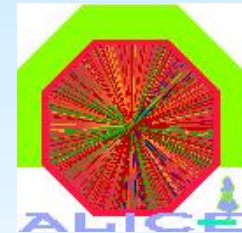# ESD tracks and the TRD

Global Aspects of ESD Tracks
TRD Information in the ESD Tracks
TRD: Energy Loss and PID
First Experience with PDC06 Events

Silvia Masciocchi
GSI Darmstadt
October 2, 2006
CERN - Offline Week

MC Samples

MC events used:

1. **PDC06 events**
   /alice/cern.ch/user/a/aliprod/prod2006_2/output_pp
   runs 100-206

2. **TRD events**
   Aliroot v4-04-Rev-08
   see next page

TRD MC Sample

- AliRoot v4-04-Rev-08

- AliGenBox as generator: flat particle distribution in θ and ϕ

- 11 fixed momentum values: 0.6, 0.8, 1, 1.5, 2, 3, 4, 5, 6, 8, 10 GeV

- In every event 100 each: $e^{\pm}, \mu^{\pm}, \pi^{\pm}, K^{\pm}, p^{\pm}$
  500 particles per event

- For each mom point, 50 samples of 20 events each:
  $\rightarrow$ 100,000 electrons, muons, pions, kaons and protons of given momentum

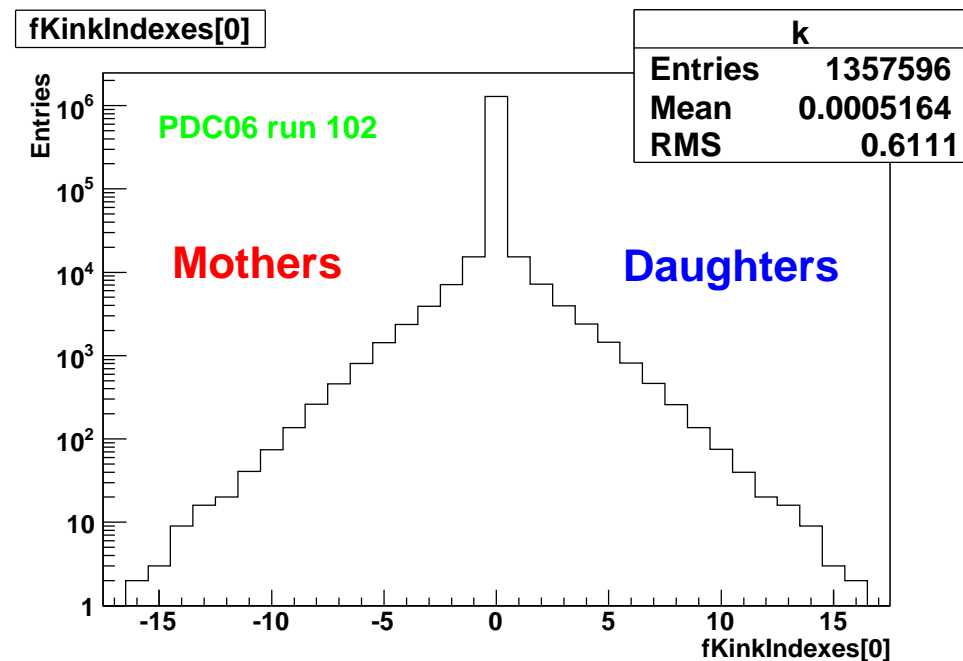- Settings: Rapidity range: $-1 < \eta < 1$, only the barrel detectors

All events generated, traced through the detector and reconstructed

Kink Candidates

Candidate "kink" tracks have fKinkIndexes[0]!=0

- significant fraction of all ESD tracks:
  PDC06 events: $\approx$ 5%
  TRD events: up to 40% !!!

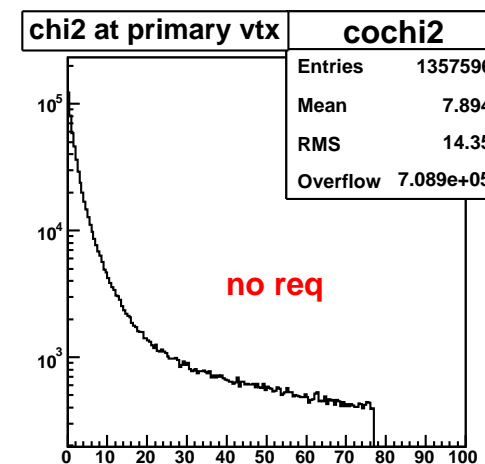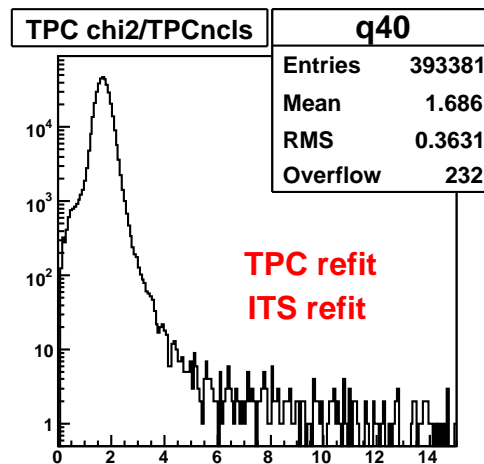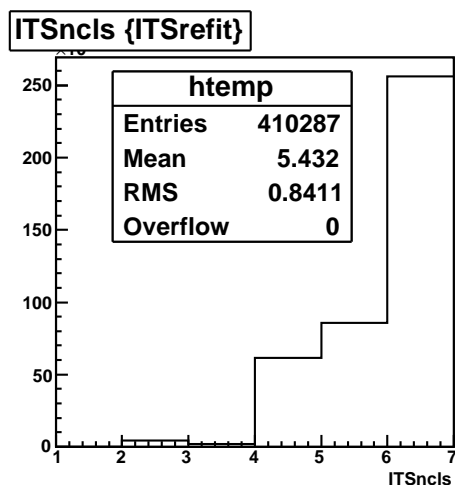- multiple matching of individual MC tracks to reconstructed tracks:
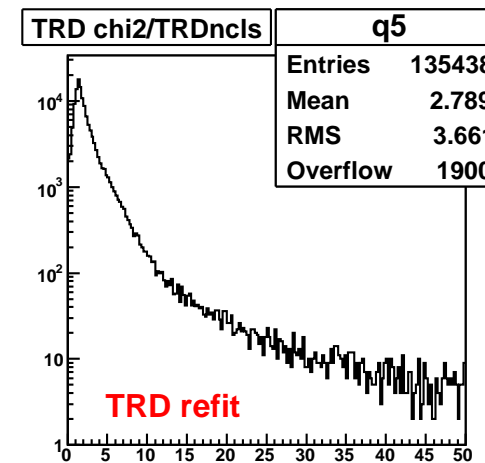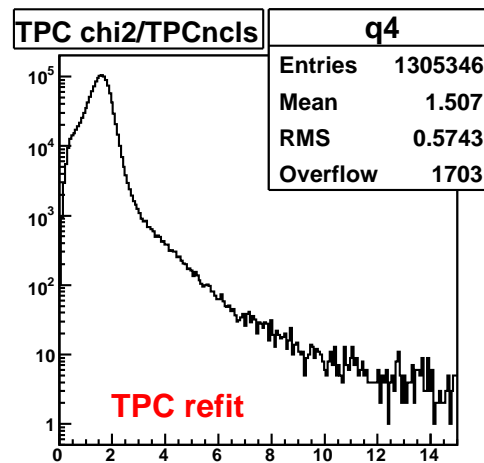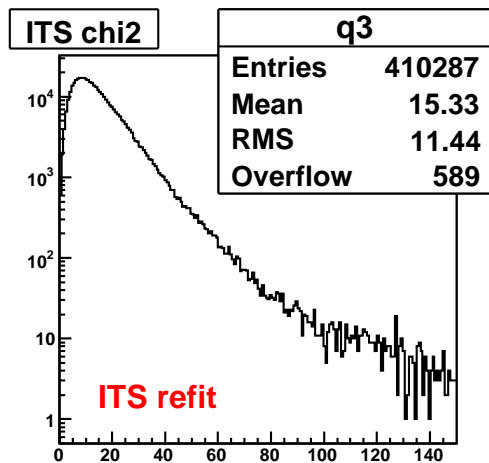 up to 4-6 times!!

- Which indices should we check?

