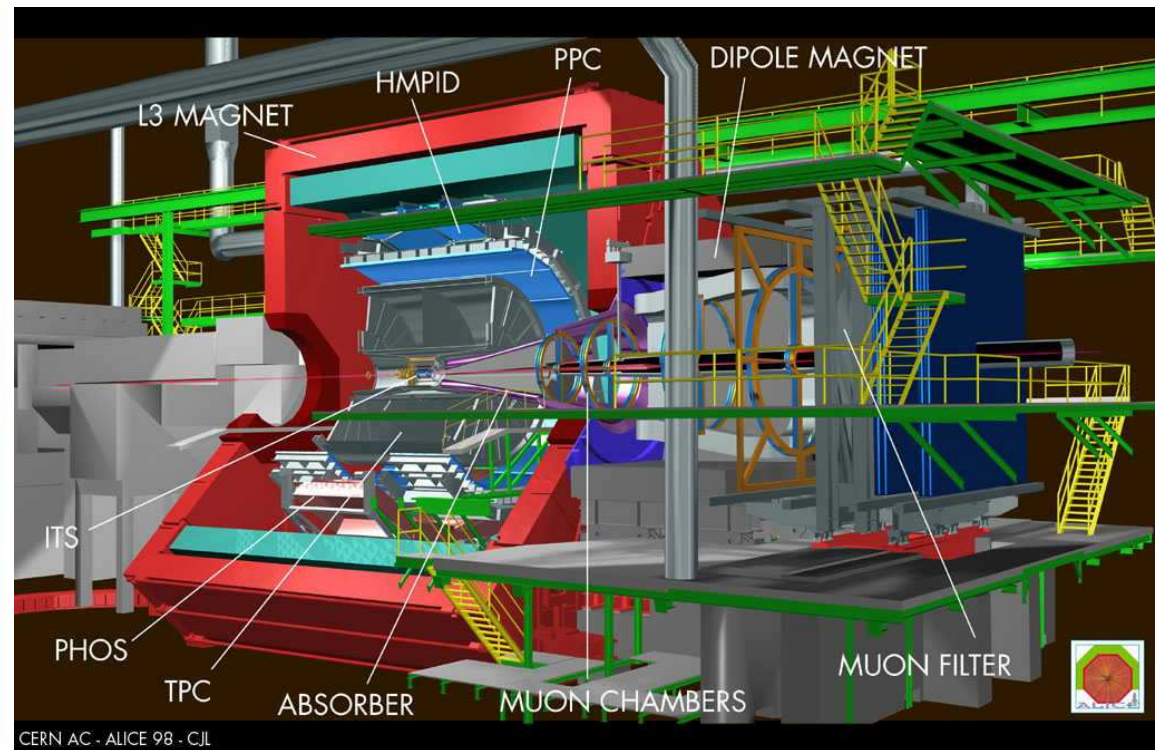
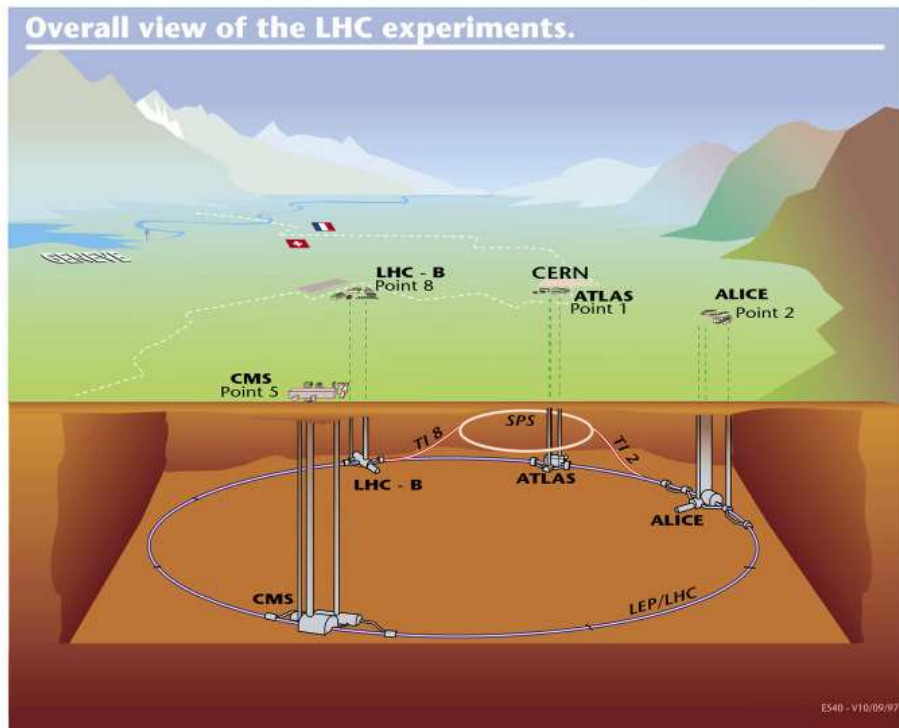


