

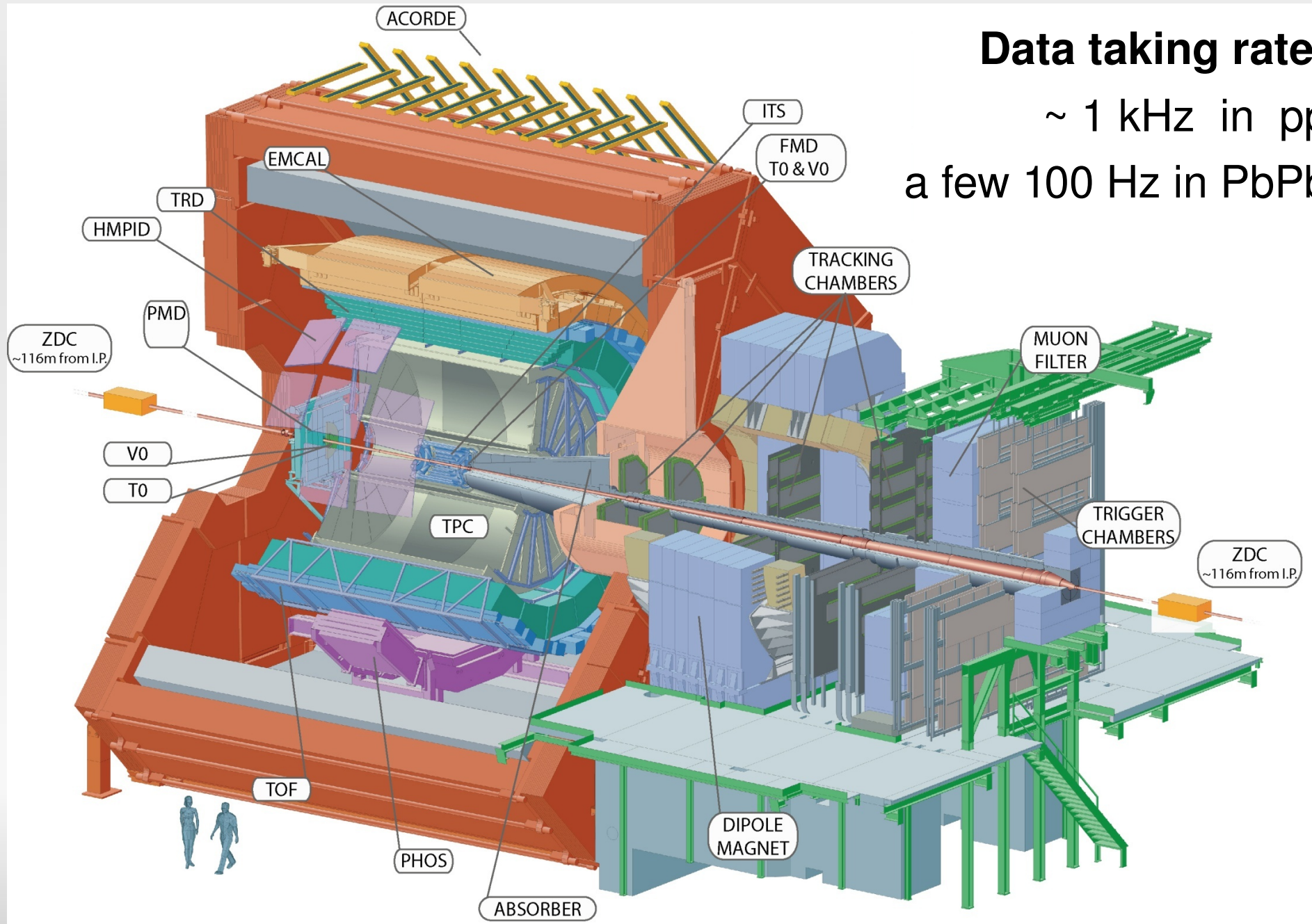
**Stefan Rossegger**

TPC Analysis Jamboree – Orsay (May 2009)

# ALICE TPC status

Following slides mainly from  
**QUARK MATTER talk (2009)**  
with permission from the presenter,  
**JENS WIECHULA**