- How to handle the kinks CORRECTLY?
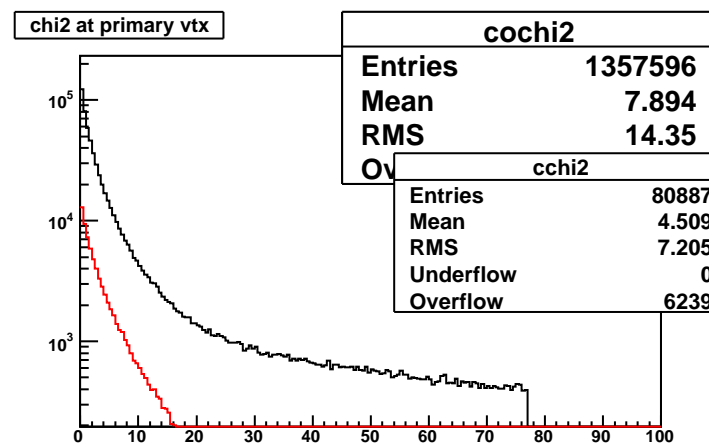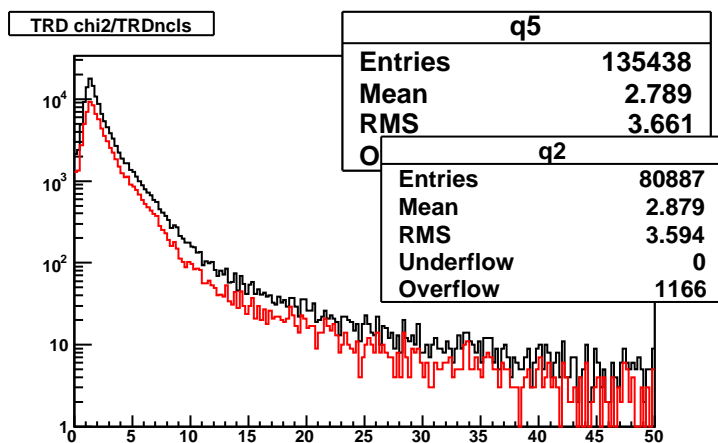
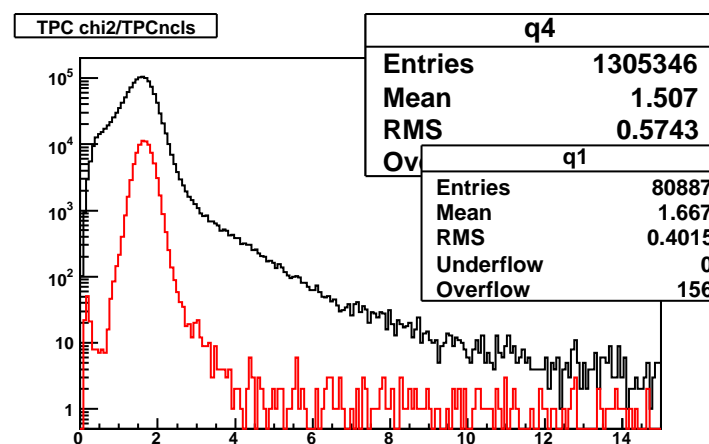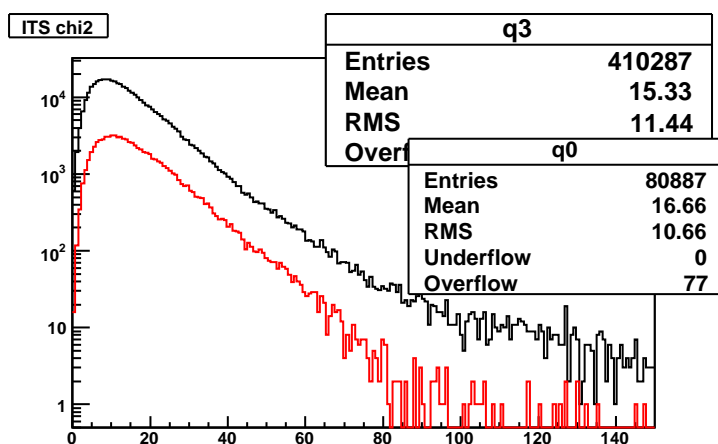# ESD Track Chi2
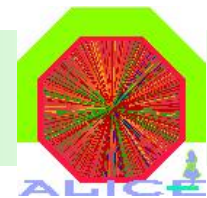
PDC06 run 102

- ITS: what is the correct normalization?
- No global chi2 other than from the constrained fit to the primary vtx?
- What global cut should one use?

Track Chi2 - selection
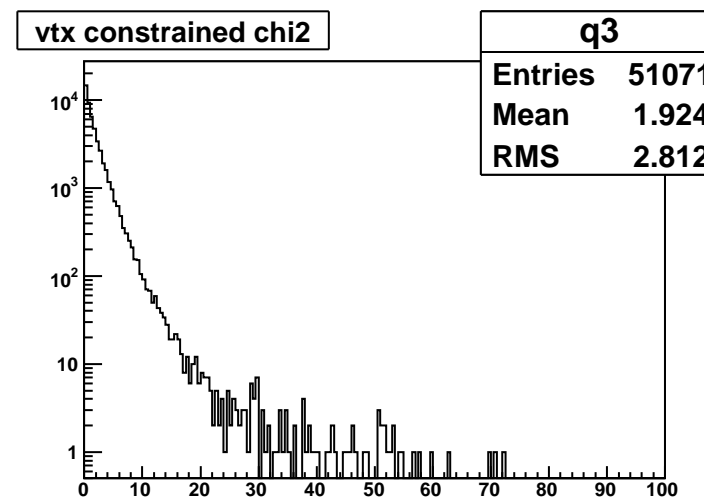
PDC06 run 102:
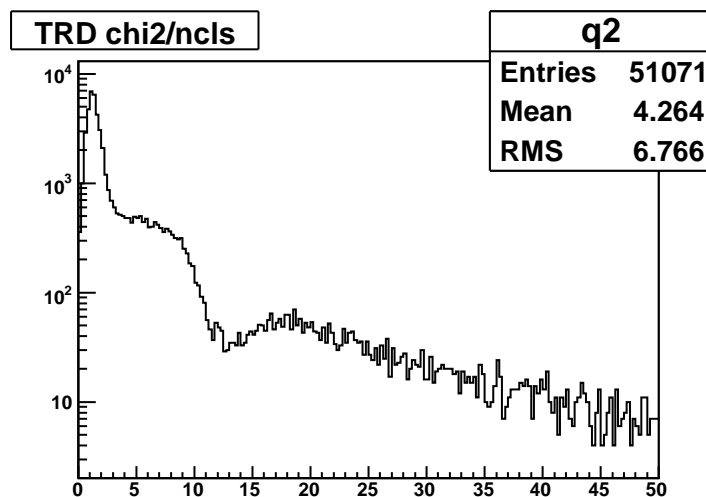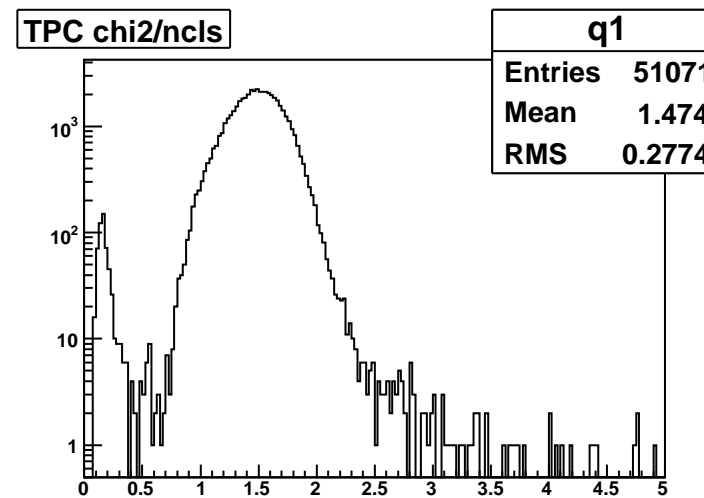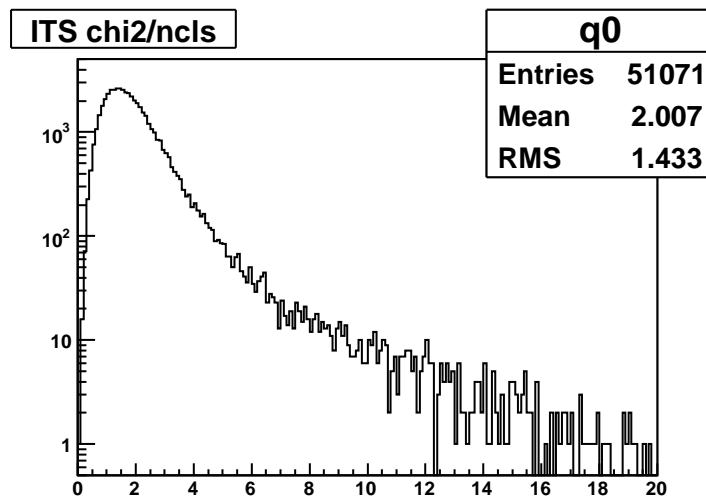ESD tracks with no kink, ITS+TPC+TRD refit

Track Chi2 - TRD
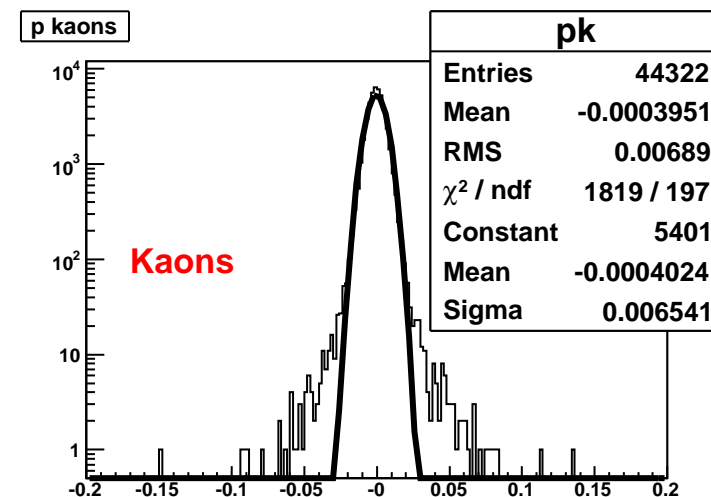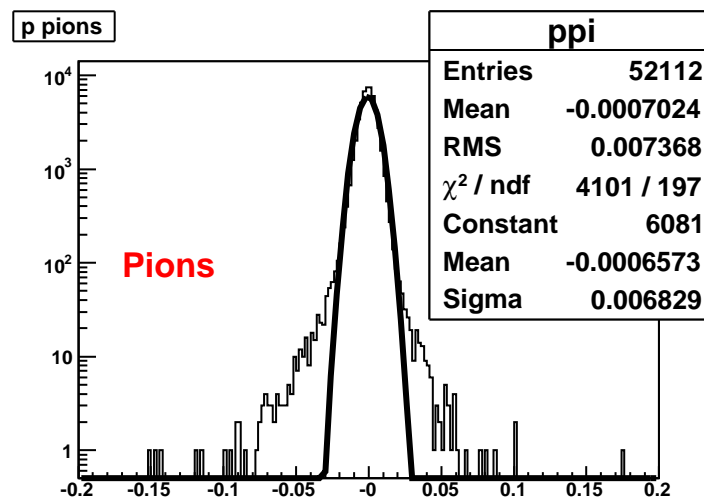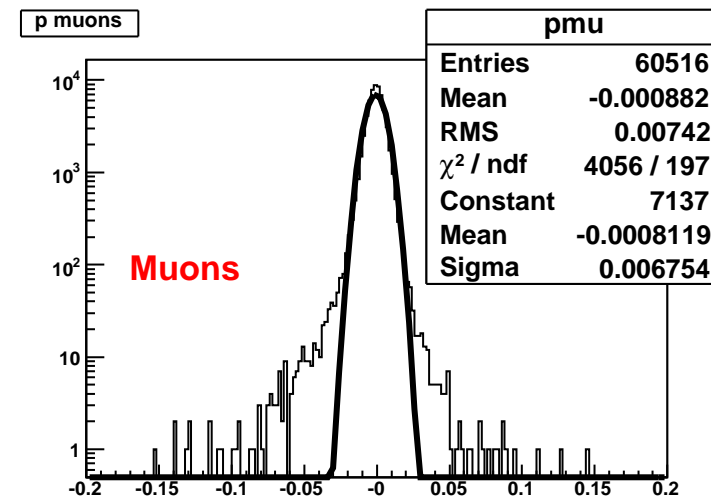
TRD events
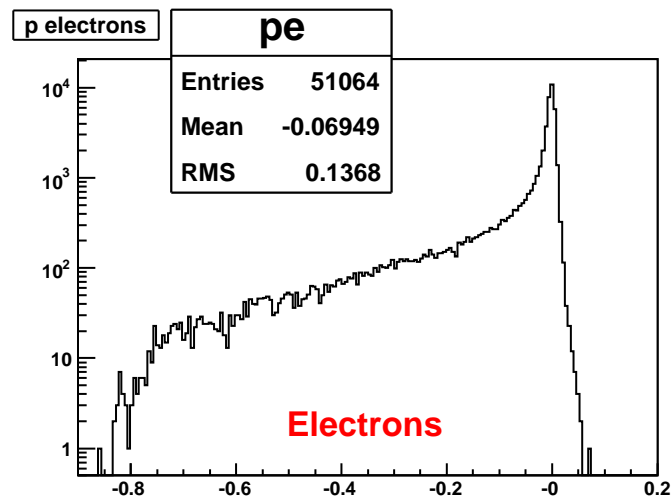2 GeV: no kink, ITS+TPC+TRD refit, close to primary vertex

