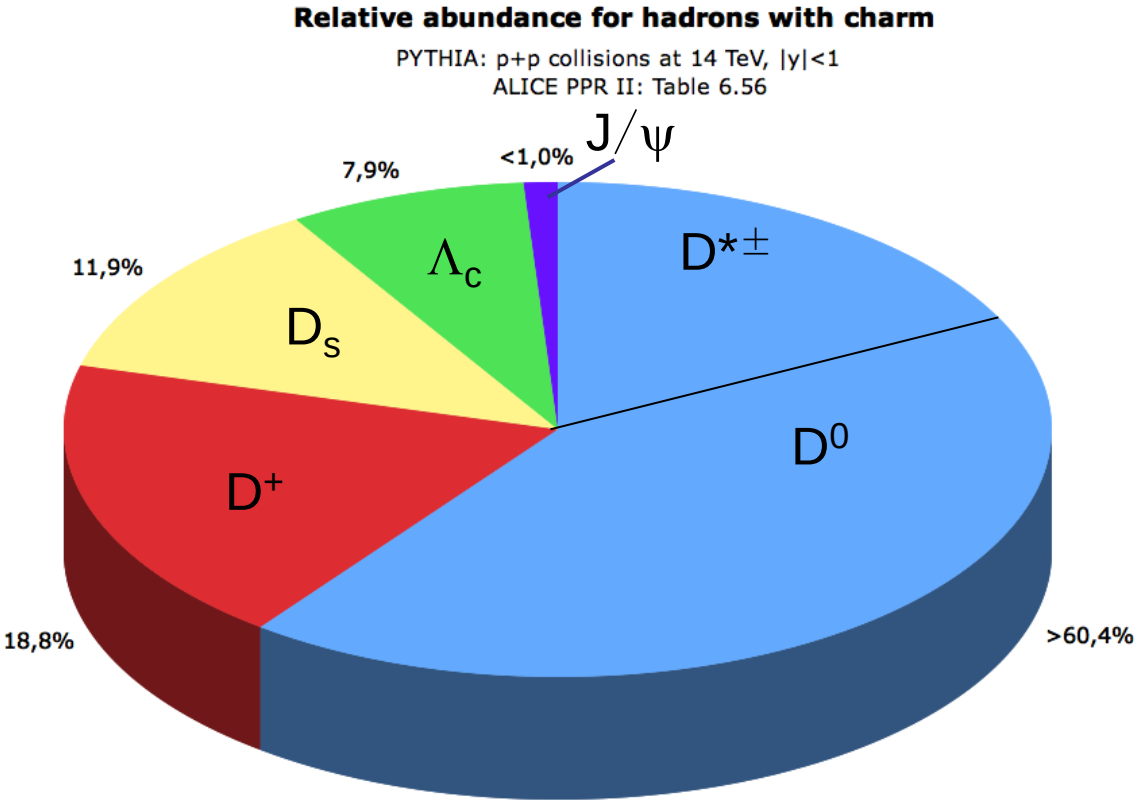
~ **10** ($c\bar{c}$) to

~ **10^2** ($b\bar{b}$) to

> **10^5** (very high p_T jets)

$\Rightarrow$ LHC is the ultimate machine for quark matter studies with hard-probes

Where does all the charm go?



open charm measurement in ALICE:

- $D^0 \rightarrow K^- \pi^+$
- $D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-$
- $D^{*+} \rightarrow D^0 \pi^+$
- $D^+ \rightarrow K^- \pi^+ \pi^+$
- $D_s^+ \rightarrow K^+ K^- \pi^+$
- $\Lambda_c^+ \rightarrow p K^- \pi^+$
- $\Lambda_c^+ \rightarrow \Lambda \pi+$
- $\Lambda_c^+ \rightarrow p K_s^0$

