ITS Reconstruction for HLT

C.Cheshkov & J.Belikov

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ALICE Offline Week

Outline

- Physics cases
- Tracking for ITS
- Trigger for open charm (new)
- Summary – current code status

ITS HLT – Physics cases

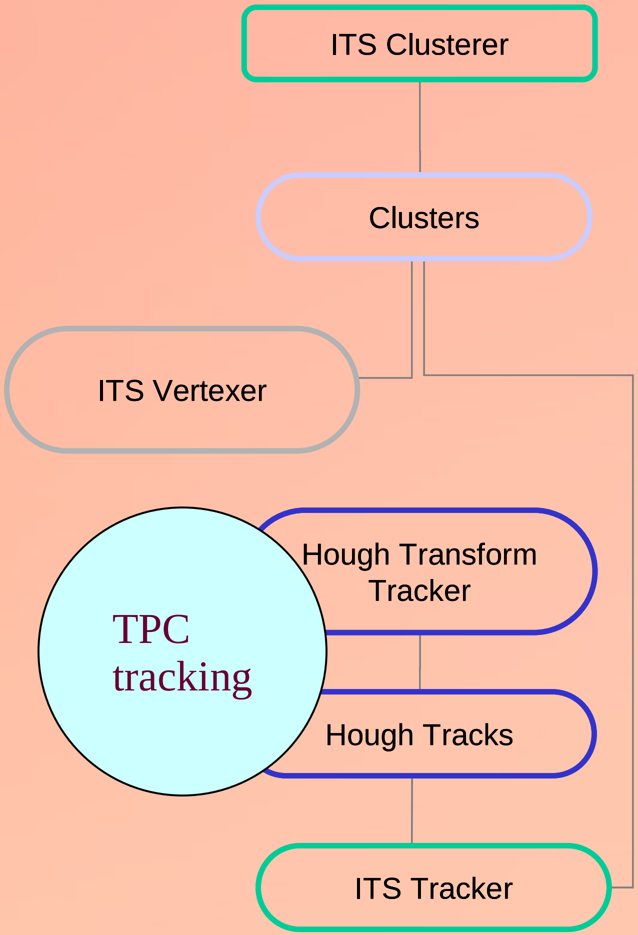
- **Jets**
  - Aim: trigger for high-Et jets
  - Requires: TPC tracking (+ITS tracking?)
    - ITS tracking will improve the resolution and remove 'ghosts'

- **Open charm**
  - Aim: trigger for D0$\rightarrow$Kπ
  - Requires: TPC and ITS tracking (+PID?)

- **Z position of the primary vertex from ITS in dHLT**
  - Aim: improve the di-muon mass resolution
  - Requires: SPD clustering + vertex finder

ITS tracking for HLT

- **Motivation:**
  - Needed for open charm trigger
  - Desirable for jet analysis
  - ITS vertexer (based on SPD clusters) can provide vertex for TPC tracking and possibly for MUON tracking
- **Algorithm based on optimized for time performance off-line ITS tracking code (clusterer, vertexerZ & tracker V2)**