Momentum

2 GeV: no kink, ITS+TPC+TRD refit, close to primary vertex
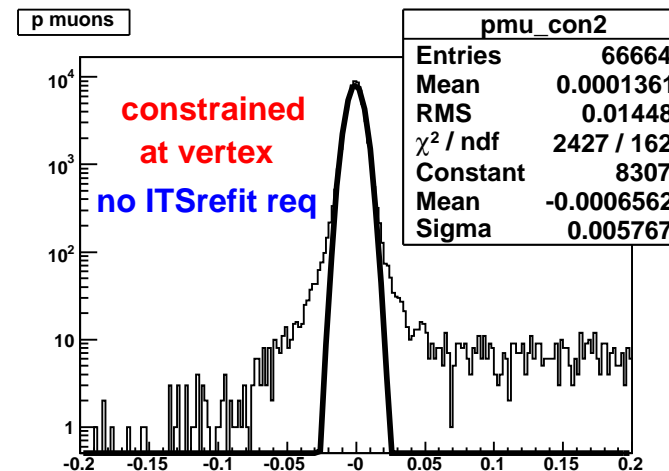
$$\frac{p_{reco} - p_{mc}}{p_{mc}}$$
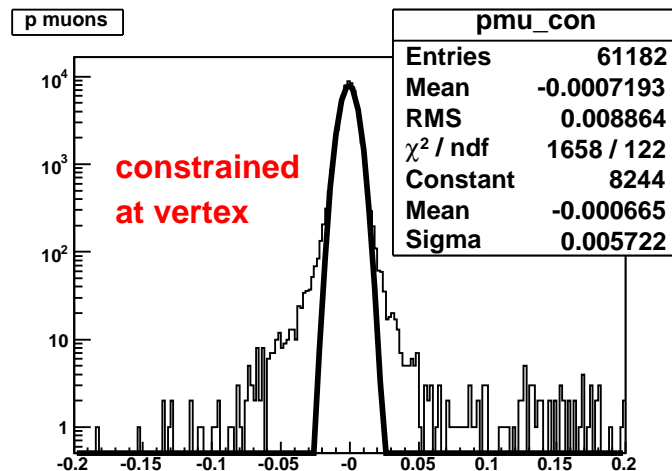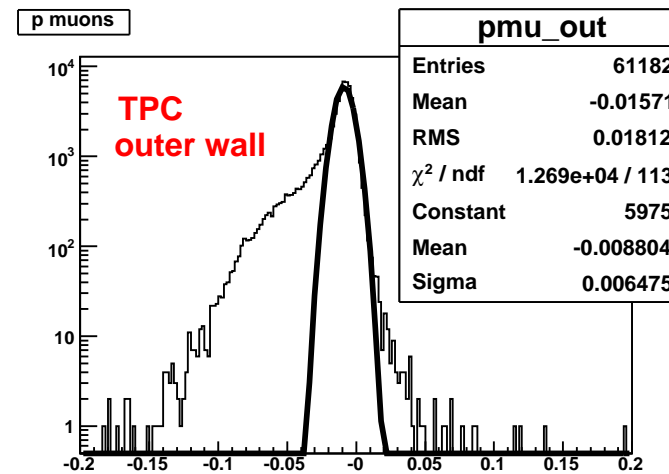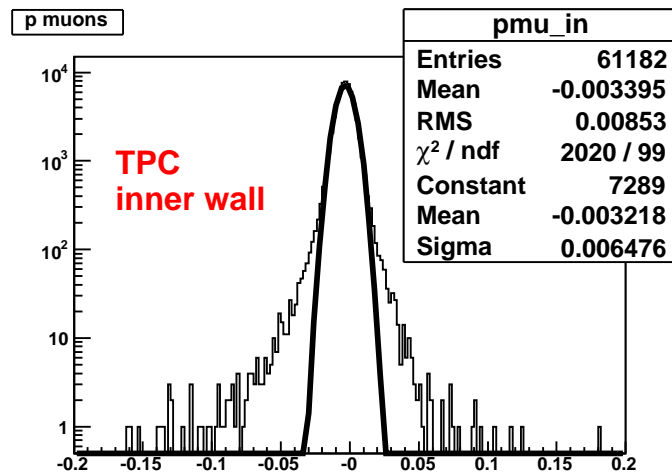
Momentum - 2