R. Bala's talk

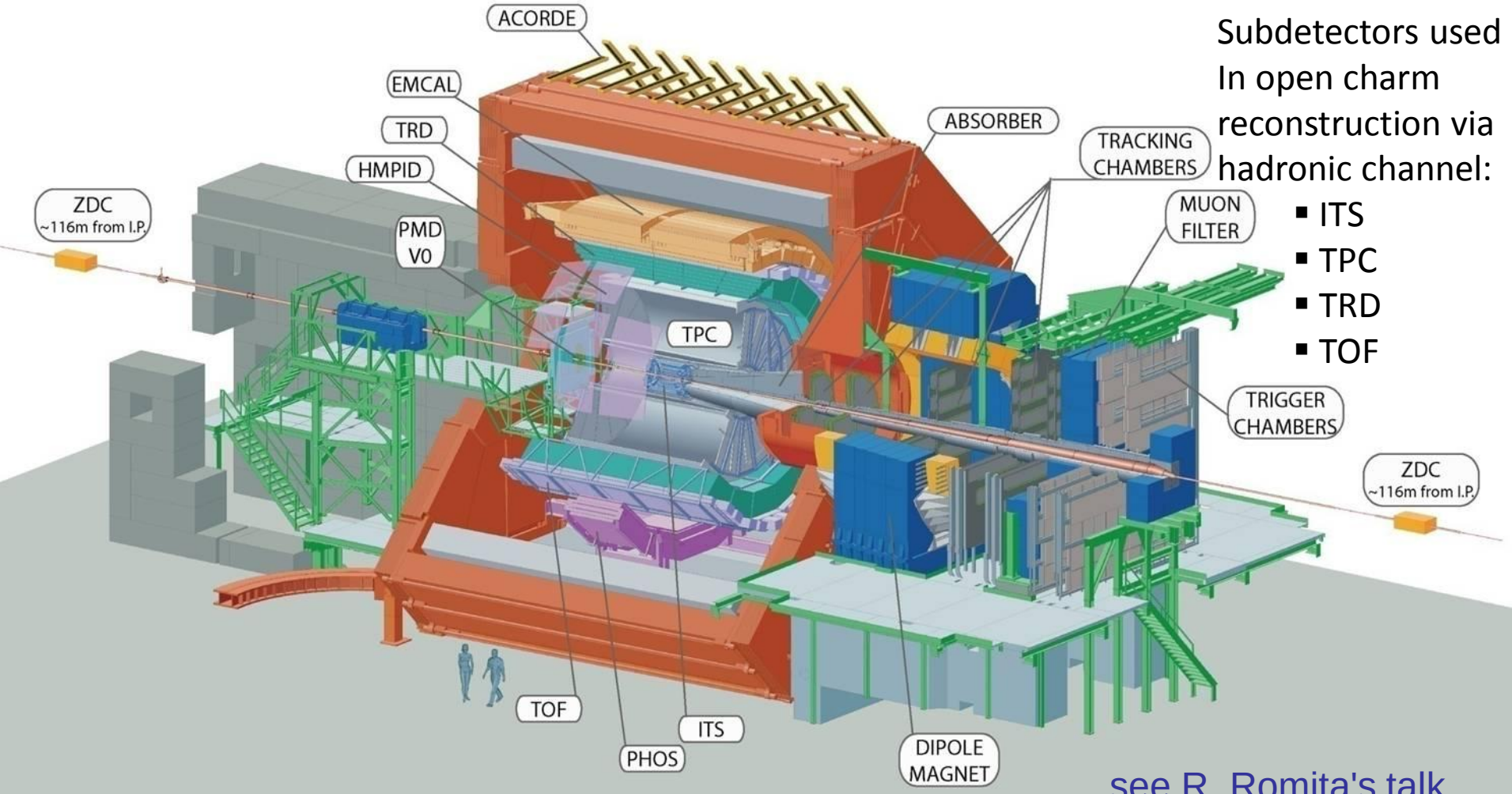
… …

- Measure open-charm mesons, e.g. D^0 and D^* to address:

  (a) total charm production in pp and AA

  (b) heavy-quark collectivity in AA

A Large Ion Collider Experiment



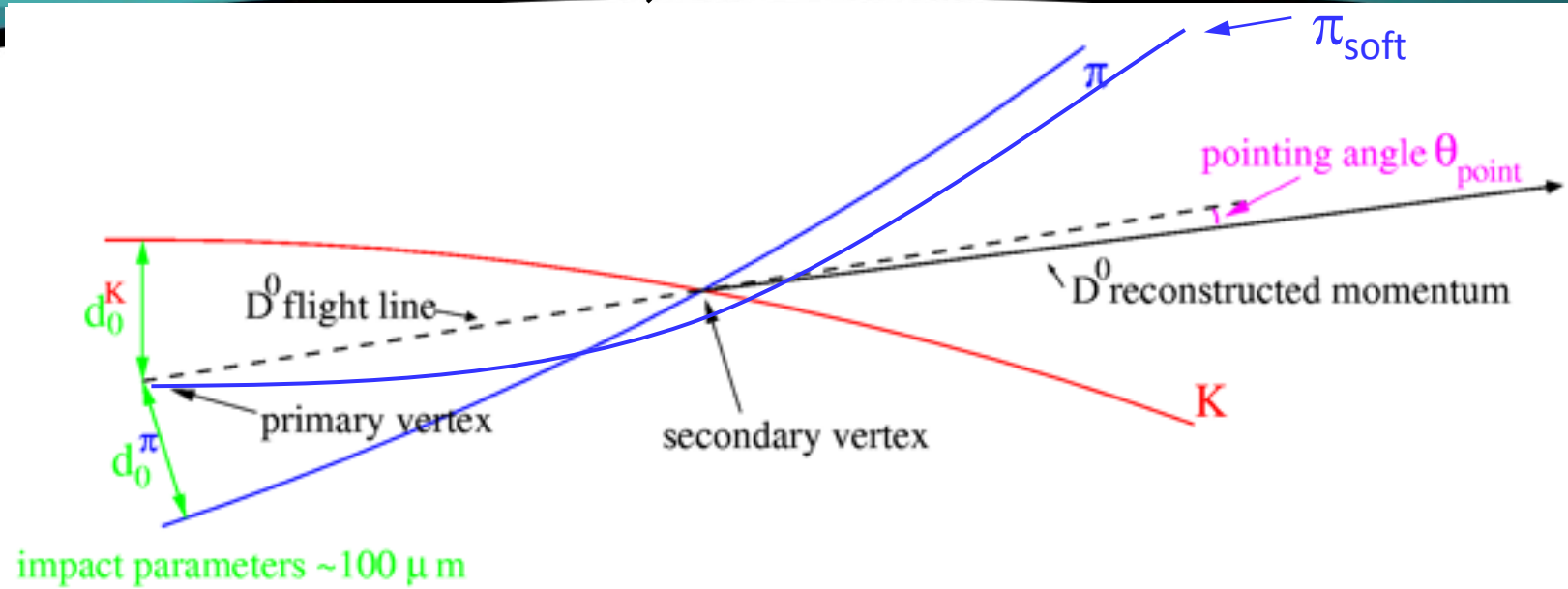
Subdetectors used In open charm reconstruction via hadronic channel:

- ITS
- TPC
- TRD
- TOF

see R. Romita's talk

$D^{*+} \rightarrow D^0 \pi^+$ Channel

$\hookrightarrow K^- + \pi^+$



D^0 Mass m = 1864.5 ± 0.5 MeV

Mean life $c\tau$ = 123.0 ± 0.4 μm

$D^0 \rightarrow K^- + \pi^+$ (3.80 ± 0.07)%

D^{*+} Mass m = 2010.0 ± 0.5 MeV

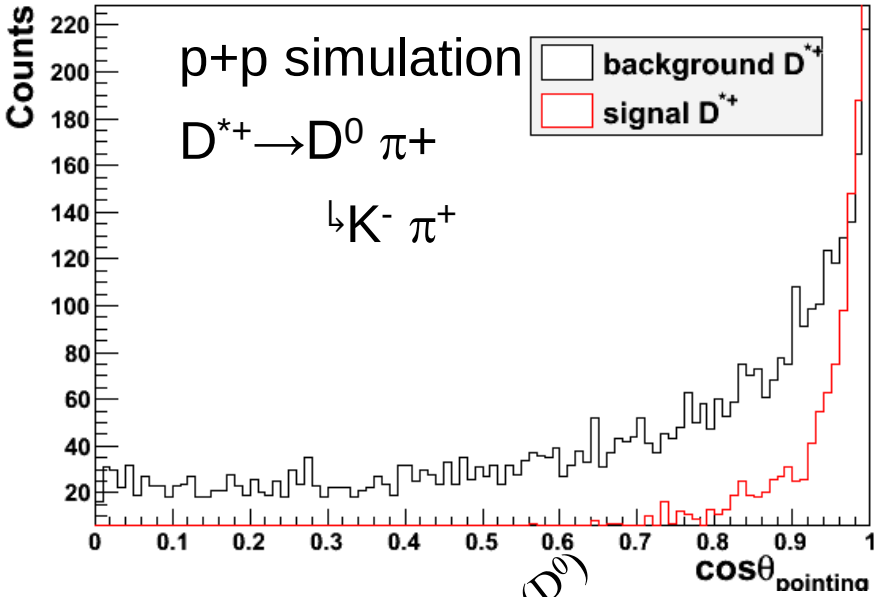
Full width Γ = 96 ± 22 keV

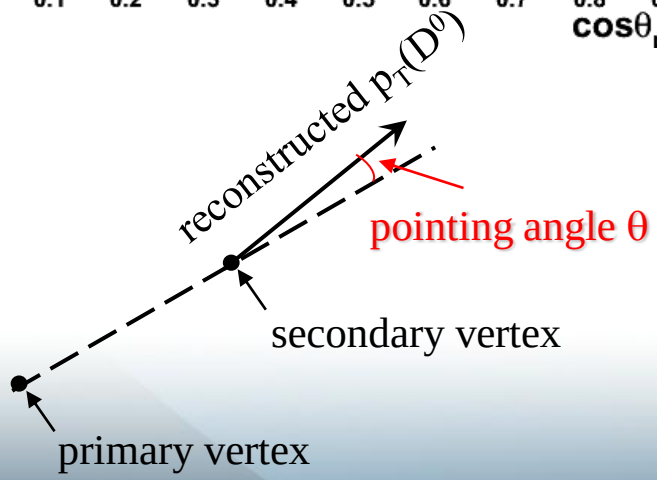
Kinematics q value: 39 MeV/c

$D^{*+} \rightarrow D^0 \pi^+$ (67.7±0.5)%

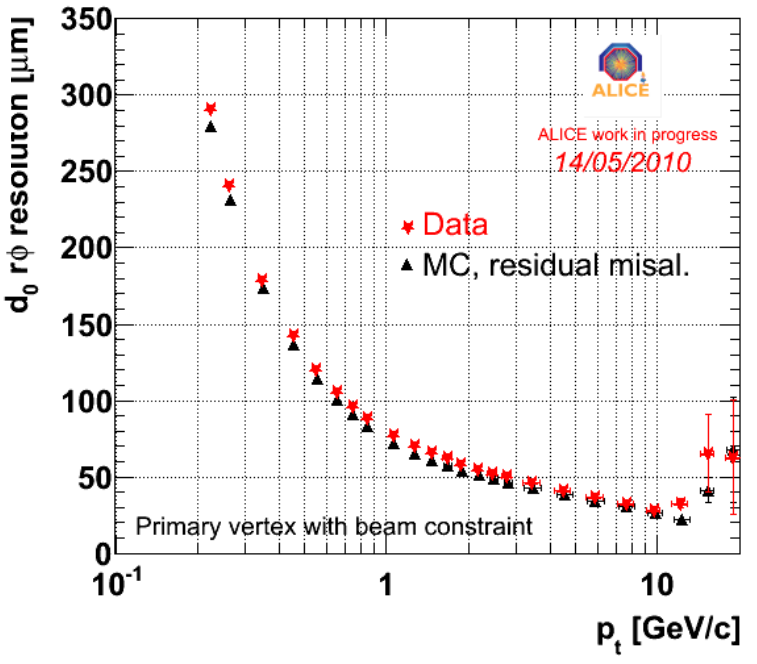
W-M Yao et al, J. Phys. G: Nucl. Part. Phys. (2006) 1-1232