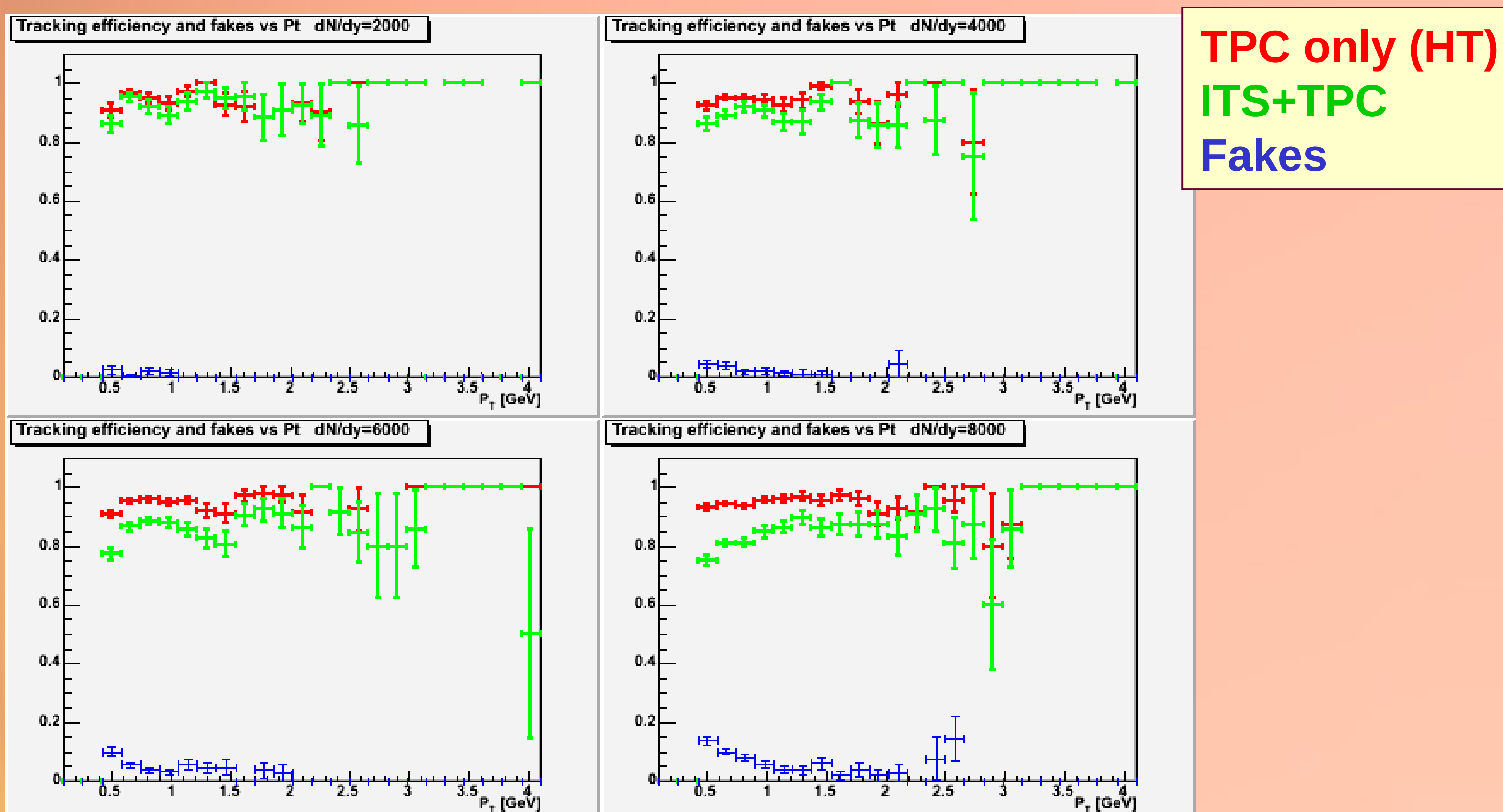


ITS tracking for HLT

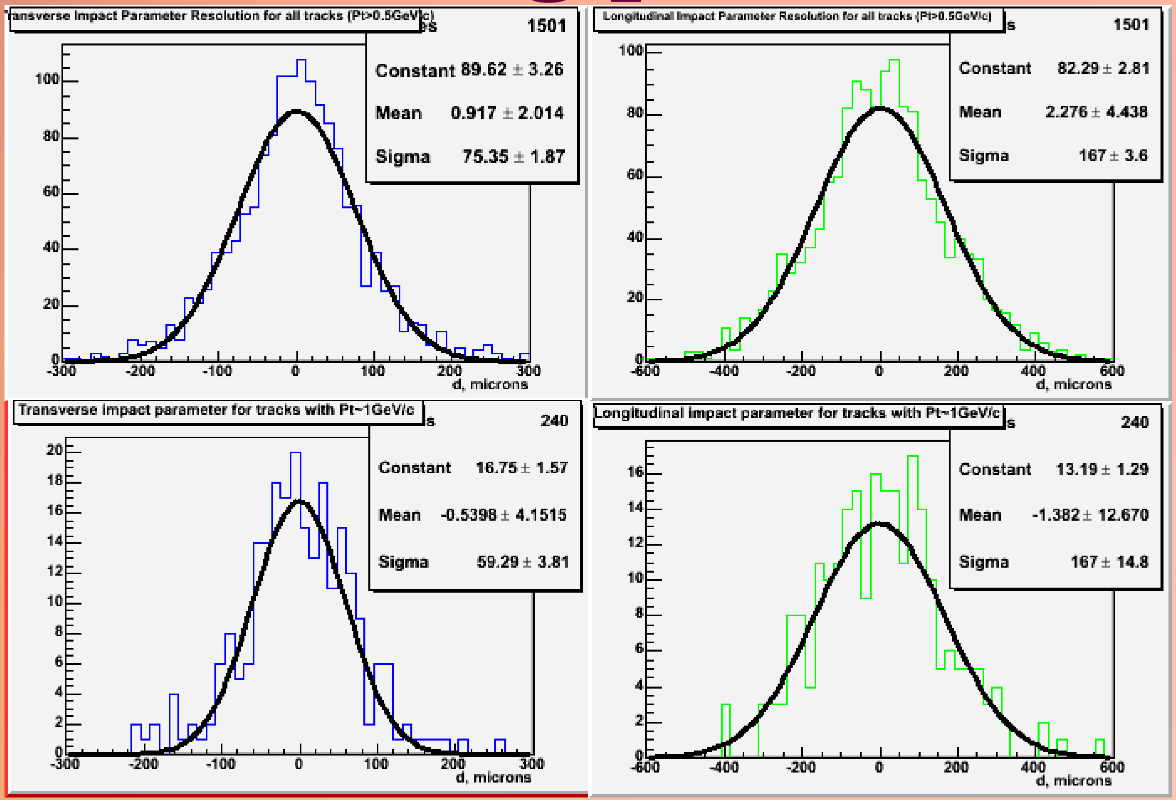
- Clusterer (AliITSClustererV2) and vertexer (AliITSVertexerZ):
  - Off-line code optimized for time performance
  - Vertexer about 40x faster than original one
  - Resolution on Z vertex about 60-70 microns
- Tracker (AliITStrackerV2):
  - Clusters sorted in Z and ϕ
  - Kalman filter matrix operations via explicit calculations
  - Factor 5-10 in time performance
  - Two reconstruction passes: with and without vertex constraint