2 GeV MUONS: no kink, (ITS+)TPC+TRD refit

AliExternalTrackParam: momentum at different positions

$$\frac{p_{reco} - p_{mc}}{p_{mc}}$$

TRD information in ESD

TRD ESD structure: AliESDtrack.h

kNplane = 6   kNslice = 3

```
// TRACKING information
Int_t fTRDncls;                        // number of clusters assigned in the TRD
Int_t fTRDncls0;                       // number of clusters assigned in the TRD before
                                          first material cross ← getter missing!!

Float_t fTRDchi2;                      // chi2 in the TRD
Float_t fTRDBudget;                    // TRD material budget
Float_t fTRDQuality;                   // TRD quality factor for TOF
Int_t fTRDLabel;                       // MC label according to TRD


// PID information
Float_t fTRDsignal;                    // truncated mean of signals in 6 chambers
                                          (180 time slices)

Float_t fTRDsignals[kNPlane][kNSlice]; // TRD signal per plane, in 3 time slices each
Int_t fTRDTimBin[kNPlane];             // Time bin of Max cluster per plane
Float_t fTRDr[AliPID::kSPECIES];       // PID probabilities (e, μ, π, K, p)
```
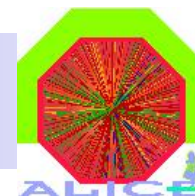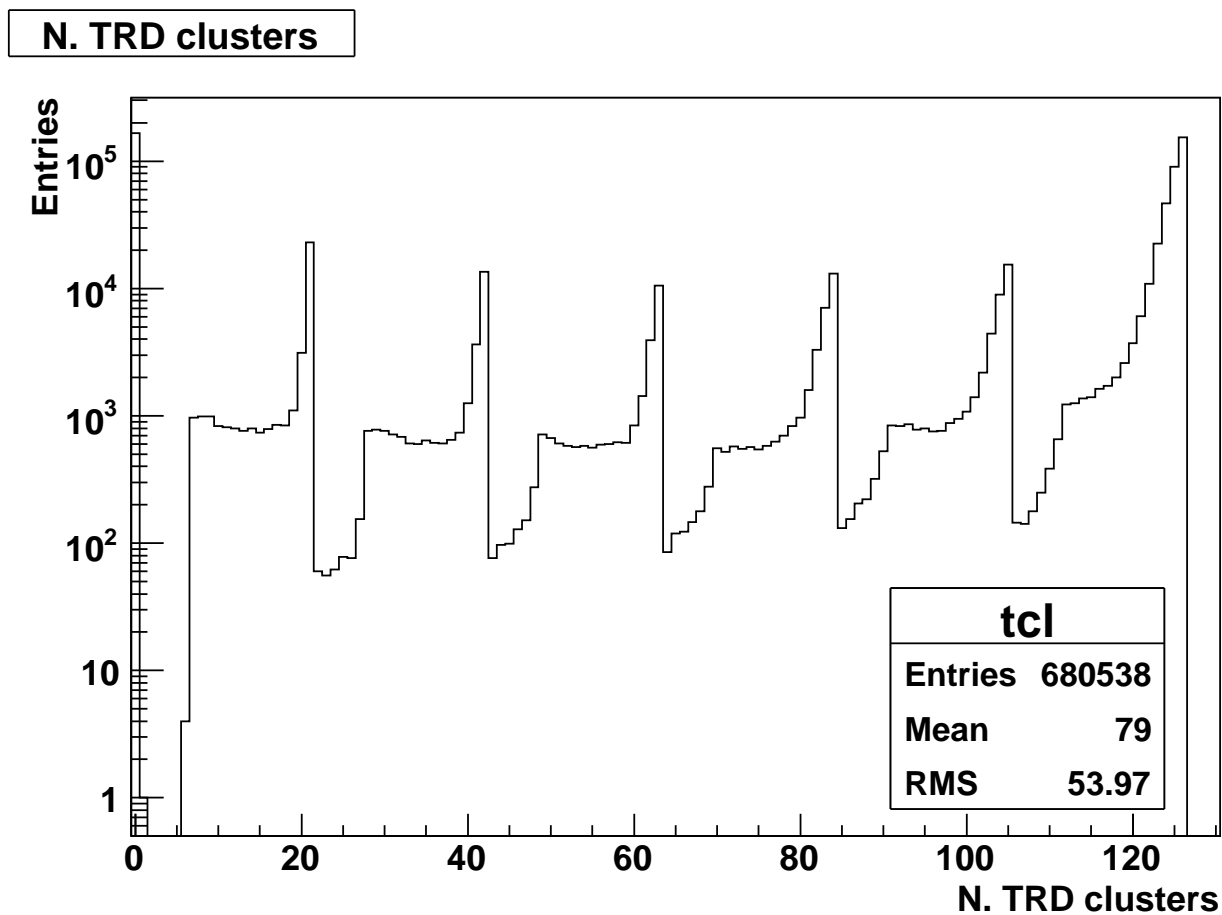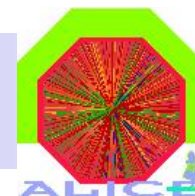
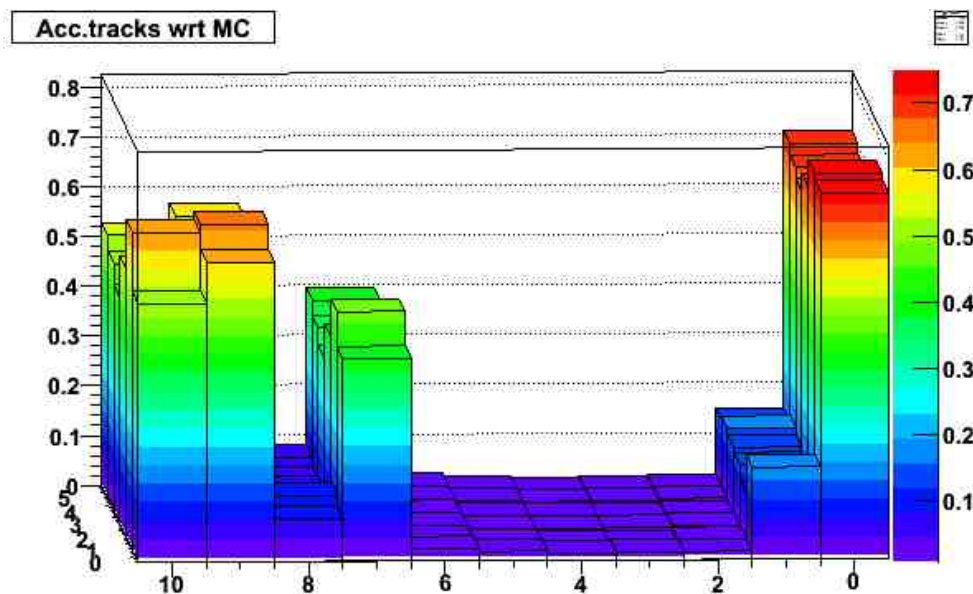# TRD tracking: ncls/track

TRD sample – 2 GeV: all ESD tracks

Track "Acceptance"

TRD sample (-1 $< \eta <$ 1), 2 GeV

| Criterion	all	$e^{\pm}$	$\mu^{\pm}$	$\pi^{\pm}$	$K^{\pm}$	$p^{\pm}$
no kink, vtx	.706	.730	.743	.708	.665	.687
only up to ITS+TPC refit	.146	.183	.105	.141	.143	.159
TRDout	.566	.606	.643	.569	.482	.532
TRDrefit	.530	.521	.630	.544	.459	.500

y=0 any ESD, no kink, close to vertex
y=1 up to ITS+TPC refit, then stop
y=2 up to layer 0
y=3 up to layer 1
y=4 up to layer 2
y=5 up to layer 3
y=6 up to layer 4
y=7 up to layer 5
y=8 in TRD with holes
y=9 TRDout
y=10 TRDrefit

x=0 electrons
x=1 muons
x=2 pions
x=3 kaons
x=4 protons
x=5 all

Acceptance wrt TRD
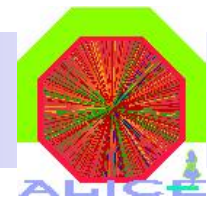
2 GeV
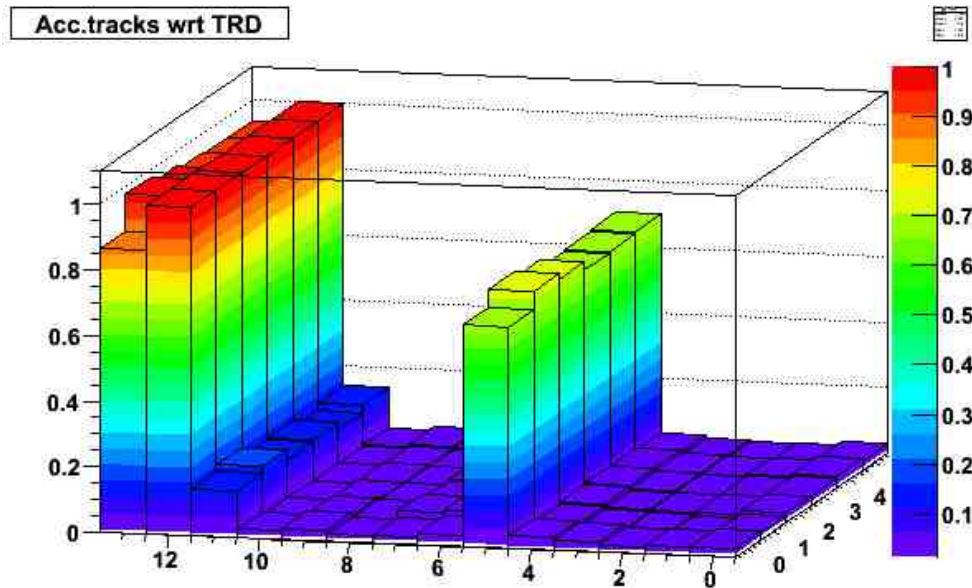
y=0 up to layer 0
y=1 up to layer 1
y=2 up to layer 2
y=3 up to layer 3
y=4 up to layer 4
y=5 up to layer 5
y=6 in TRD with 1 hole
y=7 in TRD with 2 holes
y=8 in TRD with 3 holes
y=9 in TRD with 4 holes
y=10 in TRD with 5 holes
y=11 all tracks in TRD with holes
y=12 TRDout
y=13 TRDrefit

x=0 electrons
x=1 muons
x=2 pions
x=3 kaons
x=4 protons
x=5 all

| Criterion	all	$e^{\pm}$	$\mu^{\pm}$	$\pi^{\pm}$	$K^{\pm}$	$p^{\pm}$
up to layer 0	.027	.027	.024	.028	.025	.031
up to layer 1	.022	.022	.016	.023	.027	.026
up to layer 2	.021	.021	.011	.020	.025	.033
up to layer 3	.027	.029	.015	.030	.028	.032
up to layer 4	.036	.035	.028	.036	.041	.043
up to layer 5	.706	.685	.731	.719	.691	.699
1-5 holes	.142	.146	.167	.128	.143	.114

TRD tracks with holes
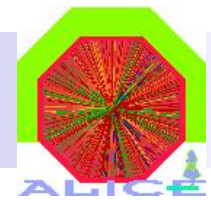
About 15% of TRD tracks have "holes"
no signal in an intermediate layer