# ALICE – A Large Ion Collider Experiment – at LHC



# The ALICE Time Projection Chamber

## in numbers

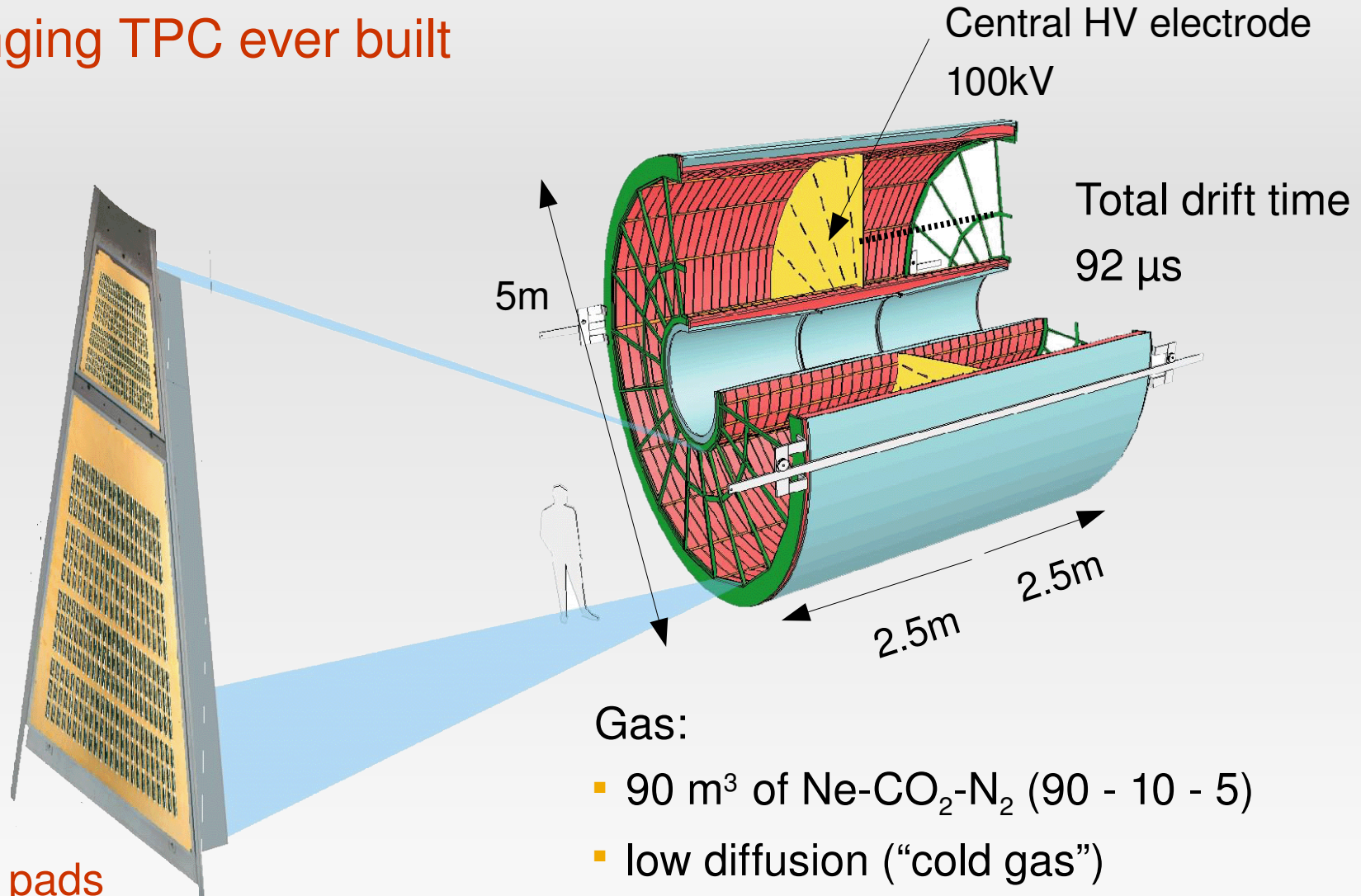
Most challenging TPC ever built

2x18 Inner  
Readout  
Chambers

2x18 Outer  
Readout  
Chambers

557568 readout pads

1000 samples in time direction



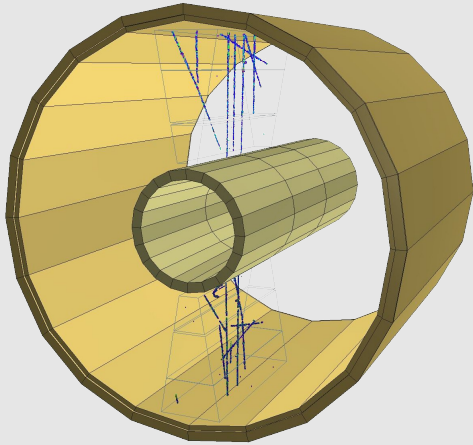
Gas:

- 90 m<sup>3</sup> of Ne-CO<sub>2</sub>-N<sub>2</sub> (90 - 10 - 5)
- low diffusion (“cold gas”)
- drift velocity non saturated
  - temp. stability of 0.1K required

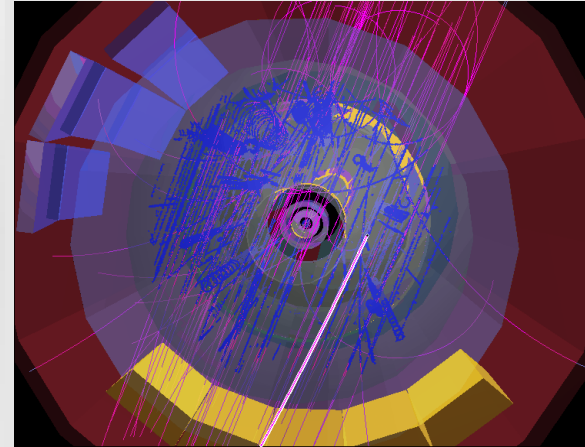


# Commissioning

## Milestones



- transport to experimental area
- ITS integration
- commissioning of one readout side with final services



- Further improvements

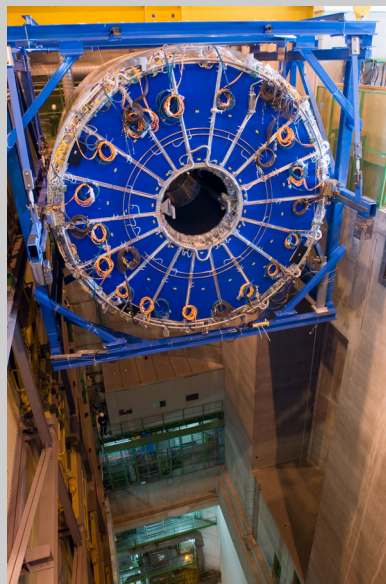
→ 2006

2007

2008

2009

- completely assembled
- first commissioning of sector pairs



- commissioning of complete TPC with final services
- running under final conditions over several months
- extensive calibration runs

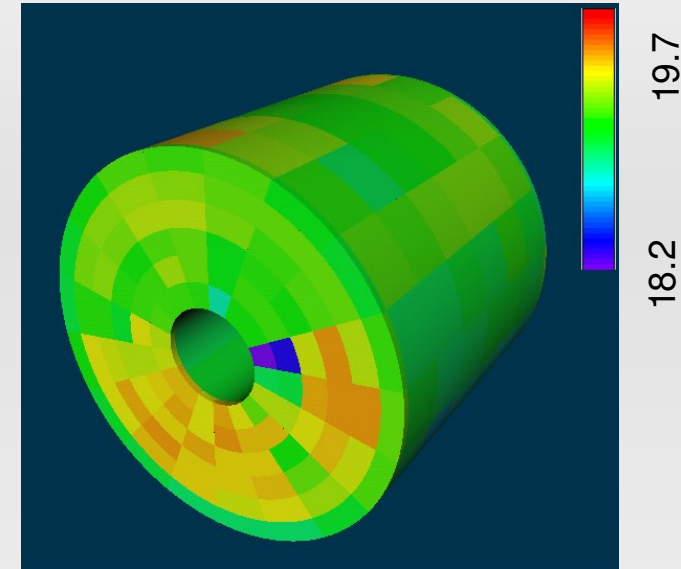
Ready for collisions



# Detector operation

Complex cooling system to equalise TPC temp.