# Particle Identification at the ALICE HMPID Detector

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3rd December 2009  
Zimányi Winter School, Budapest



## HMPID (High Momentum Particle Identification Detector)

'ring imaging Cherenkov' (RICH) detector

$$\cos\vartheta_c = \frac{1}{n\beta}$$

radiator: 15 mm liquid  $C_6F_{14}$

$n_{C_6F_{14}} = 1,2989$  ( $\lambda = 175$  nm)

7 modul ( each 1.5 m x 1.5 m)

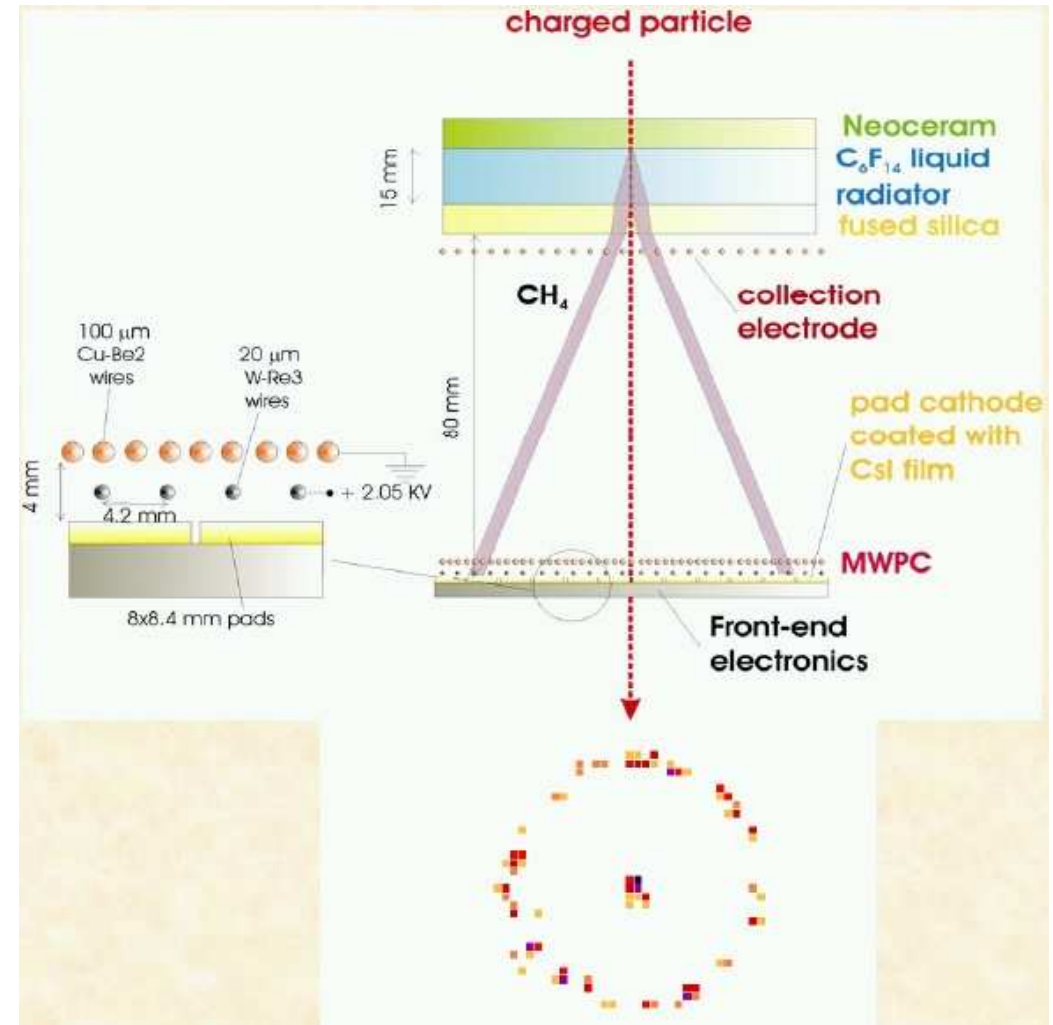
distance from the interaction point: 4.9 m