Impact parameter





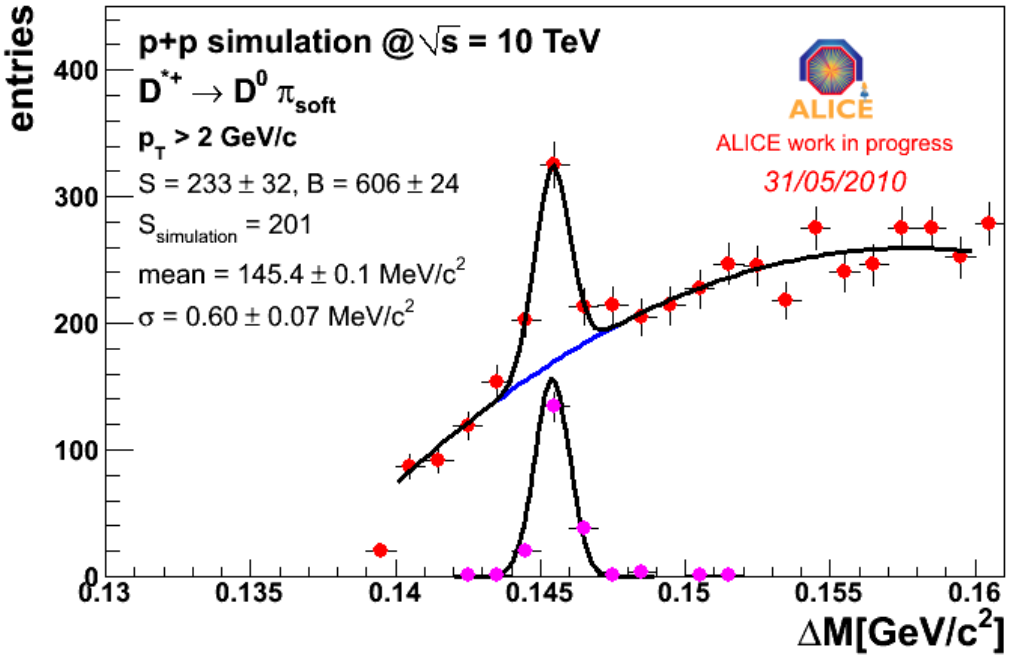
- impact parameter ~80 μm for 1 GeV/c track
- provide pointing seperation between signal and background



Monte Carlo Inv. Mass Spectrum

- binomial + gaus fit
- fit range 0.14~0.16 GeV
- signal and background counts extracted by integrating the fit function over $\pm 3\sigma$ region
- significance = $S/\sqrt{(S+B)}$