- About 60 adjustable cooling circuits
- cooling of ROC bodies and RR
- FEE enveloped in copper plates ( $\approx 27\text{kW}$ )
- thermal screens towards ITS and TRD

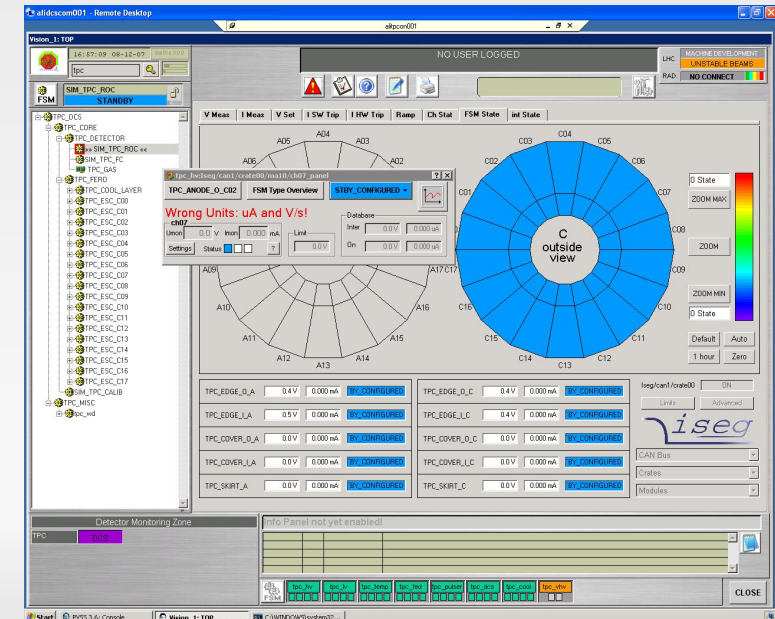


Detector Control System (DCS)

- TPC completely steerable from DCS
- successful integration into the overall Experiment Control System

Drift Voltage system & Readout chambers

- stable operation since 2006



19.7  
18.2

# TPC Calibration

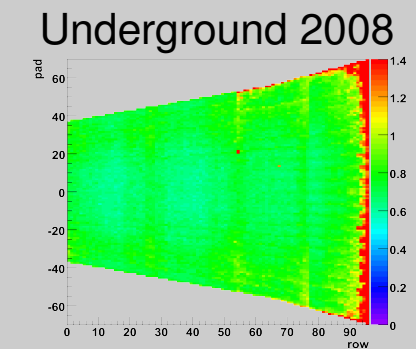
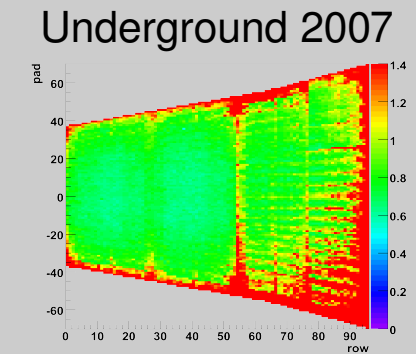
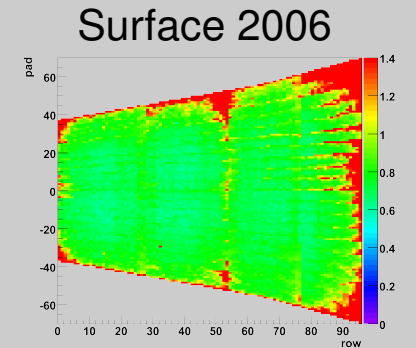
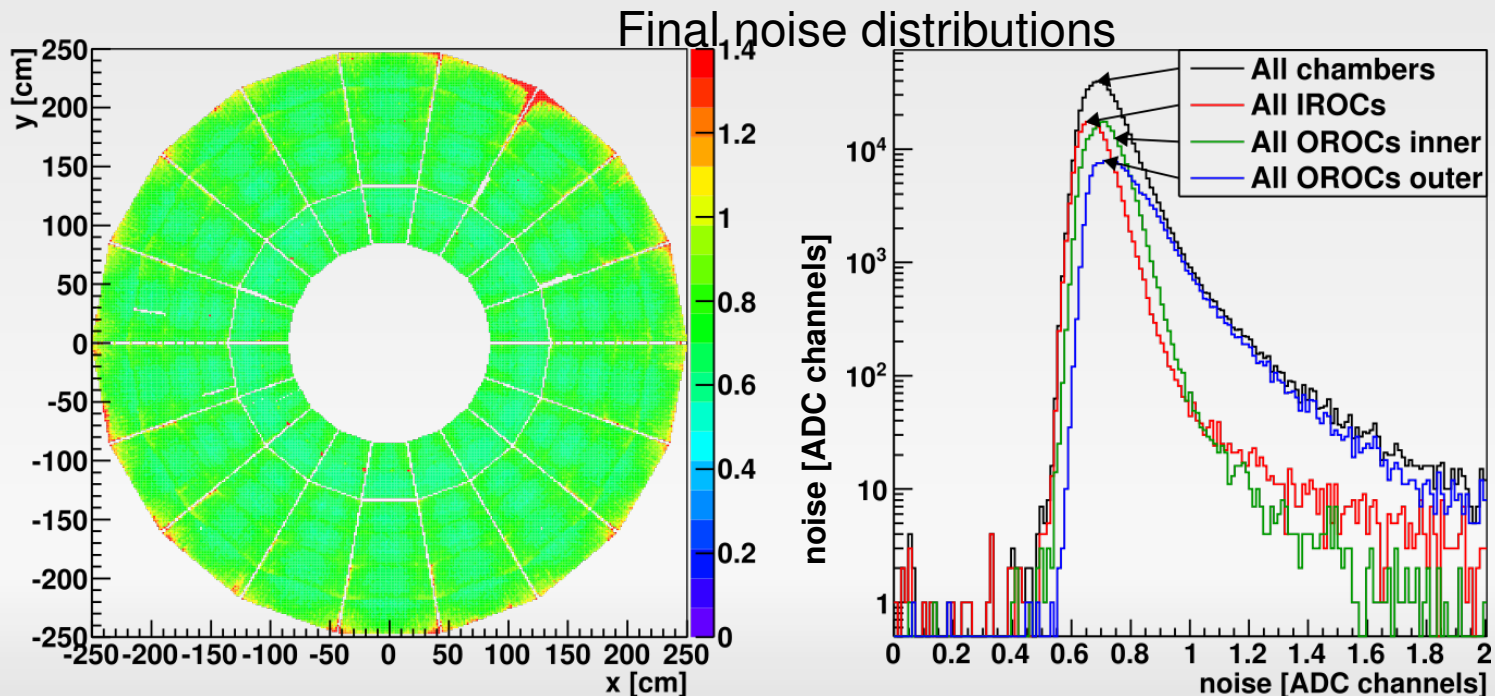
## Noise measurements