11  $m^2$  effektív surface

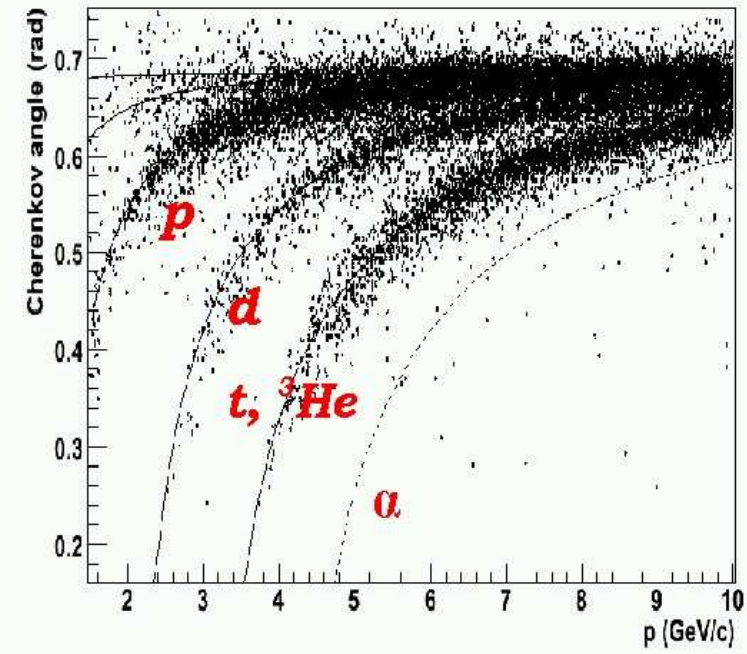
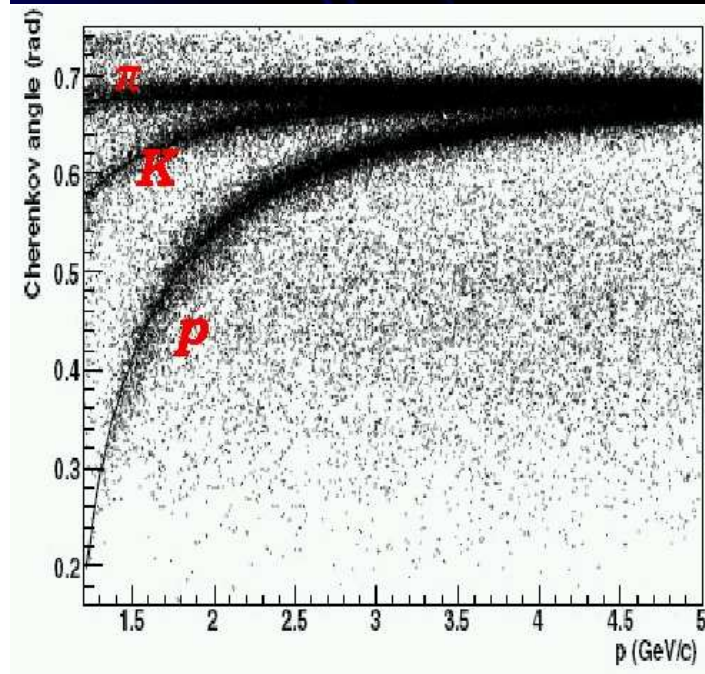
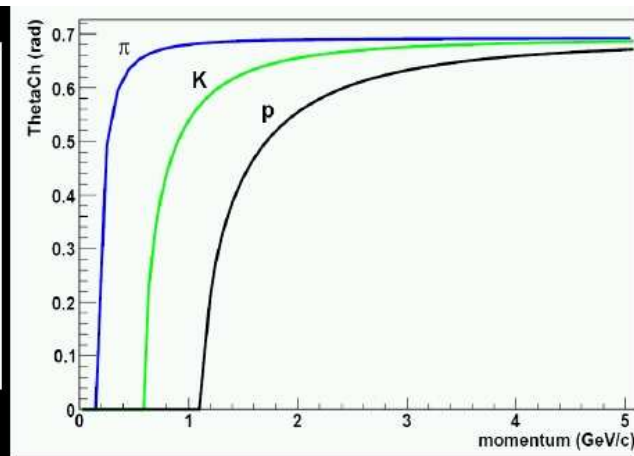
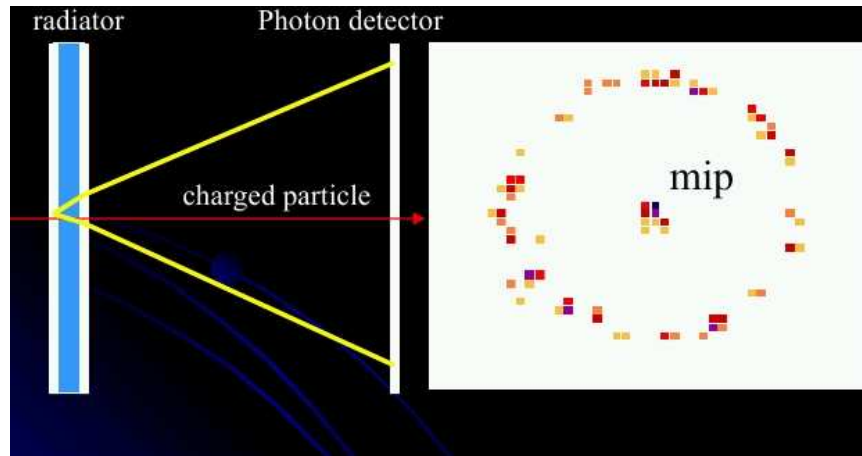
5% acceptance