θ_{MC} of

matched

primary

MC track

2 GeV μ: no kink, ITS+TPC+TRD refit, close to primary vertex
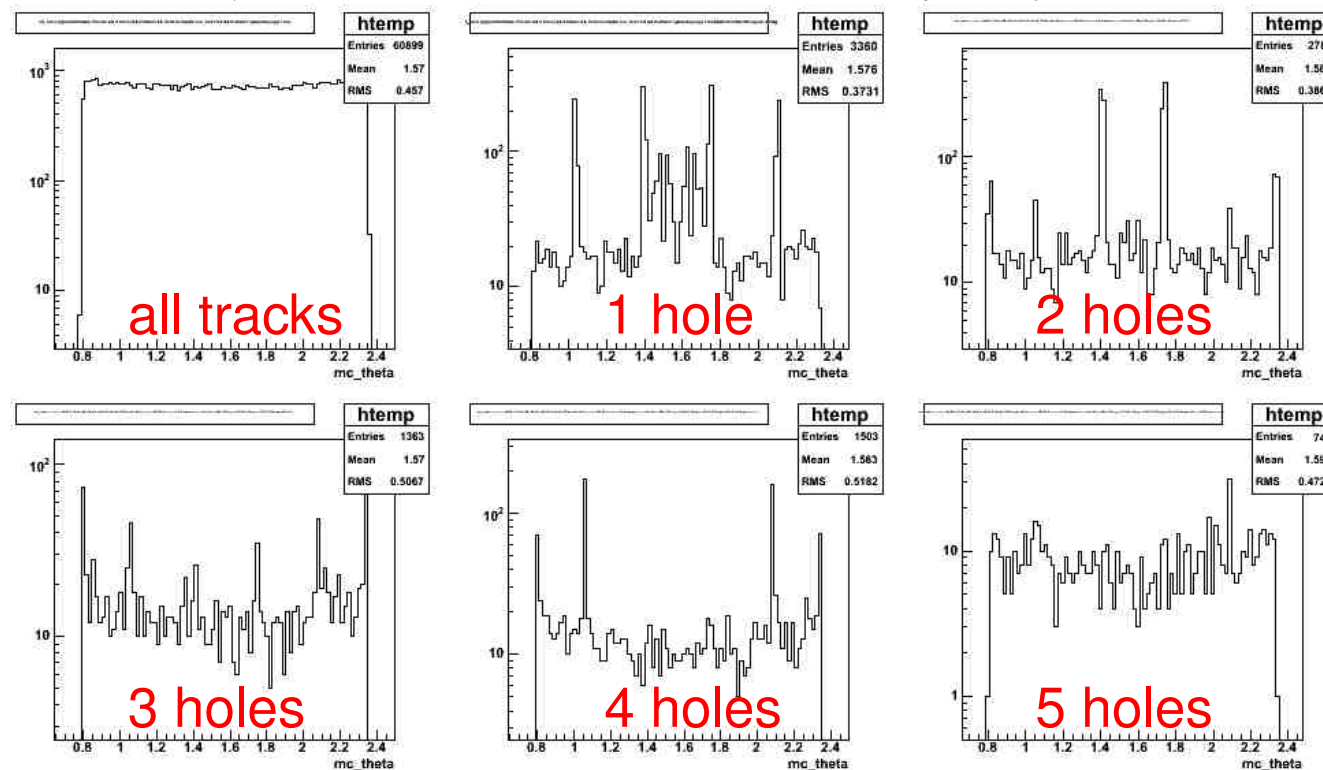
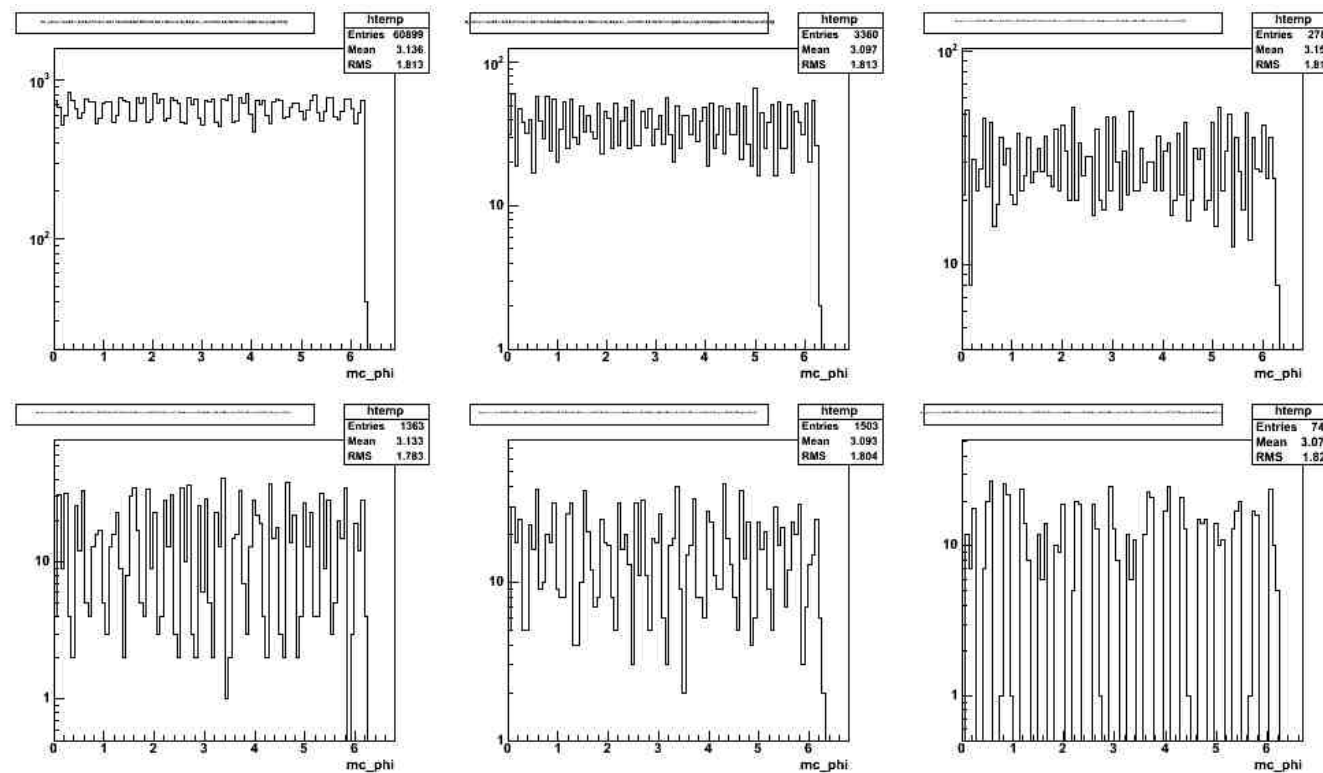**Holes are related to spaces between stacks (along z) and ...**

Holes 2

Distribution in ϕ

2 GeV μ: no kink, ITS+TPC+TRD refit, close to primary vertex

ϕ_{MC} of

matched

primary

MC track

... spaces between sectors (in ϕ)

TRD PID basics

Principles: see Christoph Blume's talk at last Offline Week

http://indico.cern.ch/materialDisplay.py?contribId=4&sessionId=2&materialId=slides&confId=a056303

Probability calculation:

ESD track → dE/dx per layer
→ time bin with maximum signal per layer

are compared to reference distributions stored in the database:

(11 momentum bins)

$\times$

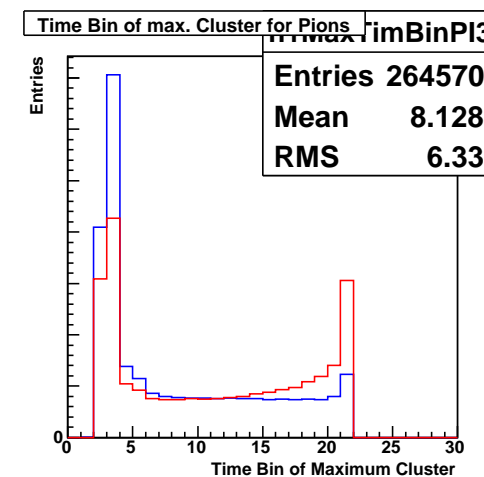((dEdx for 5 particle species e, μ, π, K, p) + (TimBin for e, π))
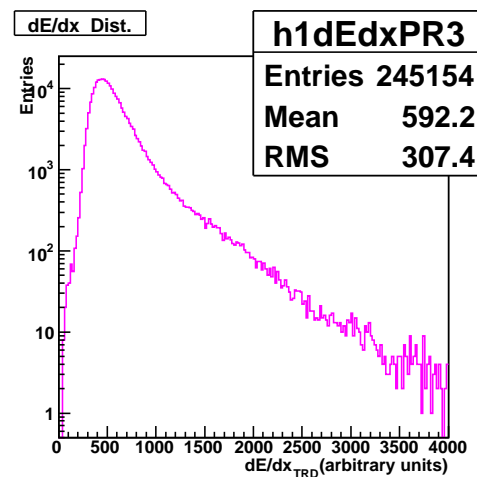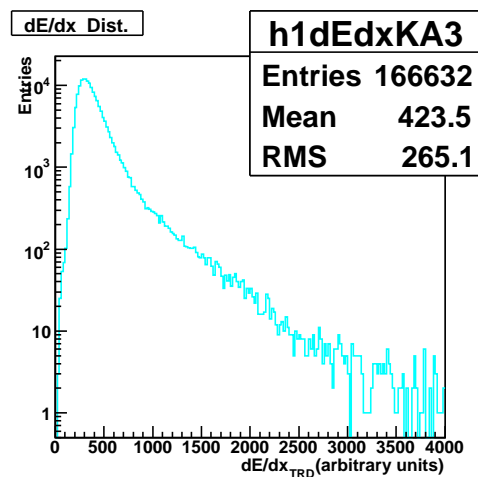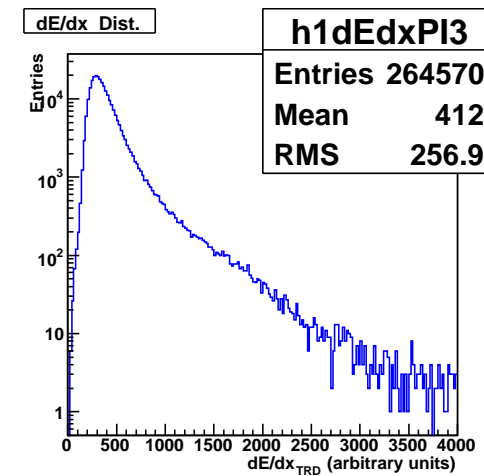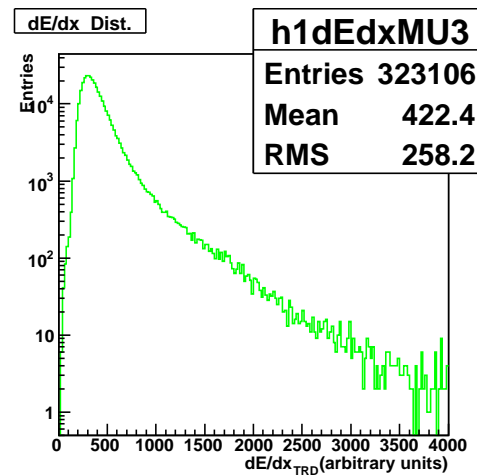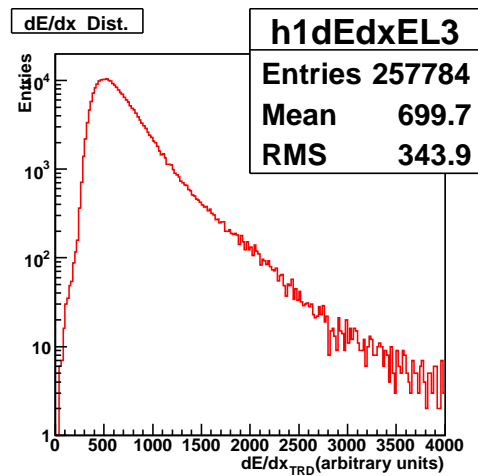
_____

77 histograms

Wrong histograms were loaded in the database for some time
TRD (and combined) PID make no sense in PDC06 event up to August 10