- in 25M 10TeV MB pp simulation



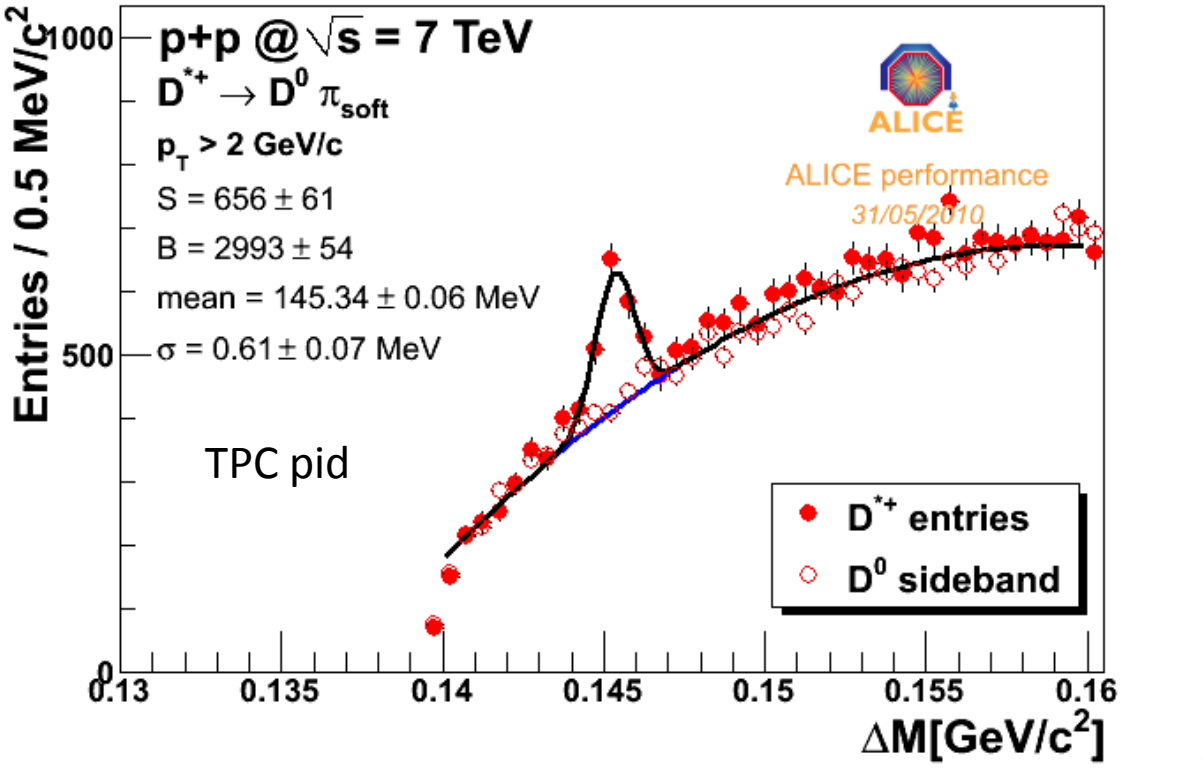
D^{*+} reconstruction

Data sets:

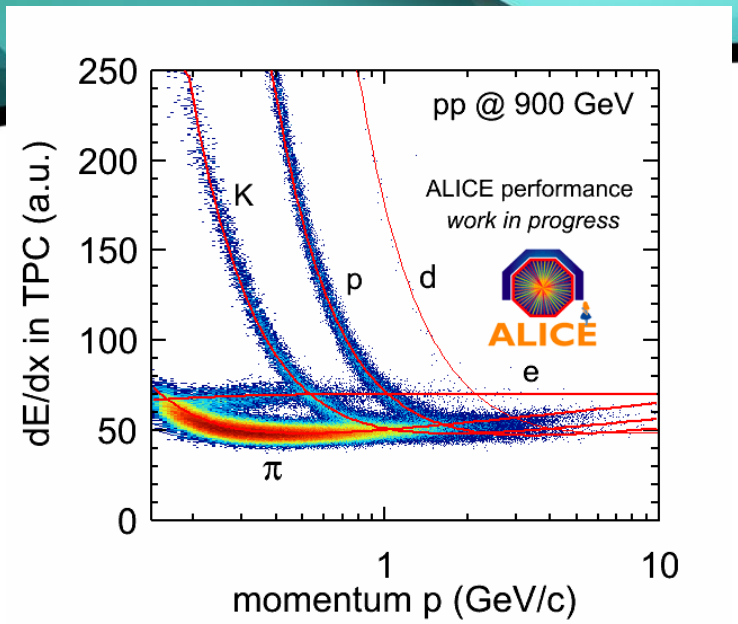
- 98M events

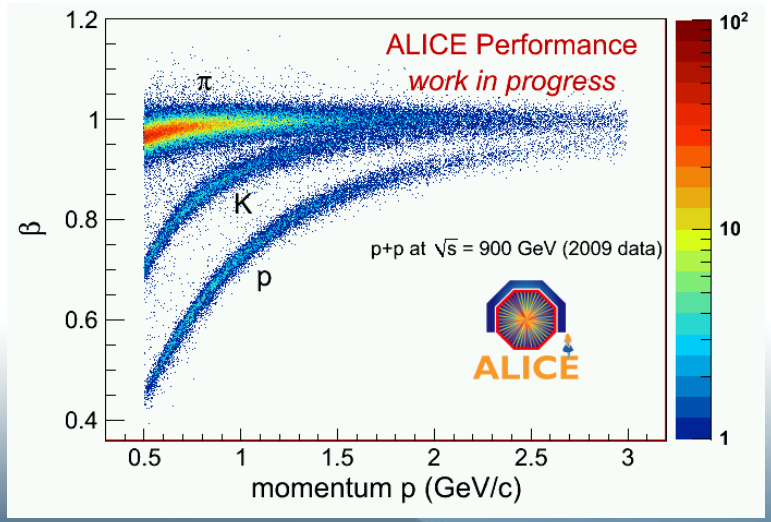
D^{*+} reconstruction:

- D^0 reconstruction with K,π
- select D^0 : $\pm 2\sigma$ ($24 MeV/c^2$)
- combine D^0 and soft π to reconstruct D^{*+}
- $\Delta M = M(K,\pi,\pi_{soft}) - M(K,\pi)$
- ΔM from PDG: 145.57MeV