ITS tracking performance

- The overall efficiency is quite satisfactory
- ITS tracking almost completely removes “ghost” Hough tracks
- Good tracks list from AliITSComparisonV2 macro
- Found tracks definition: >= 5 clusters in ITS



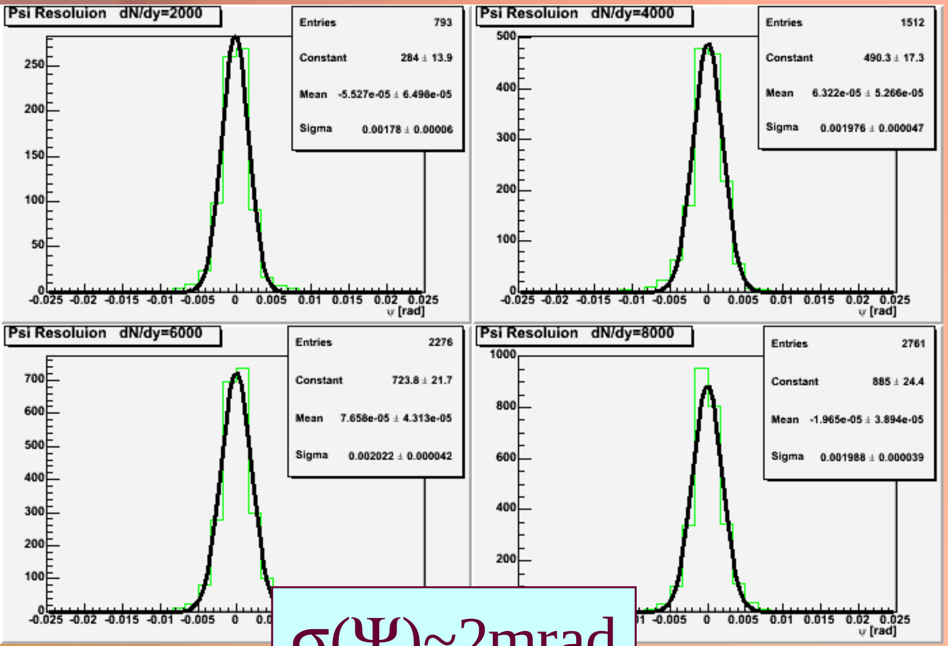
ITS tracking performance

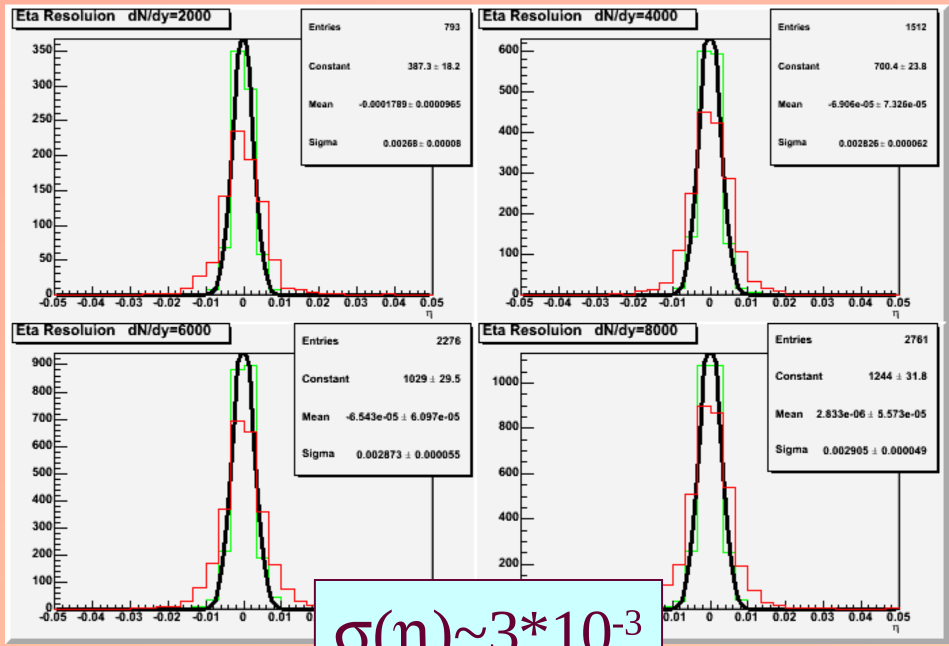


- **Impact param resolution dominated by SPD (~ off-line resolution)**
- **For 1 GeV/c track, the impact parameter resolution is:**

60 microns (trans) and 160 microns (long)

ITS tracking performance





$\sigma(\Psi)\sim 2$mrad

$\sigma(\eta)\sim 3*10^{-3}$

- **The angular resolution is improved about 2 times (w.r.t to TPC-only Hough tracking)**
- **The resolution is dominated by ITS (~off-line resolution)**
- **No significant dependence on event multiplicity**