Many sources of noise identified and eliminated during the different commissioning phases

Design goal (mean): 1 ADC channel (1000 e)

Achieved (mean): 0.7 ADC channels (700 e)

Zero suppressed (ZS) data volume (empty events) stably below 70kB (non-ZS data volume ~700MB)



# TPC Calibration

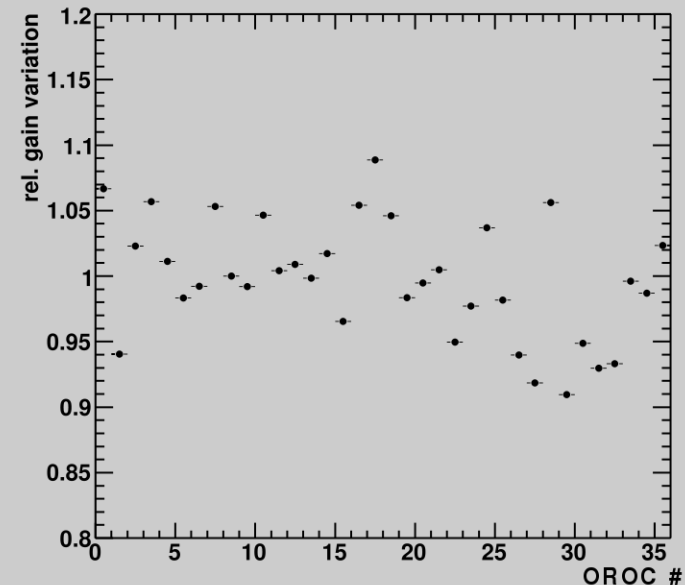
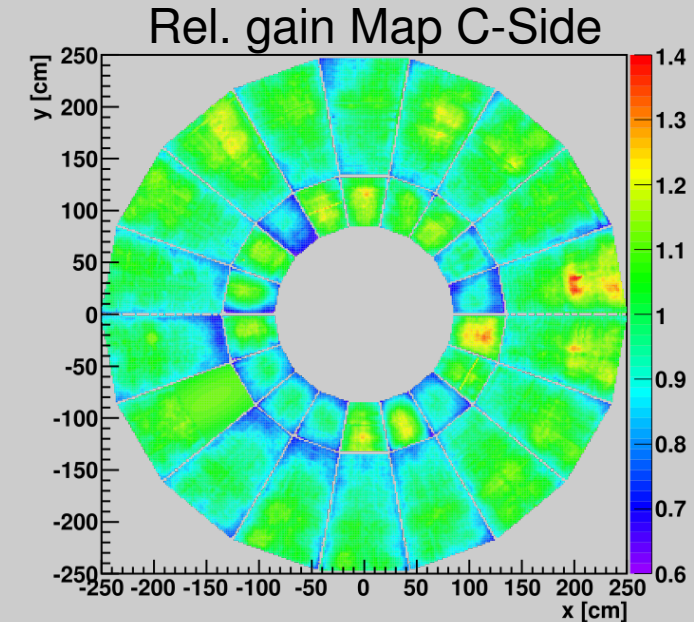
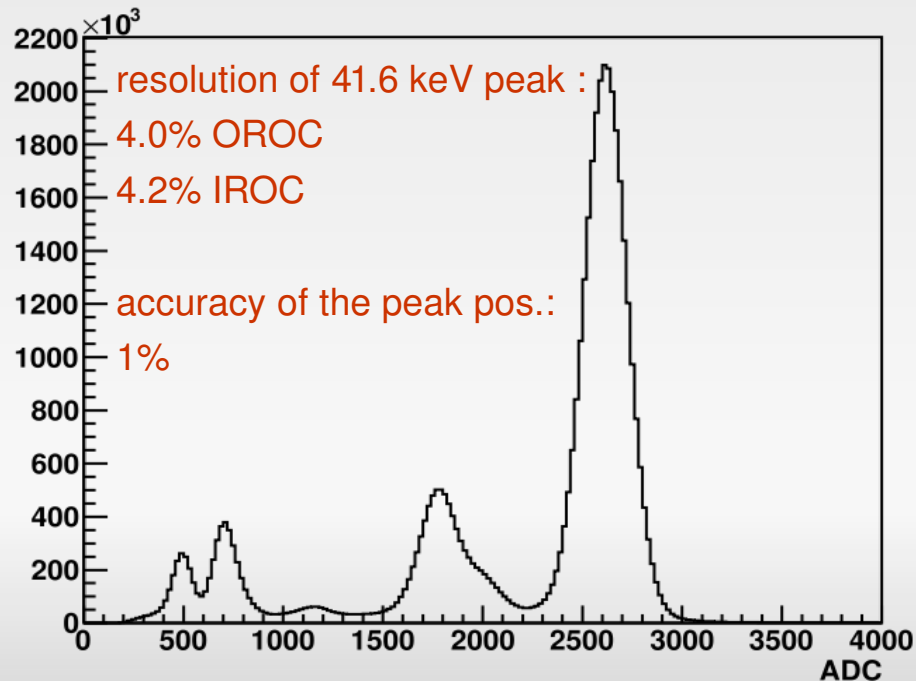
## Gain calibration using $^{83}\text{Kr}$ decays

High statistics:  $10^7$ - $10^8$  Krypton decays at three different voltage settings