DB: dE/dx and Time Bin
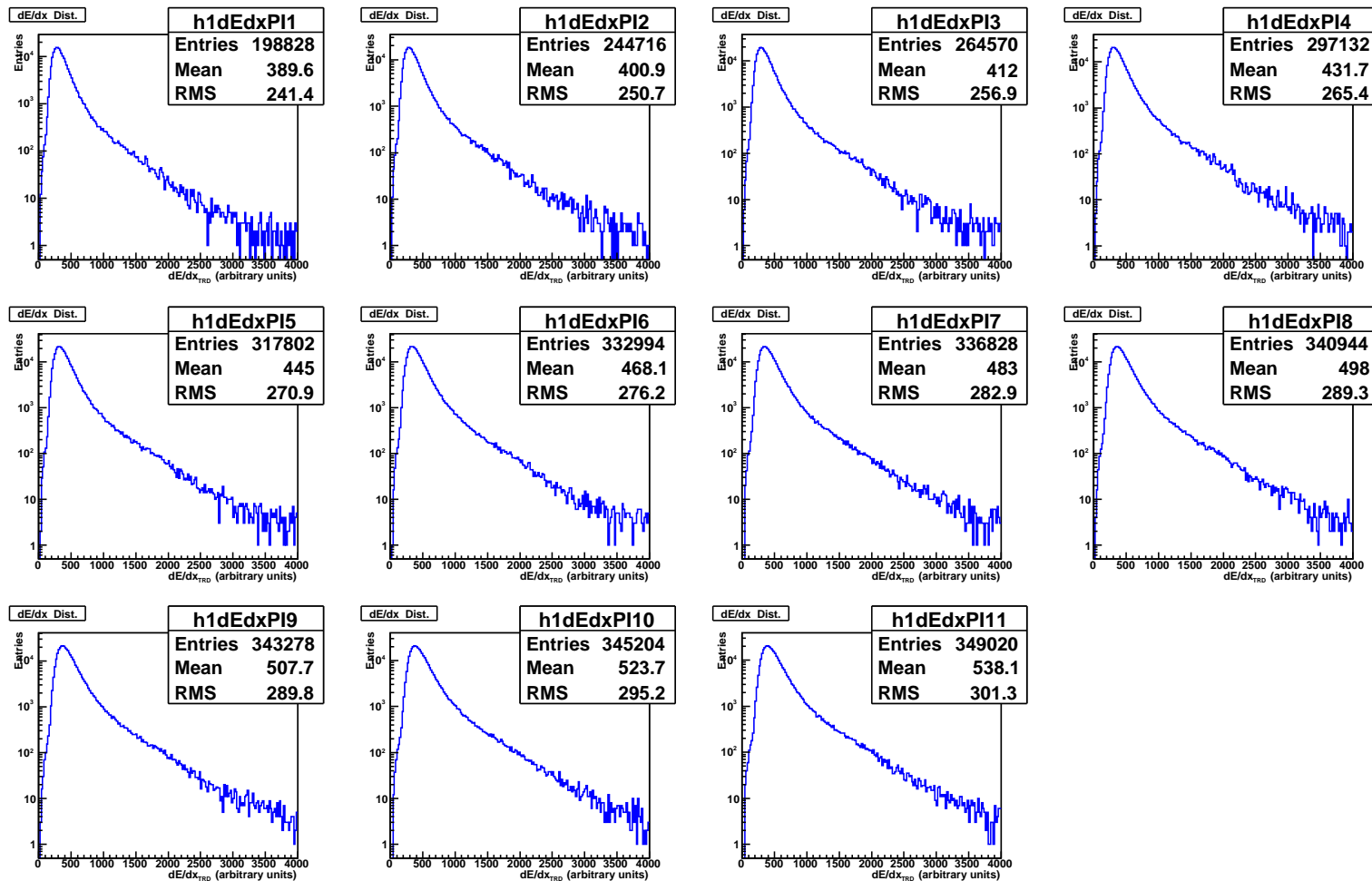
Momentum: 1 GeV
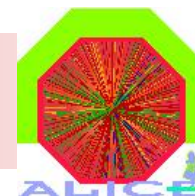Different particle species

DB: dE/dx vs momentum

Pions
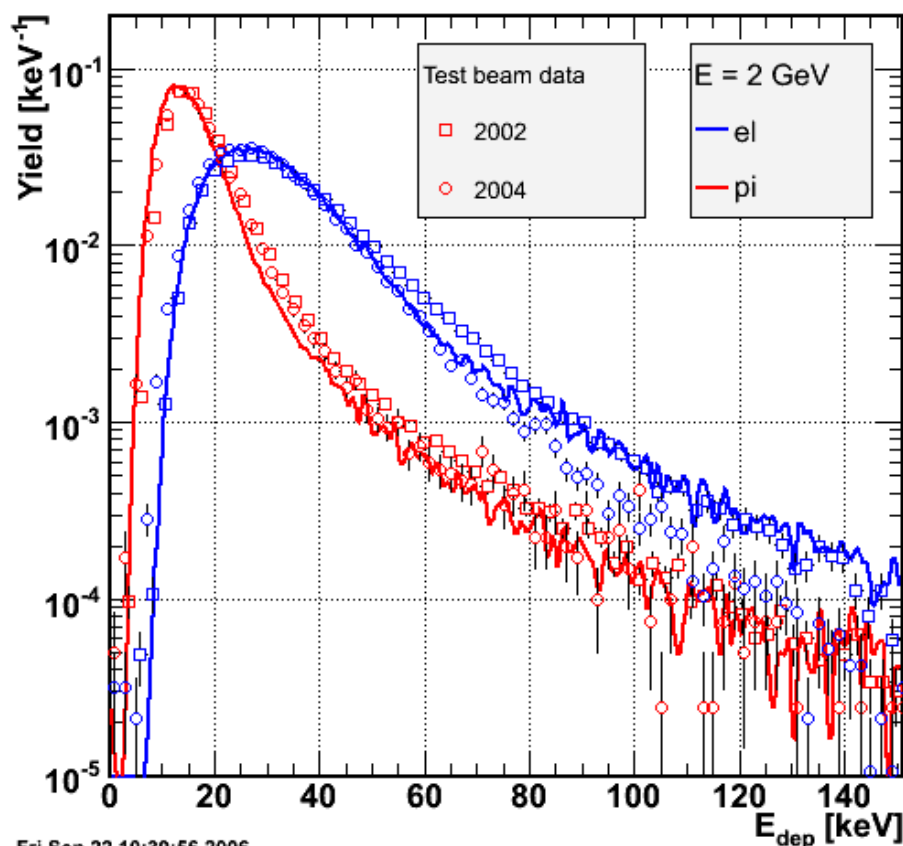Momentum values: 0.6, 0.8, 1, 1.5, 2, 3, 4, 5, 6, 8, 10 GeV

Energy loss

Important improvements in the simulation
Change from custom code to official GEANT3 v1-6 (AliRoot HEAD)
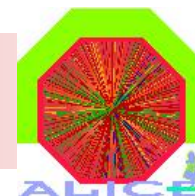### Alex Bercuci - GSI Darmstadt

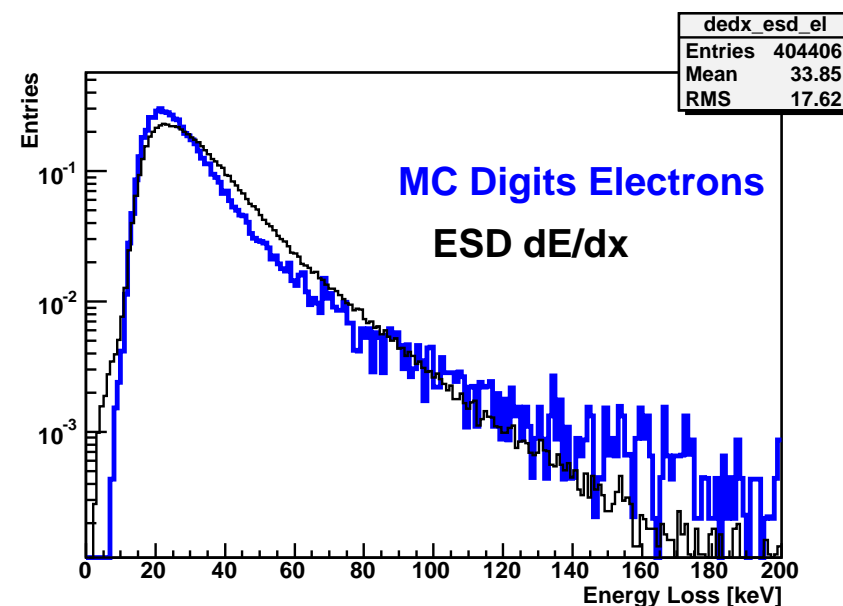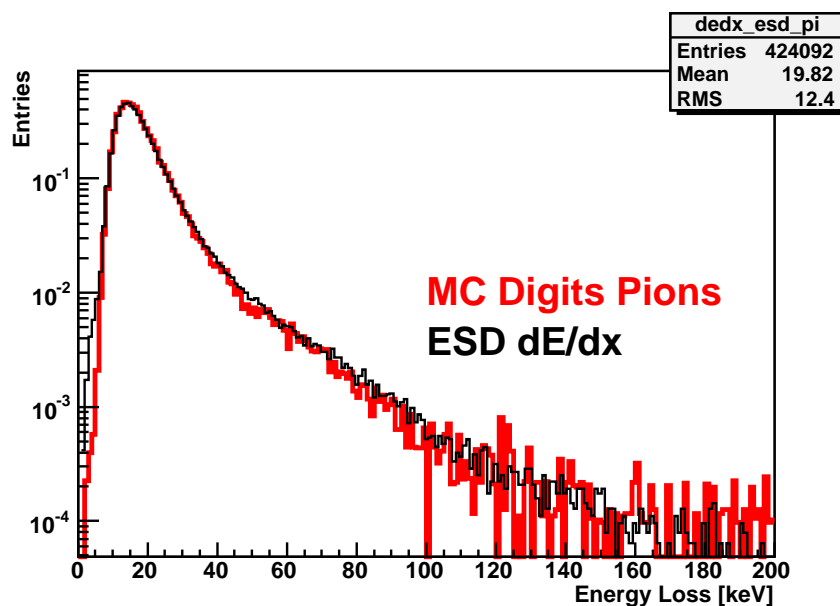Comparison of the newest simulations with test beam data