position in mid rapidity region,

usefull for  $p_T$  measurements



## Particle Identification by ring reconstruction and measuring of the ring radius ( $\vartheta_c$ )

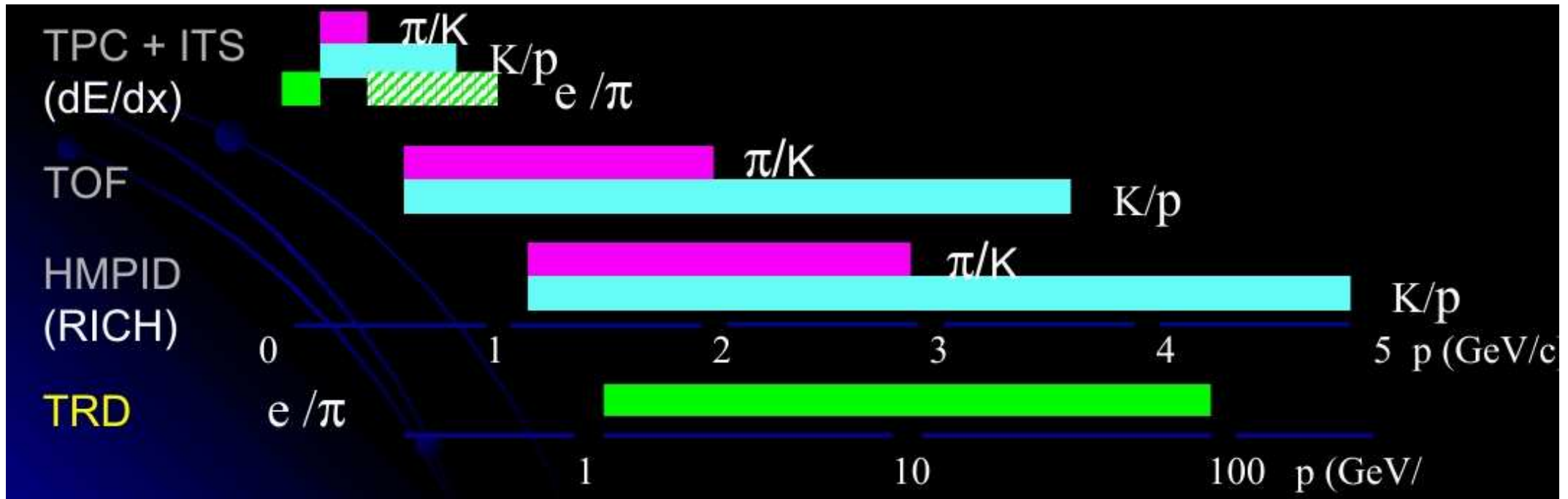




What we do is speed measurement, and use the momentum reconstruction based on the other (tracking) detectors in ALICE.