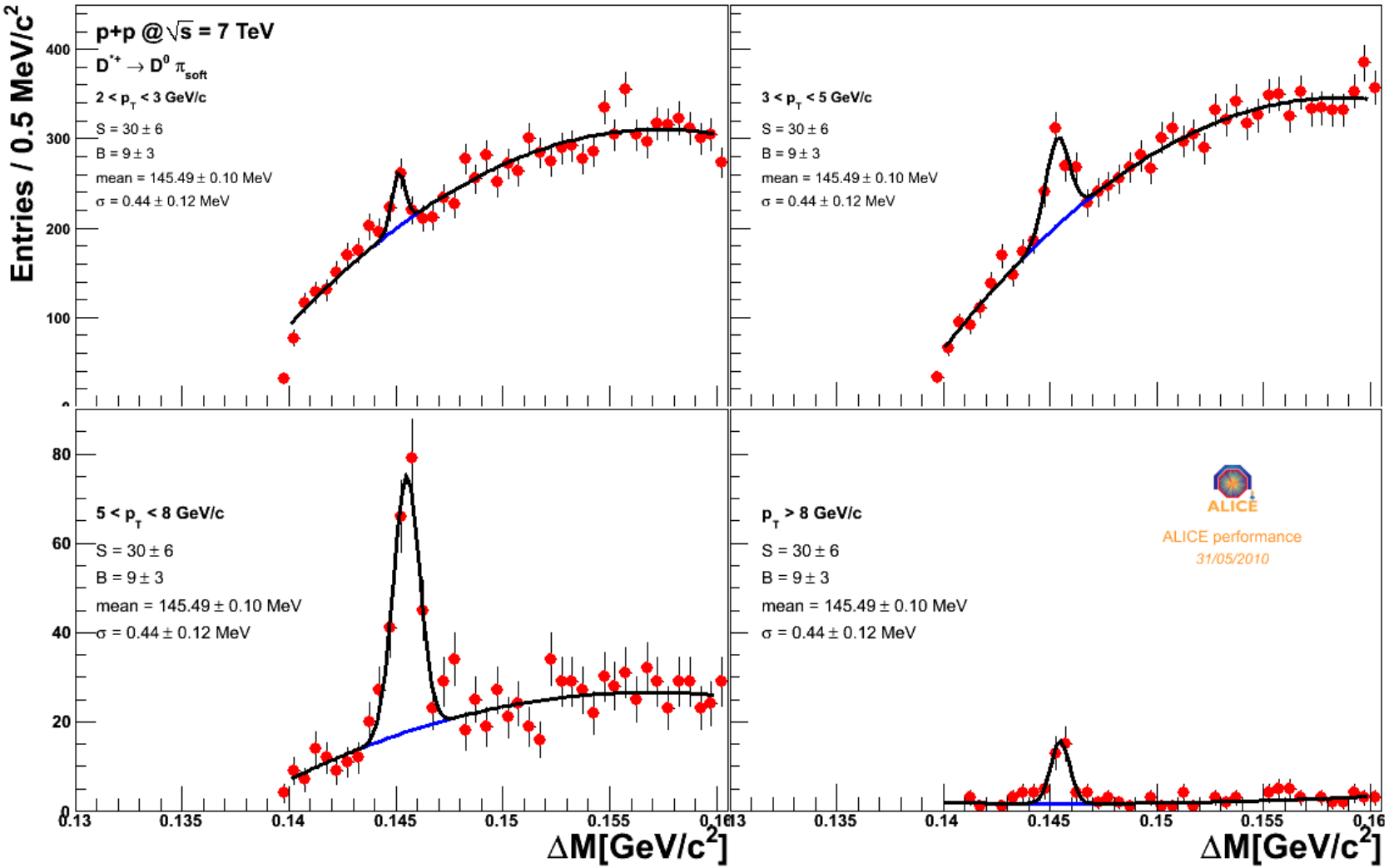
Particle Identification



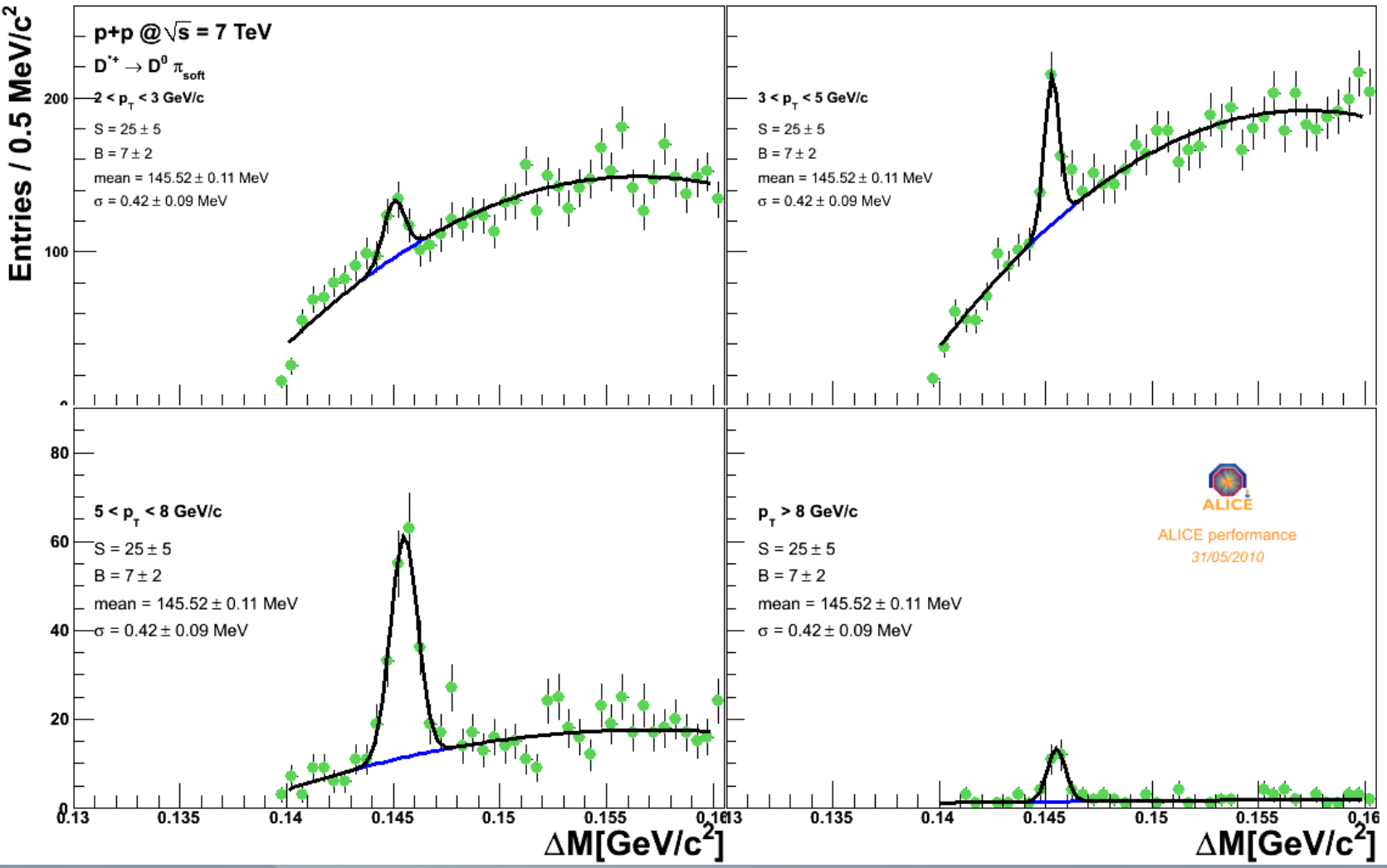


- PID used for K π from D^0
- PID method:
  - TPC dE/dx: K π seperation below 600MeV/c