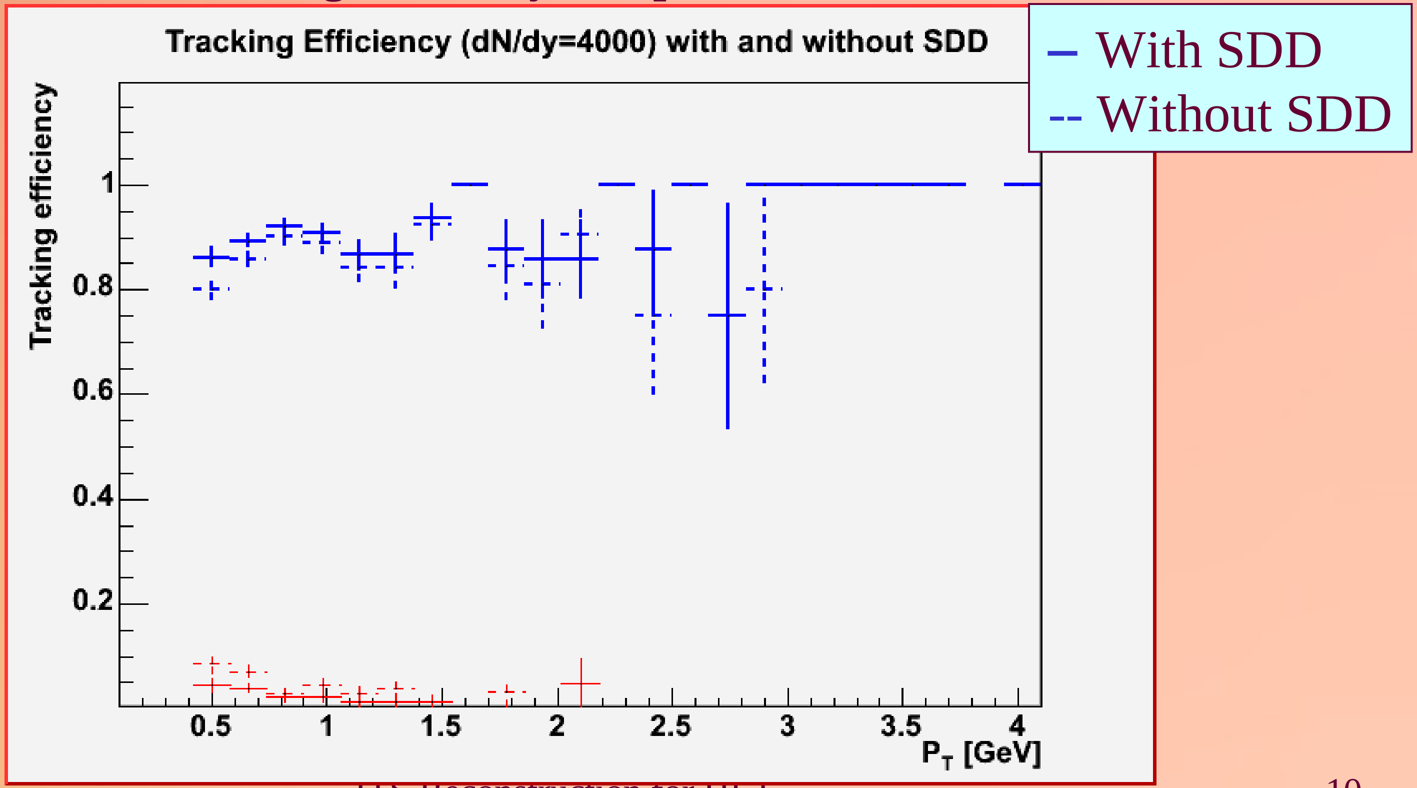
HLT ITS Timings

	dN/dy=2000	dN/dy=4000	dN/dy=6000	dN/dy=8000
Clusterer	1.29(0.53)s	1.46(0.61)s	1.66(0.70)s	1.83(0.79)s
Vertexer	0.04s	0.075s	0.125s	0.180s
Tracking	0.33(0.26)s	0.87(0.54)s	1.56(0.90)s	2.41(1.38)s

- **The numbers in brackets are without using SDD**
- **W/o any calibration/alignment**

HLT ITS: with vs without SDD

- **Main reasons to consider tracking w/o SDD:**
  - Many SDD DDLs ⇒ expensive for HLT
  - Slowest part of the clustering
  - SDD needs precise calibration (might not be available online)
  - The deterioration of tracking efficiency acceptable



D0->Kπ trigger: sim & rec

- **Simulation:**
  - **Signal events:**
    - PYTHIA6: From 100 to 500 D0 within the barrel acceptance, forcing hadronic decays
    - + Parametrized HIJING: underlaying event with dN/dy~2000
      - Realistic track reconstruction in high multiplicity environment
      - Realistic primary vertex reconstruction
  - **Background events: Parametrized HIJING dN/dy~2000**
- **Reconstruction:**
  - **Offline: Standard barrel tracking**
  - **HLT:**
    - Primary vertex reconstruction using HLT tracks
    - TPC Hough transform
    - + ITS HLT tracking