Gain Variations within production tolerances

Krypton runs will be repeated after electronics maintenance

Gain calibration done on the single pad level





# TPC Calibration

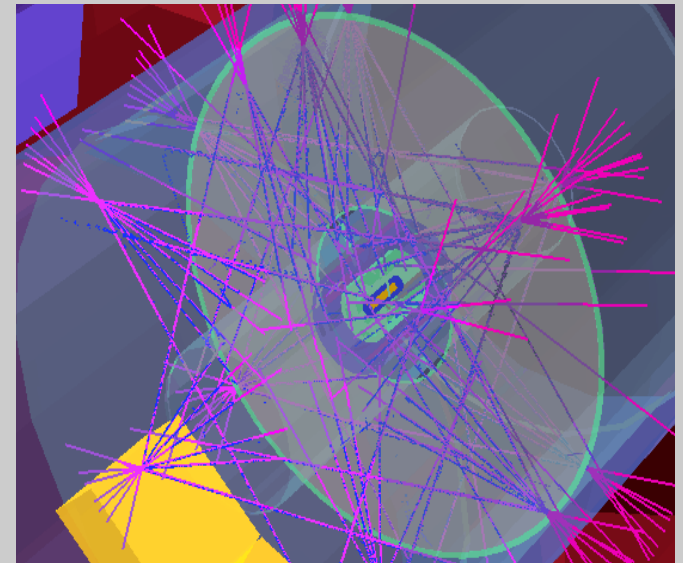
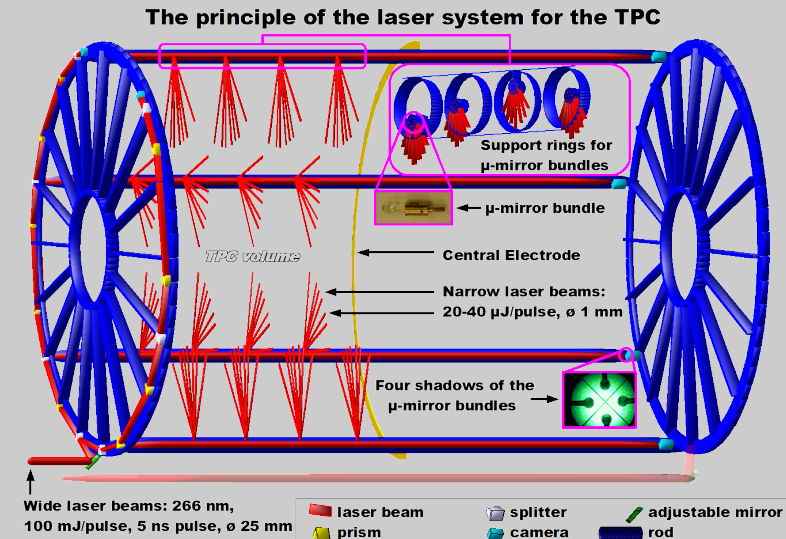
## Laser system

### Available for studies:

- 336 Laser beams
- photo electrons from Central Electrode

### Used for:

- drift velocity measurements
- ExB correction
- alignment studies



# TPC Calibration

## Drift velocity gradient and ExB effect

### Central Electrode:

- monitor drift velocity gradient
- determine gain of edge pads
- cross-check sector alignment

$$\Delta v_d / v_d \approx 0.3\% \Rightarrow \Delta T_{\max} \approx 1\text{K (achieved 0.3 K)}$$

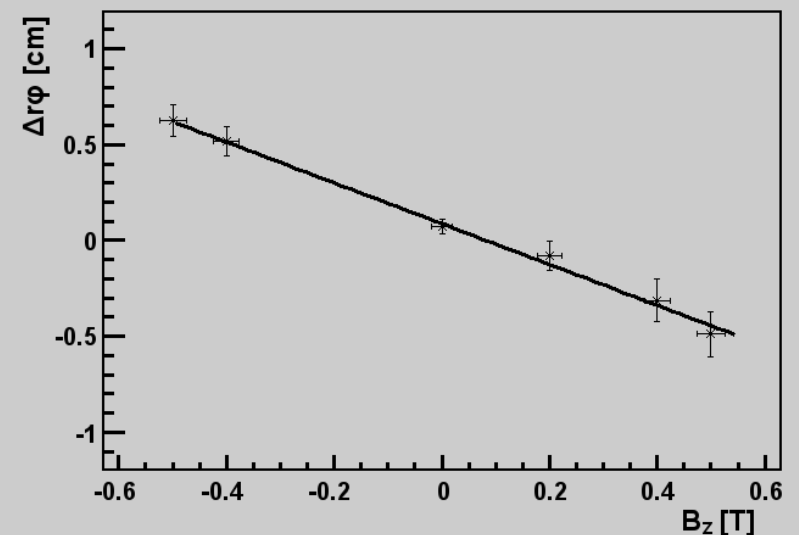
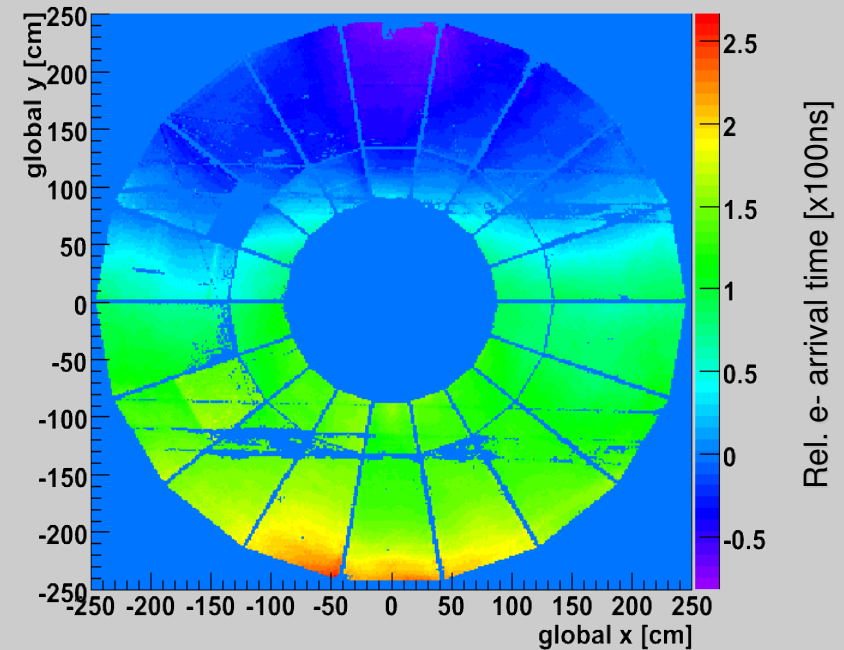
Confirmed by T-sensors inside TPC.