A. Bercuci

Energy loss, ESD

Comparison with reconstructed tracks

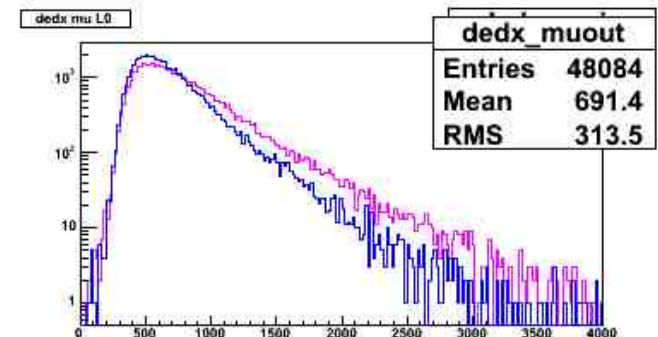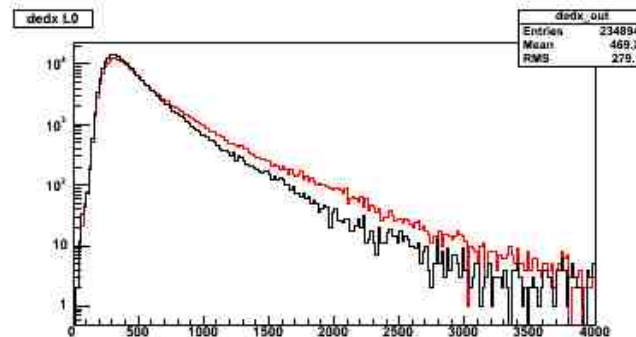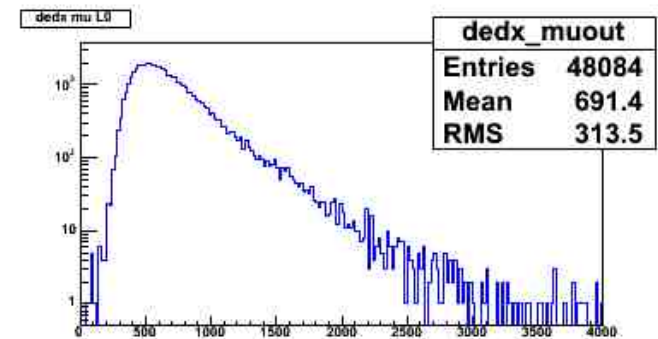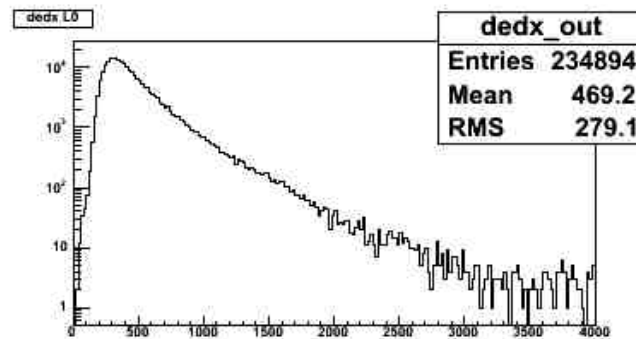**2 GeV pions and electrons.** ESD: ITS+TPC+TRD refit, vtx

TRD charge/length

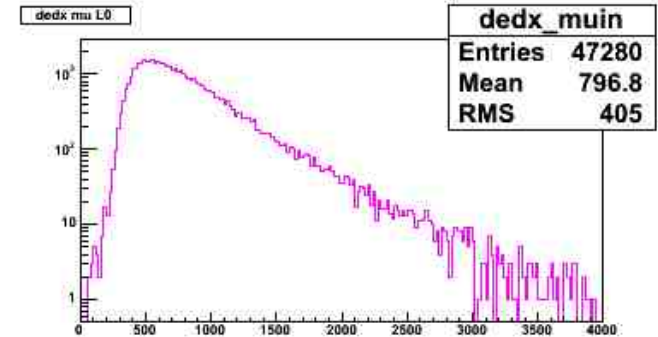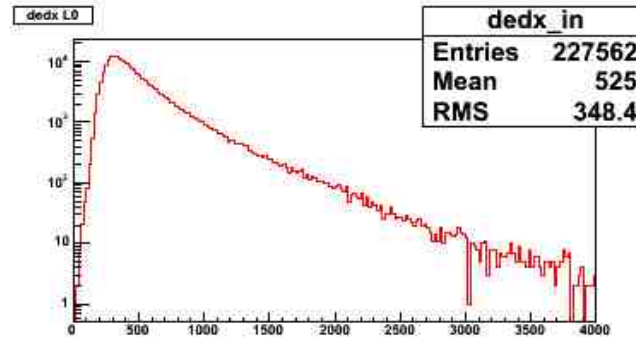2 GeV (left:all, right:muons)
no kink, ITS+TPC+TRD refit,
close to primary vertex

tracks with signal
in 6 chambers

IN= $|\theta_{MC} - \pi/2| < 0.15$
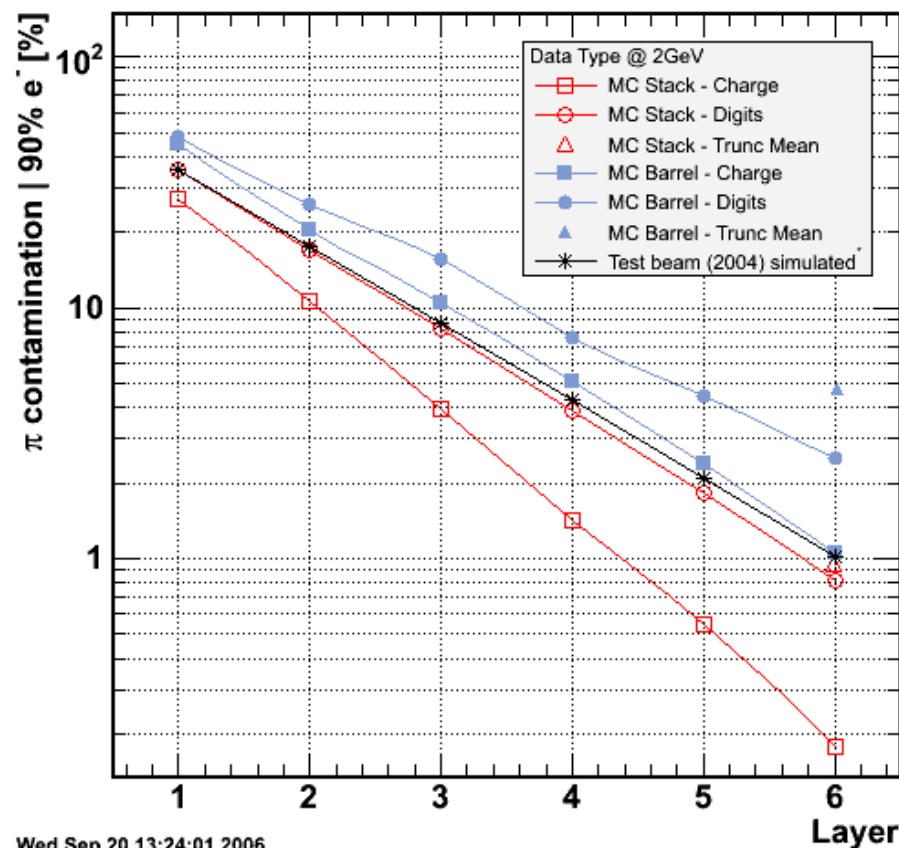
OUT= $|\theta_{MC} - \pi/2| > 0.62$
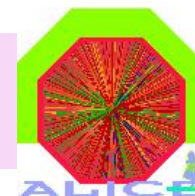
PID performance
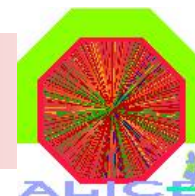
- Basic checks in progress (test beam, simulation, reconstruction)

- Many studies on-going, rethinking of the whole phylosophy

- Current expectation
  for pion contamination:

A. Bercuci

PDC06 checks

TRD systematic checks (Sylwester Radomski, Hd)

1. TECHNOLOGY

   – The programs run on a host in Hd
   – Data access: from AliEn or from a local disk
   – Data processing via TSelector scheme
     Data are processed run by run
   – Results are displayed on a web-page, built with PHP

2. RESULTS

   – http://www.physi.uni-heidelberg.de/ř̃adomski/index.php

3. COMMENTS

   – Numbering scheme? Repetitions! (run_number/sample/100_events)
   – ESD features under study