D0->Kπ trigger: selection

- Tracks selection:
  - Track reconstructed in TPC+ITS
  - Minimum Pt cut
  - Maximum impact parameter cut

- Secondary vertex selection:
- Two tracks with opposite charge
- Cut on the product of impact pars
- Cut on DCA
- Cut on the pointing angle
- Cut on cos(theta*)

- **No PID is used**
- **Same cuts for offline and HLT**

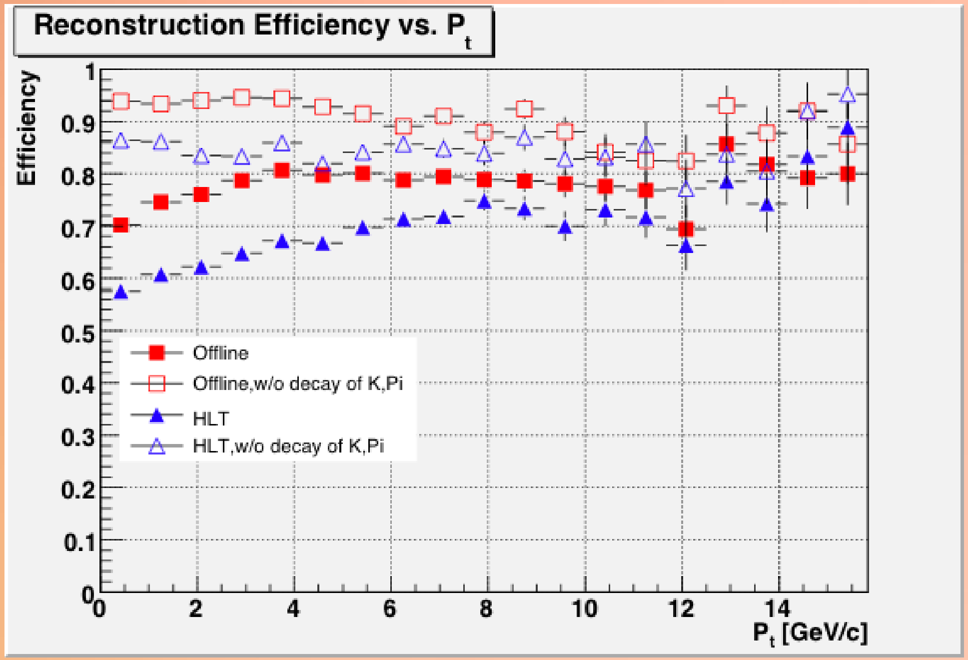
Parameter	$1 < P_t < 2GeV/c$	$2 < P_t < 3GeV/c$	$3 < P_t < 5GeV/c$	$5GeV/c < P_t$
P_t^K, P_t^π	$> 800\ MeV/c$	$> 800\ MeV/c$	$> 800\ MeV/c$	$> 800\ MeV/c$
d_0^K, d_0^π	$< 700\ \mu m$	$< 500\ \mu m$	$< 500\ \mu m$	$< 500\ \mu m$
$d_0^K \times d_0^\pi$	$< -60000\ \mu m^2$	$< -40000\ \mu m^2$	$< -30000\ \mu m^2$	$< -20000\ \mu m^2$
dca	$< 400\ \mu m$	$< 300\ \mu m$	$< 300\ \mu m$	$< 300\ \mu m$
$cos(\theta_{pointing})$	< 0.95	< 0.98	< 0.98	< 0.98
$\lvert cos(\theta^*)\rvert$	< 0.6	< 0.6	< 0.6	< 0.6

Table 1: Cuts for selection of $D_0 \rightarrow K^-\pi^+$ in Pb-Pb collisions with $\sqrt{s_{NN}} = 5.5\ TeV$

D0->Kπ trigger: efficiency

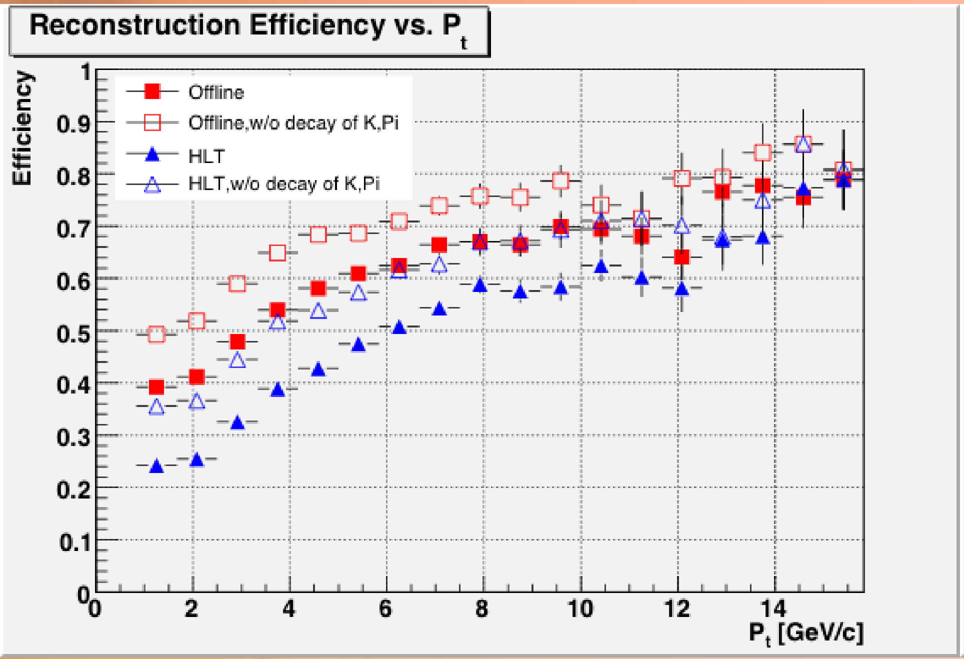
- **Good (findable) candidates defined as:**
  K, π: |Eta| < 0.9 , Pt > 0.8