  - Time of flight: K π seperation below 1.5GeV/c
- no PID applied for π_{soft}

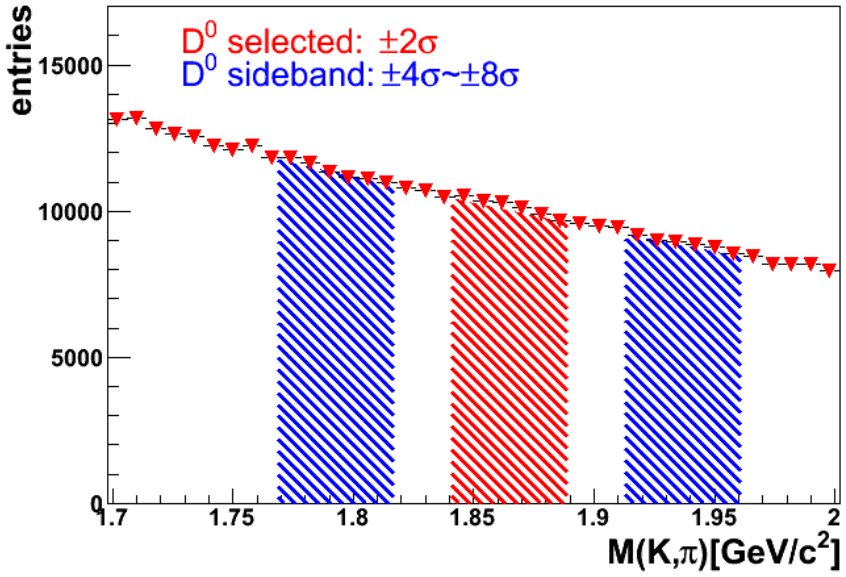
Inv. Mass in p_T (w/ TPC PID)



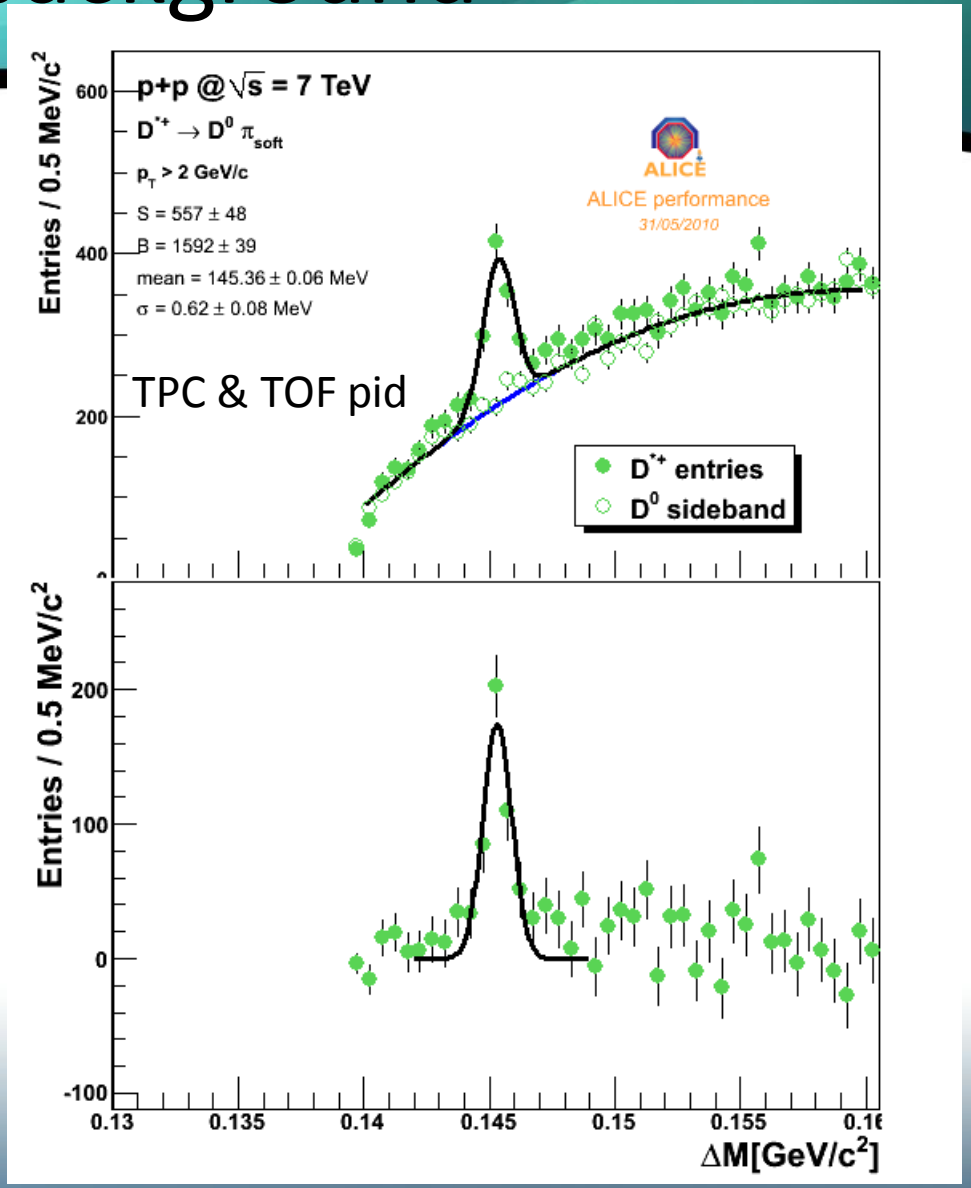
Inv. Mass in p_T (w/ TPC & TOF PID)