Before temperature stabilization

### ExB effect:

- determine ! r
- measurements done for several field settings
- verify correction map

$v_{rr} \approx 7\text{mm}$  for nominal field and longest drift



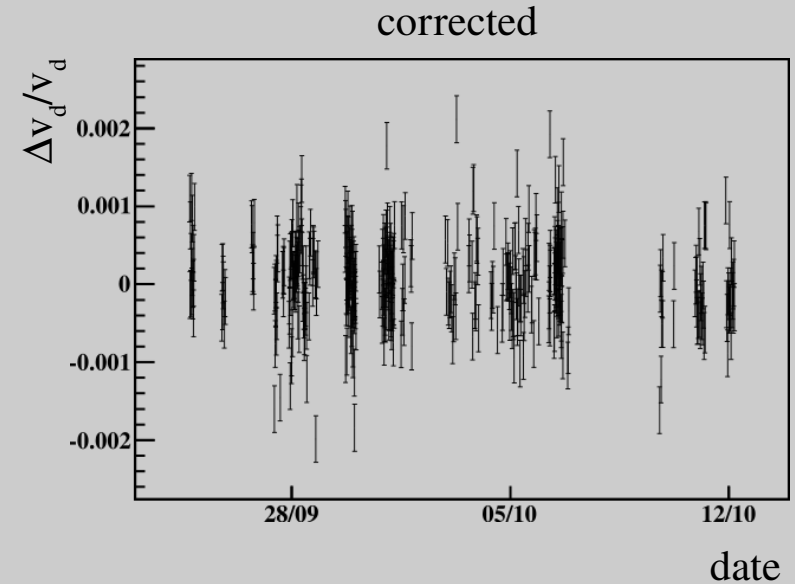
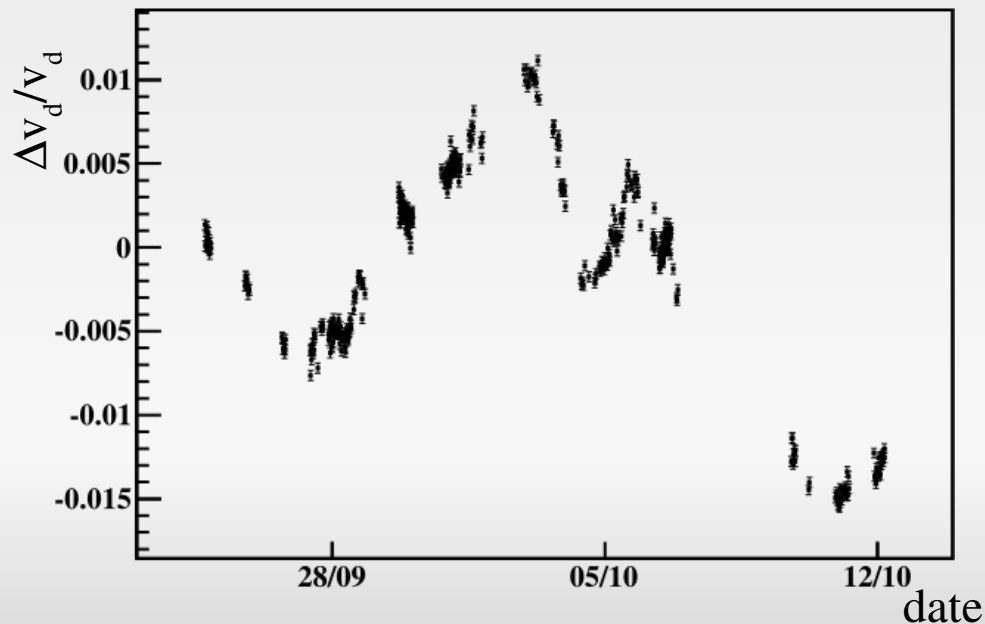
# TPC Calibration

## Drift velocity measurements

Drift velocity calibration very crucial for track matching with other detectors.

Several methods available (redundancy):

- TPC laser system
- track matching between both readout sides
- ITS-TPC track matching
- drift velocity monitor