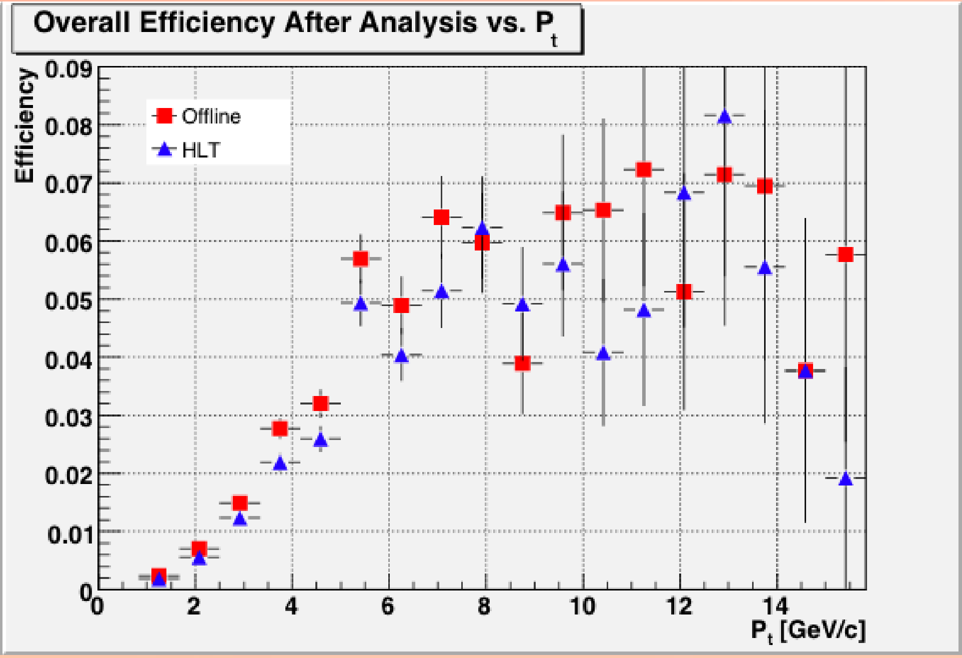
Observed D0 reconstruction eff in agreement with single-track one



D0->Kπ trigger: efficiency

- In case of "Physics" efficiency study, the findable candidates defined as:
  D0: |Eta| < 0.9 , Pt > 1.0