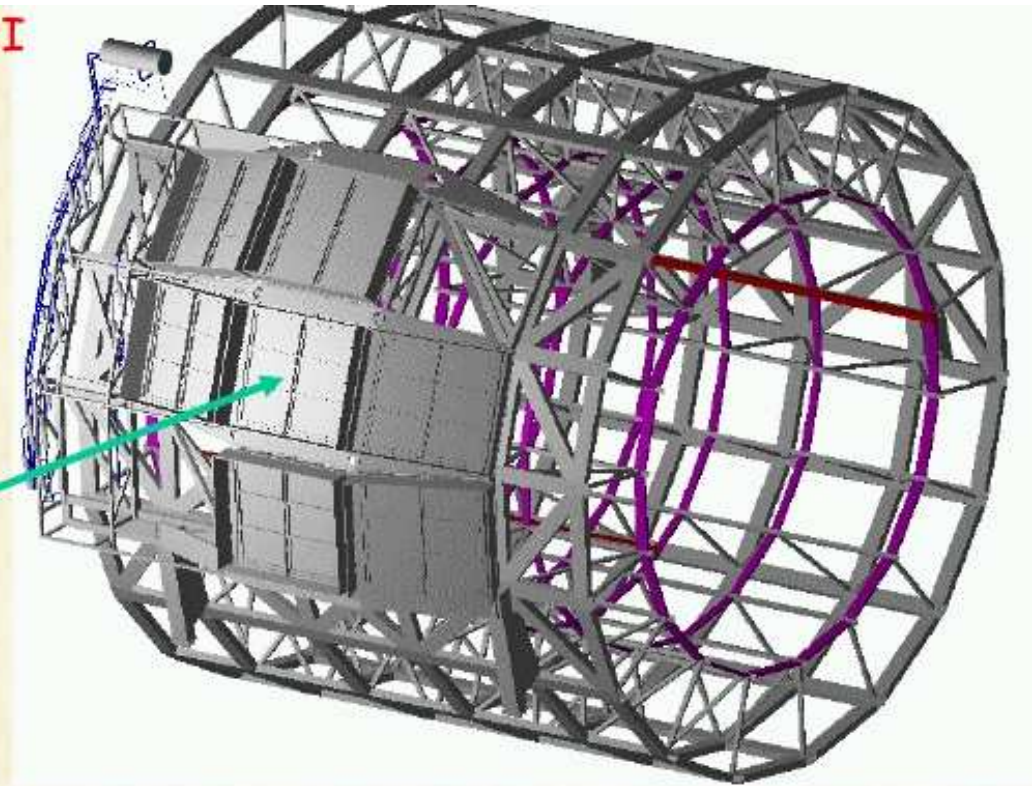
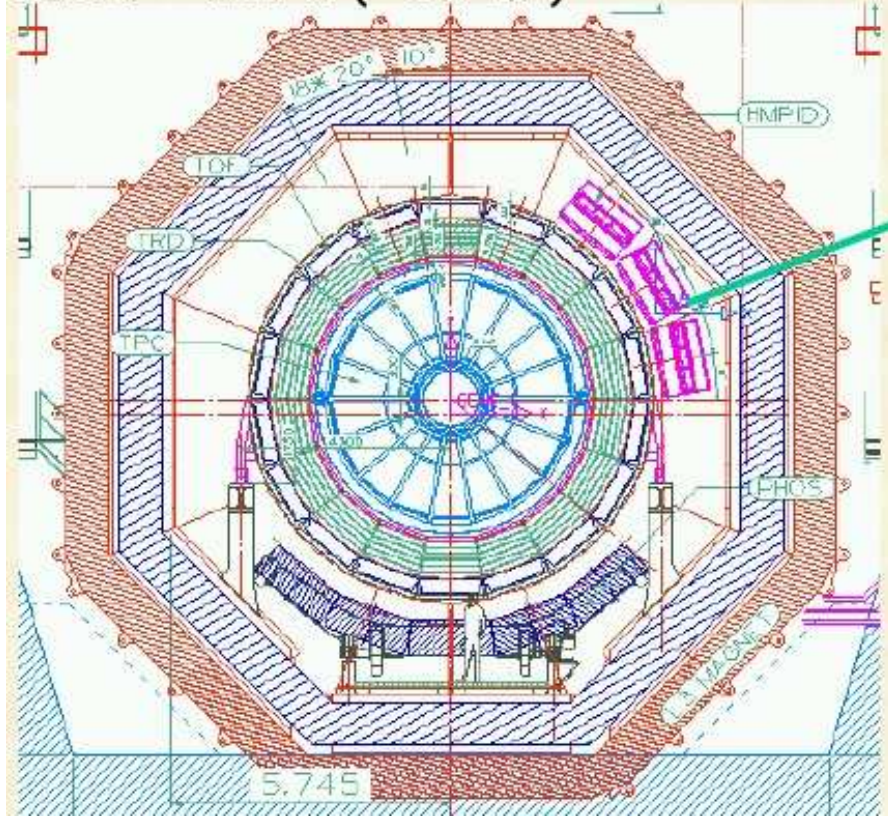
( ${}^3He$  and  $t$  can be also distinguished, because  ${}^3He$  produce much more photons due to the higher charge)

very useful detector technology, can be tuned by the choice of reflective index (choice of radiator material)



## Structure, position:

HMPID: the largest scale application of CsI photocathodes (~11 m<sup>2</sup> active surface)  
 COMPASS-RICH1 (~6 m<sup>2</sup>)  
 HADES-RICH (~1.5 m<sup>2</sup>)  
 CEBAF - Hall A (~ 0.7 m<sup>2</sup>)



acceptance ~  
 5% of the  
 central barrel  
 phase space

array of 7 modules  
 (each ~1.5 x 1.7 m<sup>2</sup>)