ESD Track Status Bits
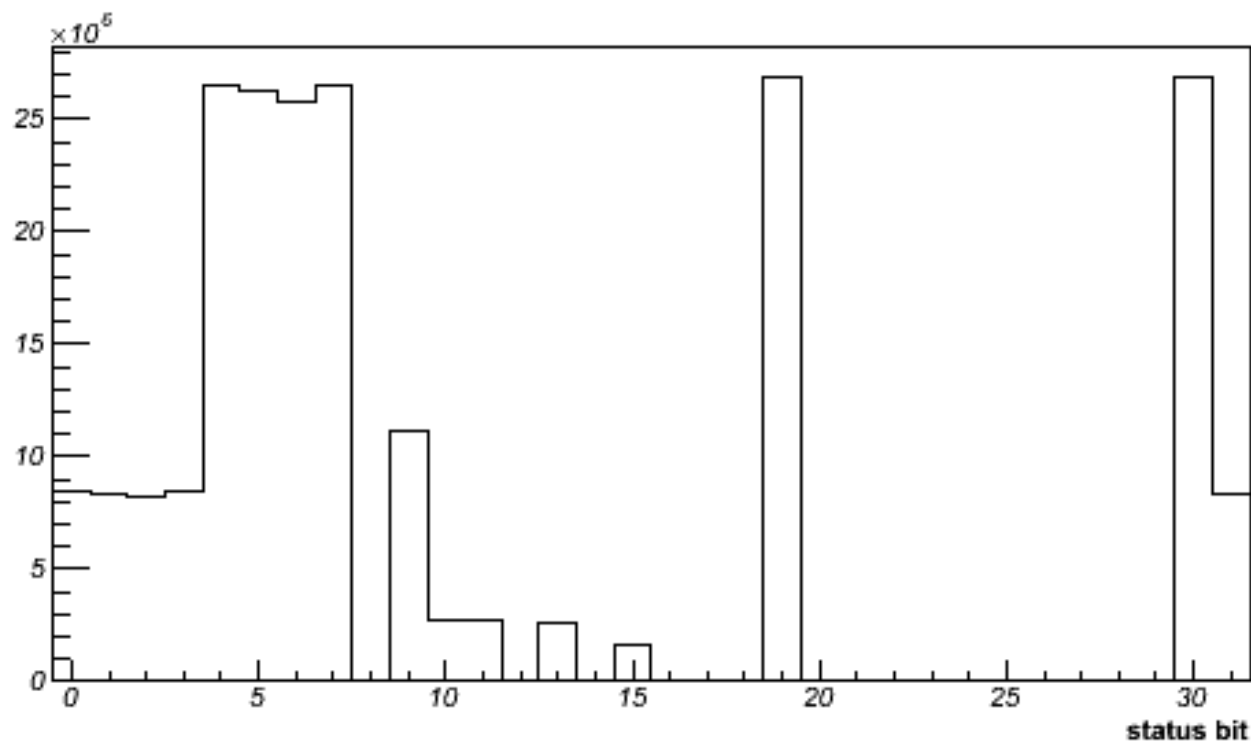
bits 0-3: ITS in, out, refit and pid
bits 4-7: TPC in, out, refit and pid
bits 8-11: TRD in, out, refit and pid

Monitor, compare with other samples.
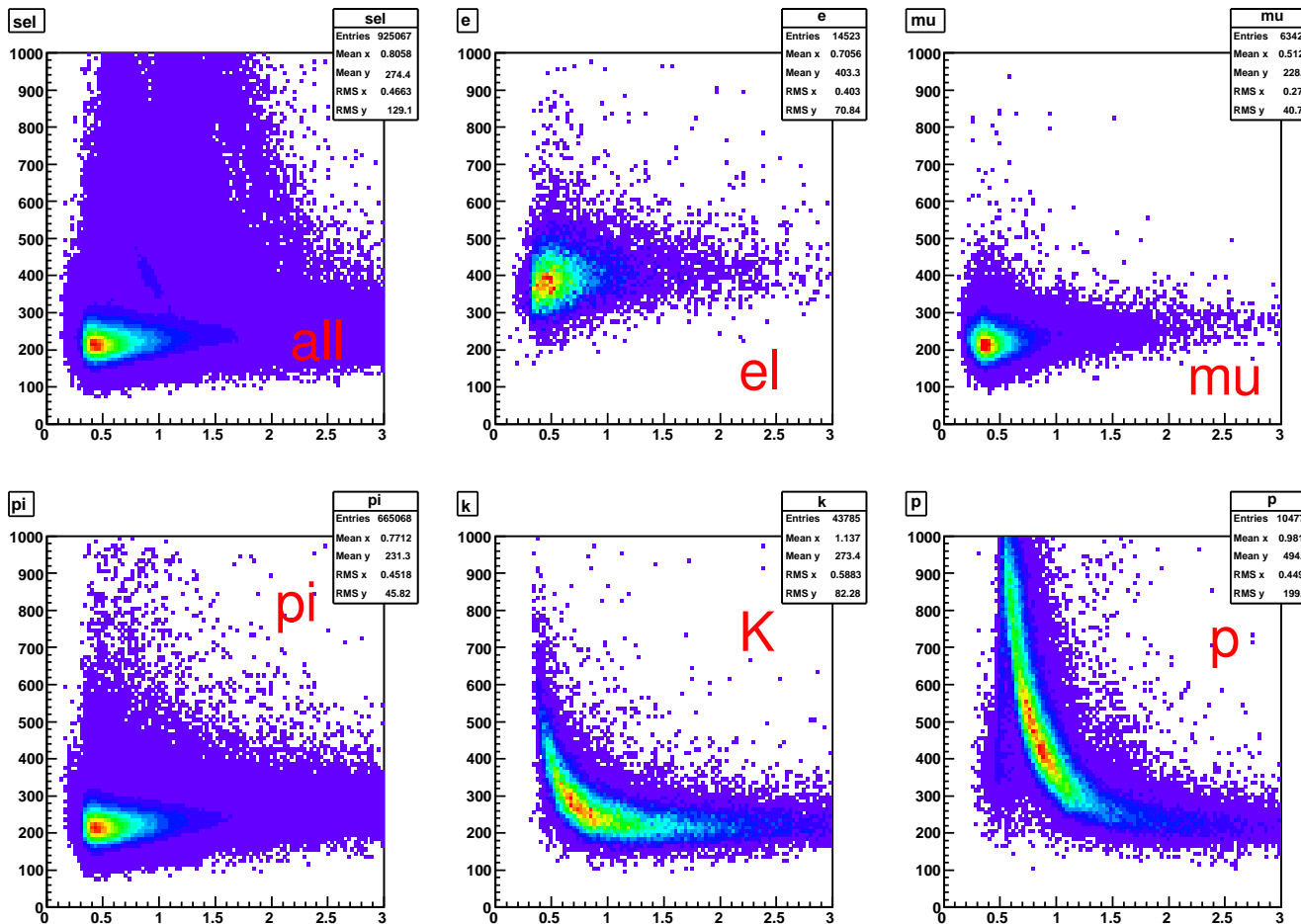**Large reduction from TRDout to TRDrefit, TRDpid expected?**

PDC06 - PID

TRD Truncated Mean Signal vs momentum

All - (electrons,muons,pions,kaon,protons)

sel	
Entries	33492
Mean x	0.7993
Mean y	270.3
RMS x	0.4658
RMS y	123.9
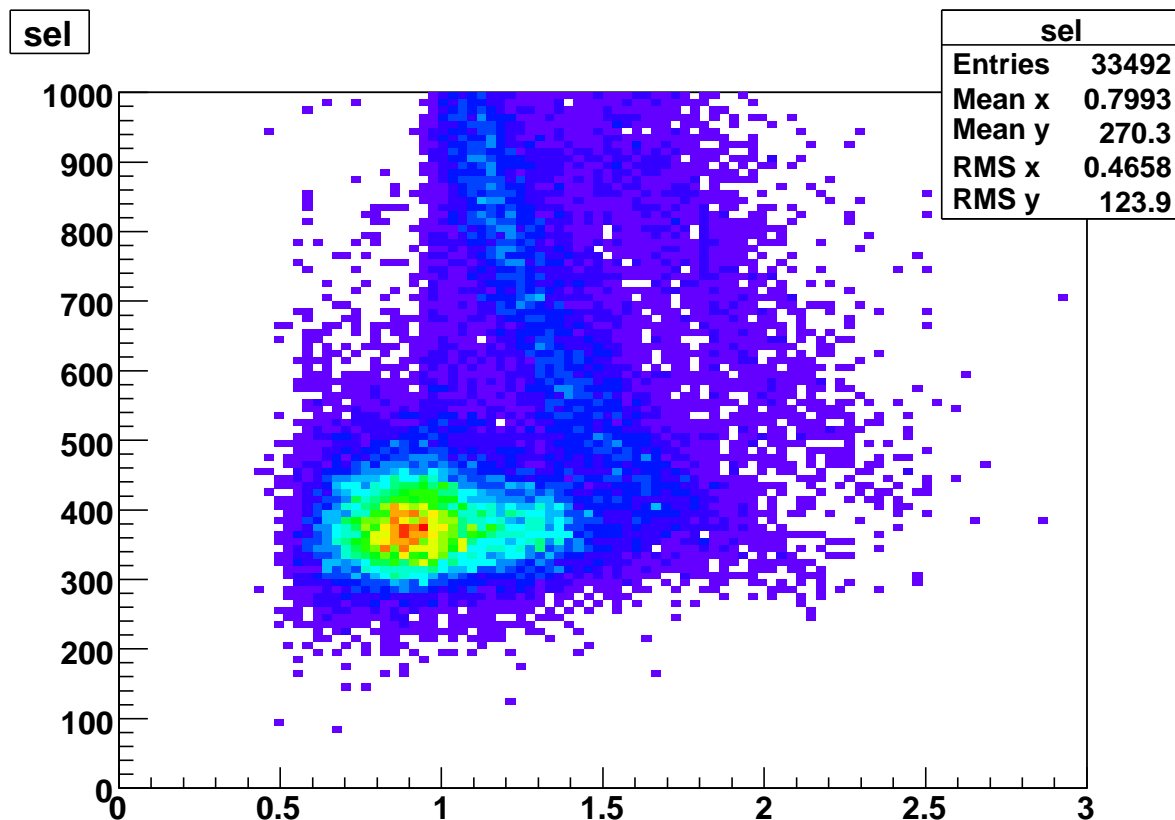
(1.3%) 10010020: Deuteron
(0.5%) 10010030: Triton
(0.01%) 10020040: Alpha

fractions wrt all ESD entries

Mostly have high electron probability, ACTION NEEDED!!!

SUMMARY

- **First Look at ESD Track Global Features**

  Few open questions, Examples to guide the non-expert user needed

- **Checks on TRD Information in ESD**

- **Studies on Energy Loss in TRD**

  Improvements in simulation, better understanding

  Good agreement with test beam data

- **Improvements of PID calculation**

  Test new strategies

  Parallel work from simulation and reconstruction sides

- **Systematic checks on PDC06 events started**