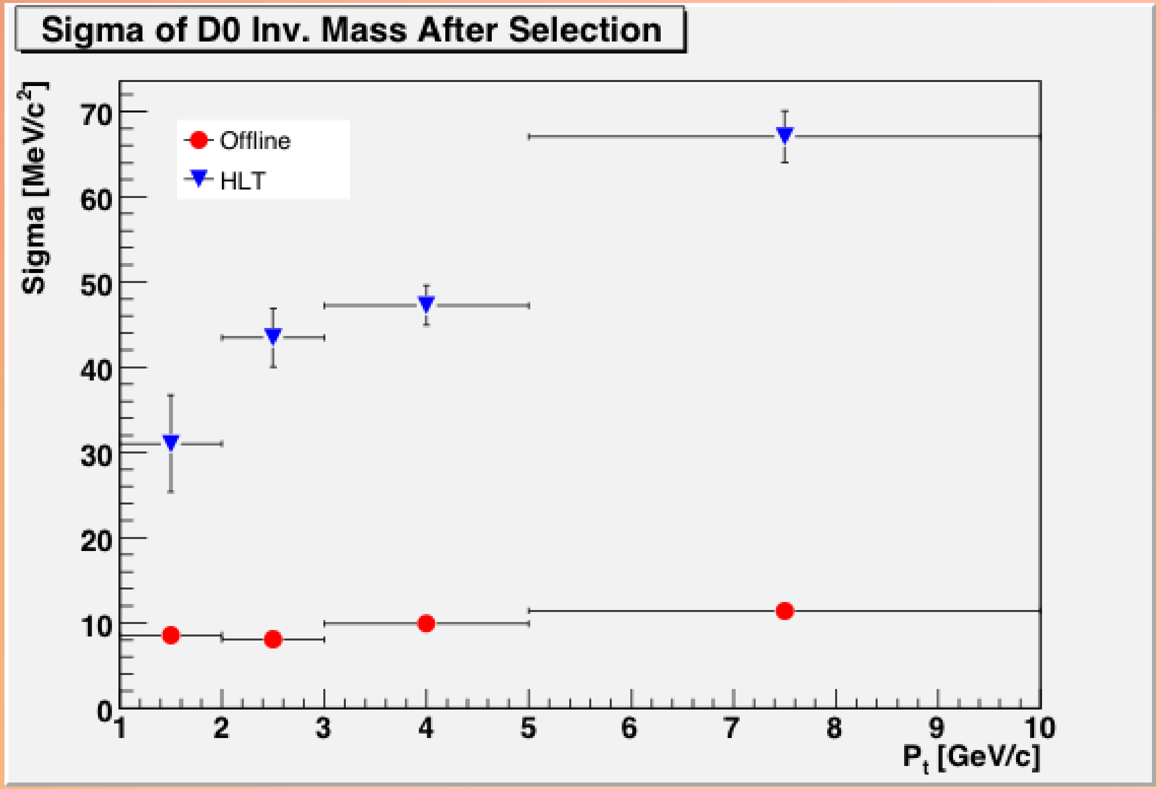




D0->Kπ trigger: resolution

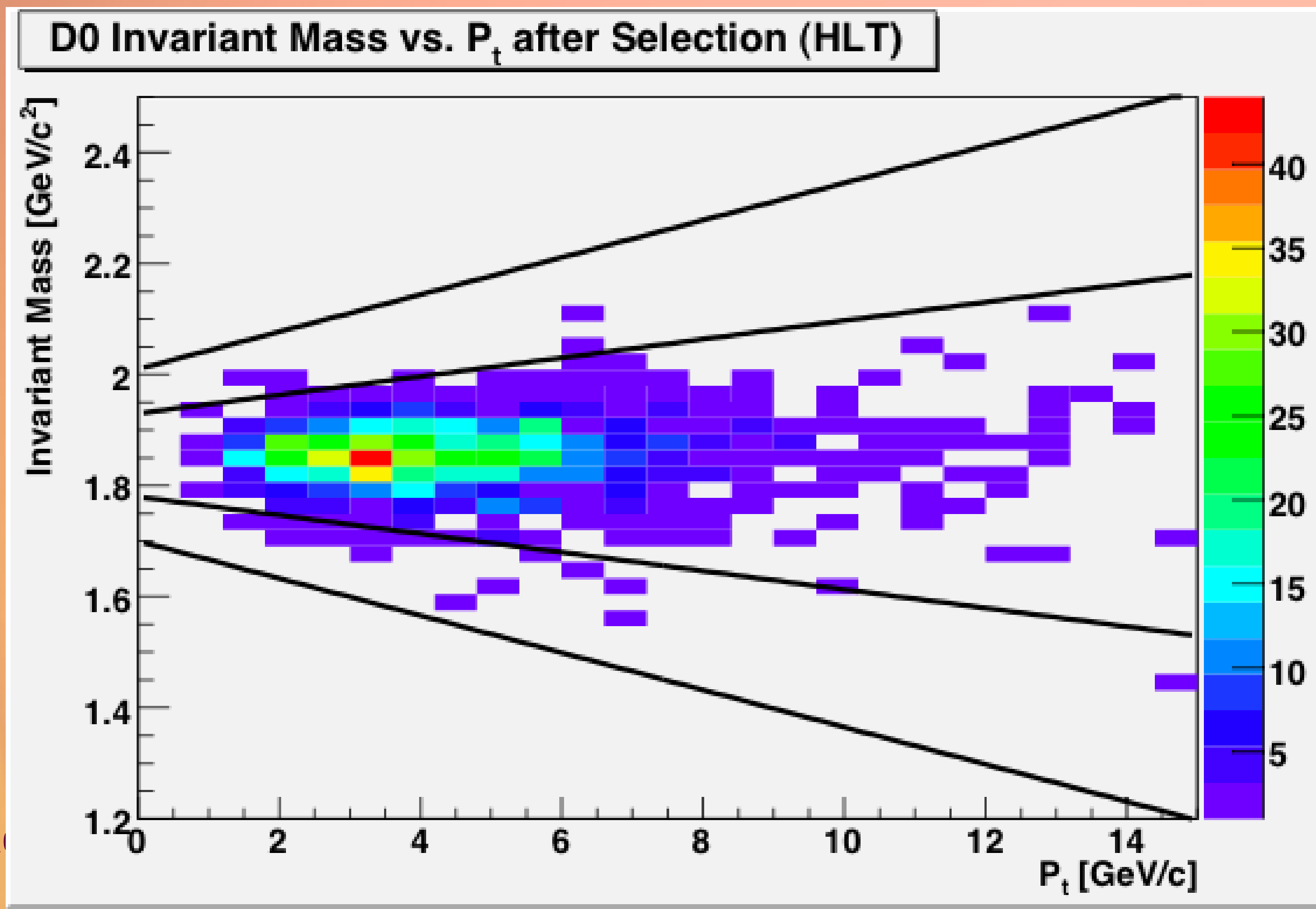
- Invariant mass resolution is dominated by track momentum uncertainty
- HLT momentum resolution is defined by the TPC Hough Transform reconstruction