Required accuracy:  $10^{-4}$   
achieved by update every  $\sim 1$ h



# TPC performance

## Space point resolution

Space point resolution depending on

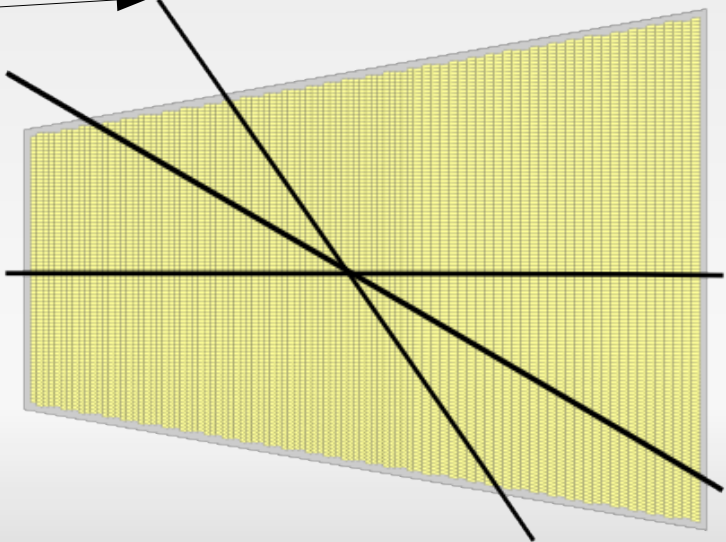
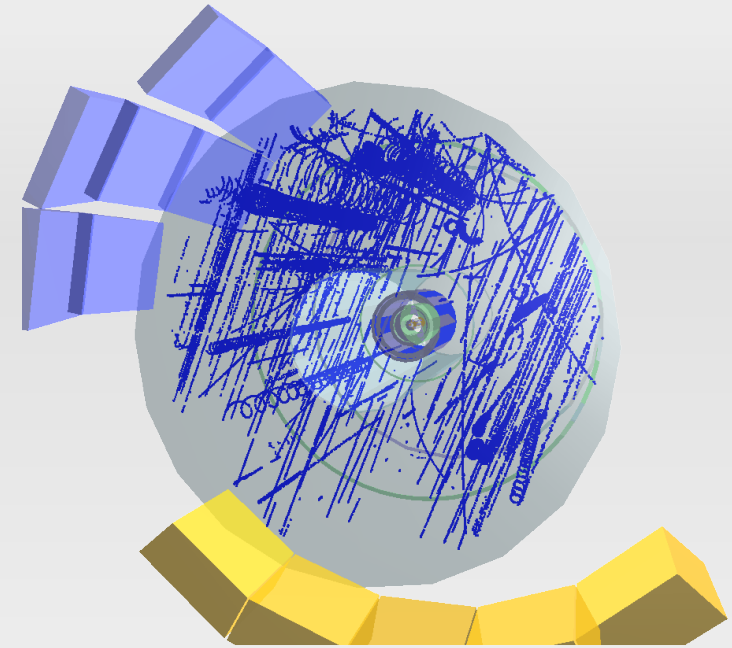
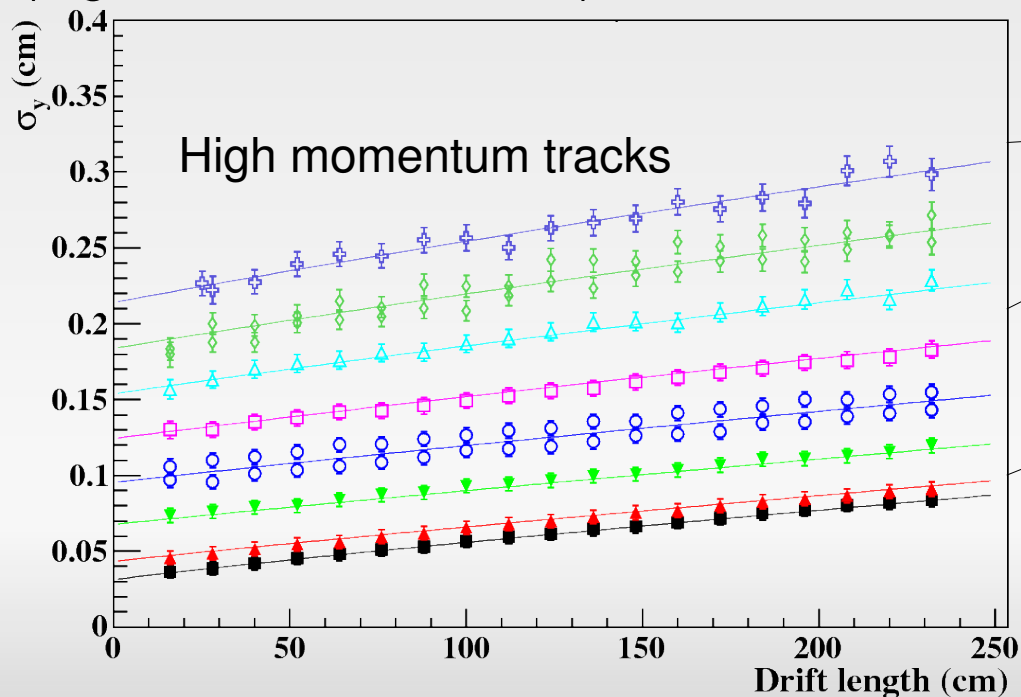
- drift length (diffusion)
- pad inclination angle (ideally close to zero)

Measurements in agreement with simulations:

space point resolution in  $r_s$  is 300 – 500  $\mu\text{m}$

for small inclination angles

(high momentum tracks)

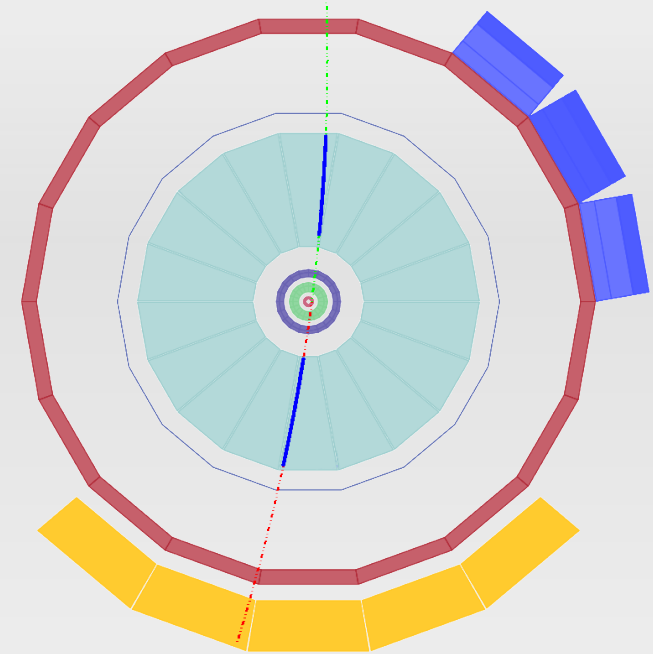


# TPC performance

## momentum resolution

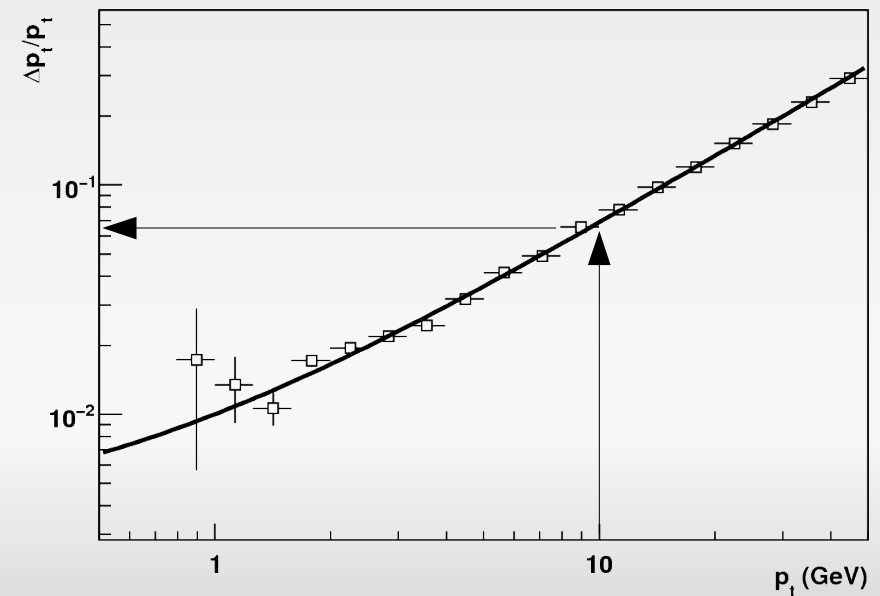
### Resolution determination

- cosmic muons reconstructed as two tracks
- use relative track information at vertex
- $\sim 5 \times 10^6$  events available