Sideband background

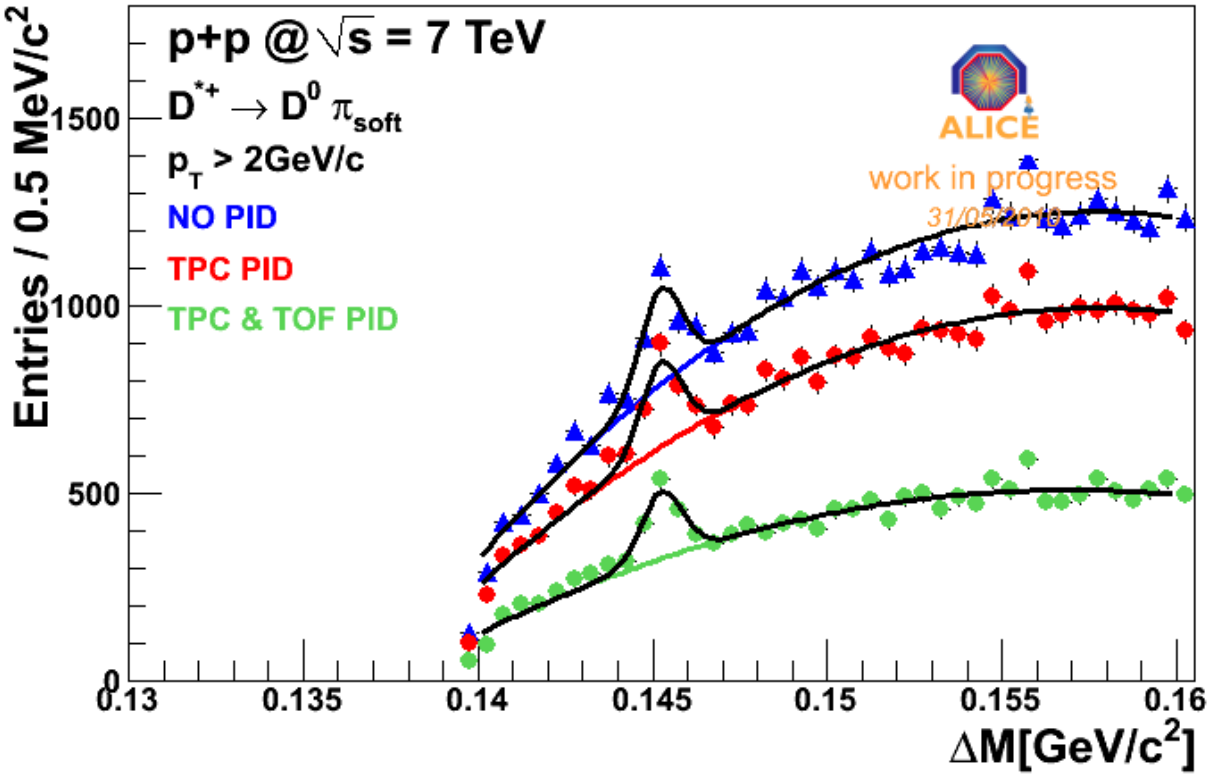


- signal D^0: -2σ ~ +2σ
- select D^0: ±4σ ~ ±8σ
- D^0 width from simulation: σ = 12 MeV/c^2
- reproduce the background shape



Conclusion

- ALICE has been taking data from p+p collisions @7TeV
- D^{*+} are reconstructed using D^0 π^+ decay channel

- Expect to collect 10^9 events in year 2010
- LHC schedule 1 month Pb+Pb run at Nov. 2010

backup PID: TPC and TOF