⇒ Mass resolution rises significantly with Pt



D0->Kπ trigger: mass cut

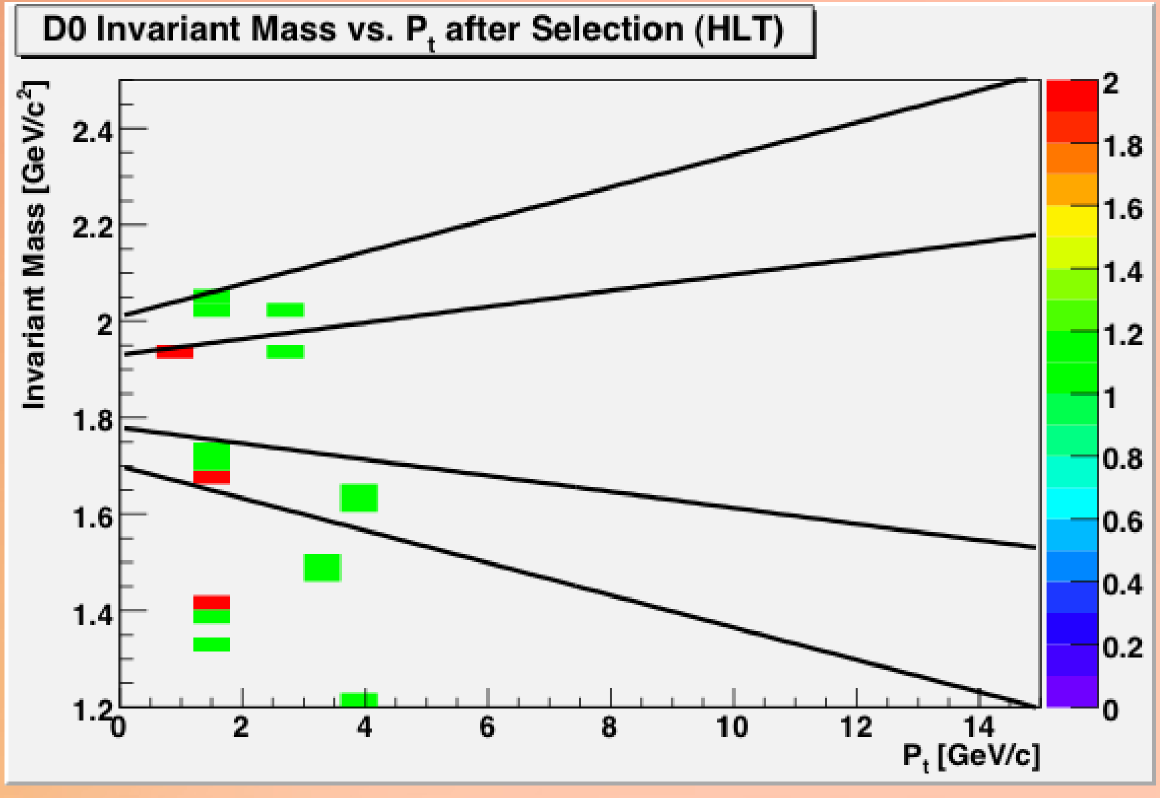
The obtained resolution is used to define the invariant mass cut for HLT



D0->Kπ trigger:Fake trigger rate

- 400 HIJING events with dN/dy~2000
- Same analysis over background
- Apply invariant mass cut defined earlier

3 sigma: Fake Trigger Rate < 0.015 (2 out of 400)
6 sigma: Fake Trigger Rate < 0.03 (6 out of 400)



D0->Kπ trigger: timing

- **The cut on $d_0(K)*d_0(\pi)$ at the beginning of track pair selection**
- **+ minor changes in the offline analysis code**

dN/dy=2000	dN/dy=4000	dN/dy=6000	dN/dy=8000
10ms	30ms	90ms	160ms

Summary – code status

- **Good news:**
  - ITS clusterer, vertexer and tracker for HLT are in CVS
  - They derive from the corresponding V2 and vertexerZ ITS classes which are operational
  - Tracker V2 is fully misalignment-aware
  - The obtained timing performances should be still valid
  - The code for D0->Kpi trigger could be easily introduced into HLT framework (as soon as we get the HLT tracks into the offline ESD format)
- **Bad news:**
  - Clusterer V2 is not calibration-aware (certain work is needed)
  - Fixes + misaligment-awareness of vertexer have to introduced
  - The code has to plugged into the new HLT processing framework

References

- **ALICE Progress Report – 25/04/2005**
  http://indico.cern.ch/conferenceDisplay.py?confId=
- **PWG3 Meeting -**
  http://indico.cern.ch/materialDisplay.py?contribId