### $p_t$ resolution

- measured: 6.5% at 10 GeV  
~1% below 1 GeV
- design value: 4.5% at 10 GeV



# TPC performance

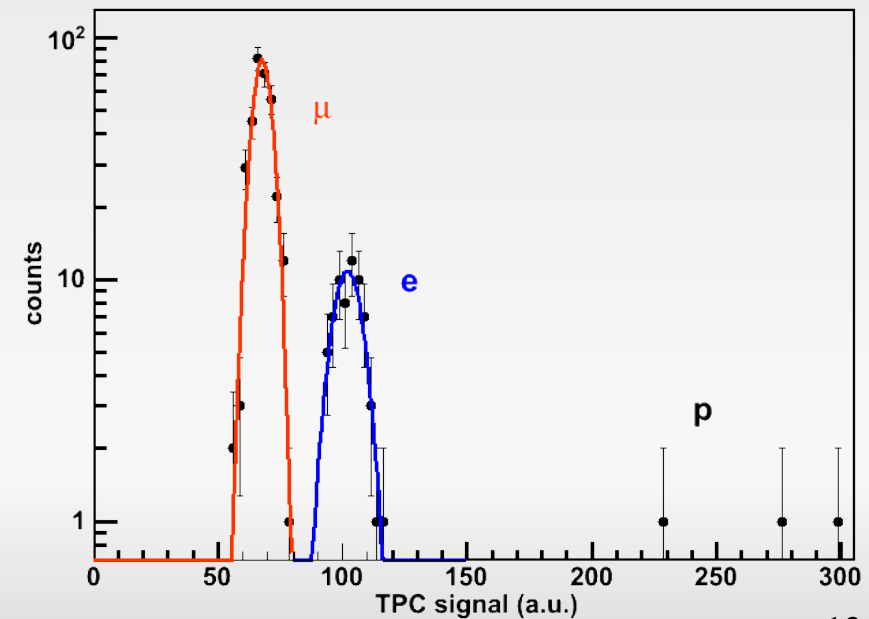
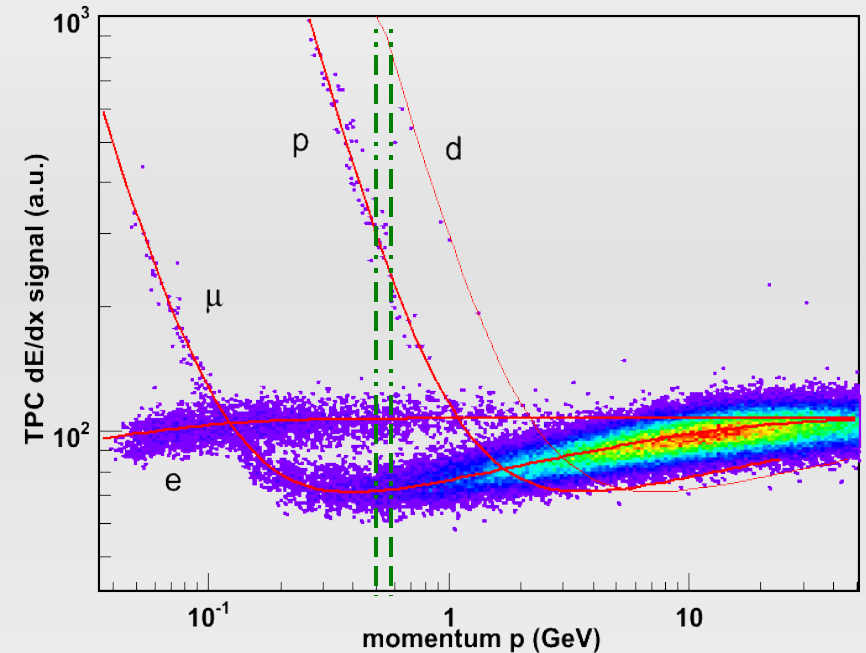
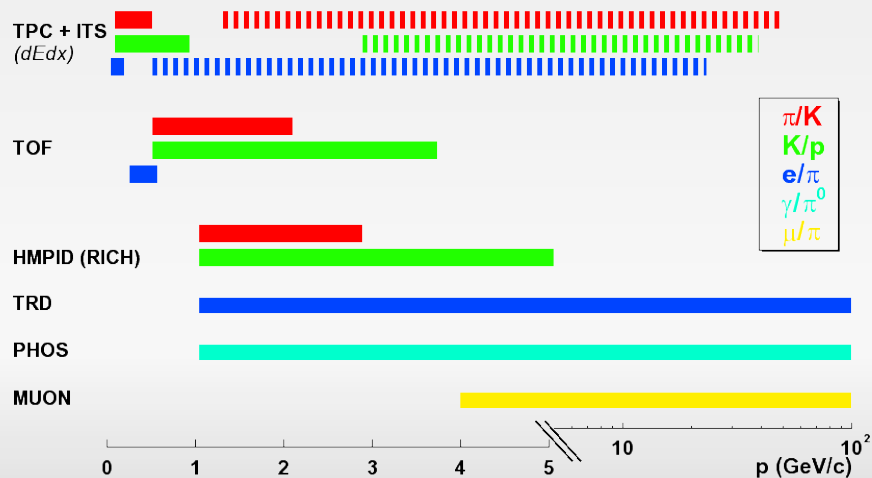
## dE/dx resolution

### dE/dx resolution

- measured: 5.7%
- design value: 5.5%
- ... close to design value

Study done with ~7.000.000 cosmic tracks from 2008

dE/dx resolution allows particle identification  
in the relativistic rise up to 50 GeV/c





# Summary

- Fully commissioned
  - Stable operation with final running conditions in 2008
  - Integrated in the Experiment Control System
- Calibration
  - Cosmic events
  - Laser events
  - Noise performance
  - Gain calibration using  $^{83}\text{Kr}$
- Performance
  - Already close to specifications
- Looking forward to record first collisions