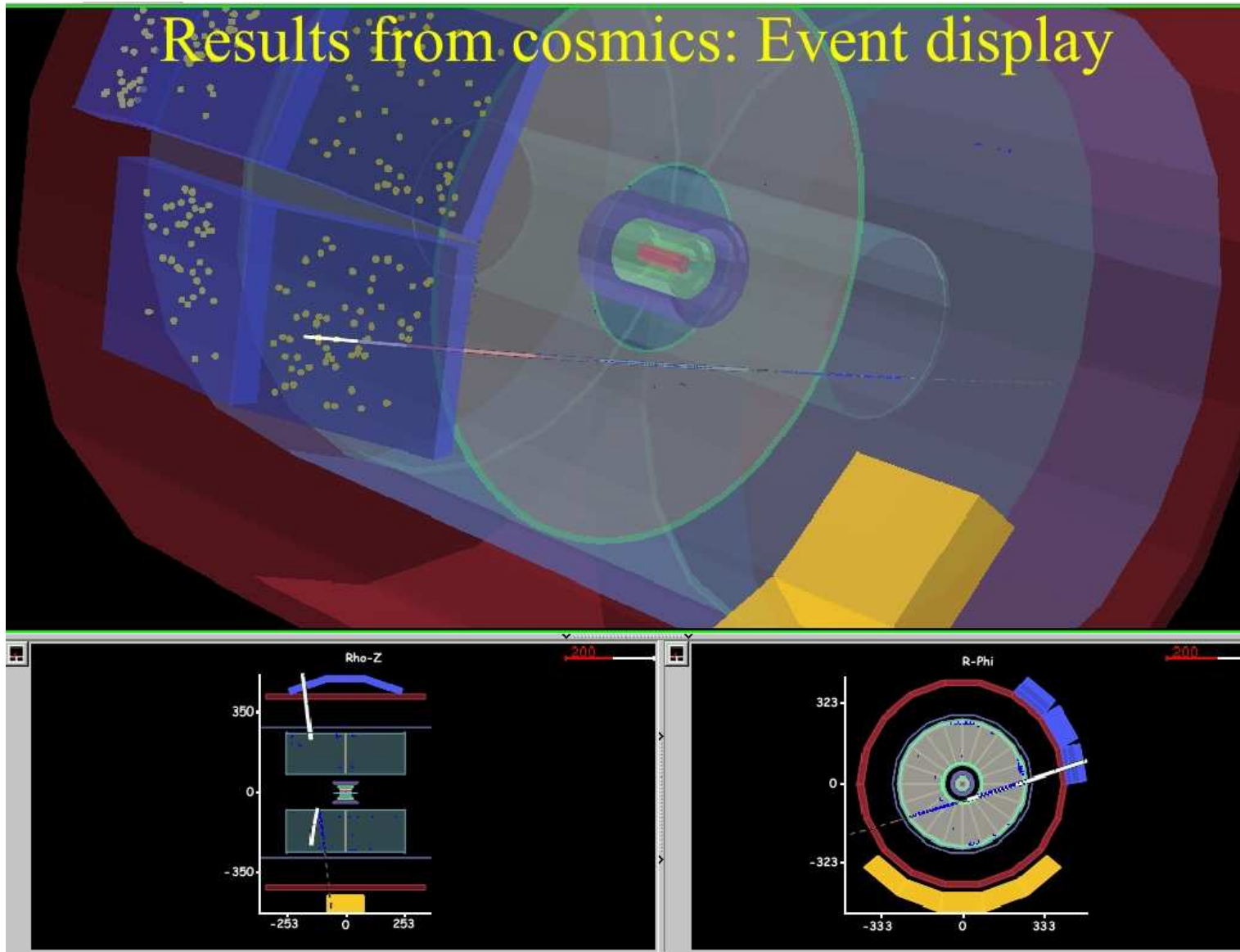
## Transport, installation:





Installed inside the L3 magnet since 23 September 06







## Event Display – pedestal

Applications Actions Wed Sep 3, 7:15 PM

zoom x1

**RICH 6**

**RICH 5**

**RICH 4**

**RICH 3**

**RICH 2**

**RICH 1**

**RICH 0**

**Event 36 Total 126**

- + TRKxPC 0
- △ Mip hits 0
- Ckov hits 0
- ◇ Feed hits 0
- Digs 15130
- ✦ Clus 5629

ddl = (0...13)  
RICH n → ddl 2n (left) & 2n+1 (right)  
phcat (0,2,4) left, phcat (1,3,5) right  
sigma cut = 0

**ALL**

Print ESD OFF Only

Print clus OFF Only

Print digs ON Only

Next Previous Quit



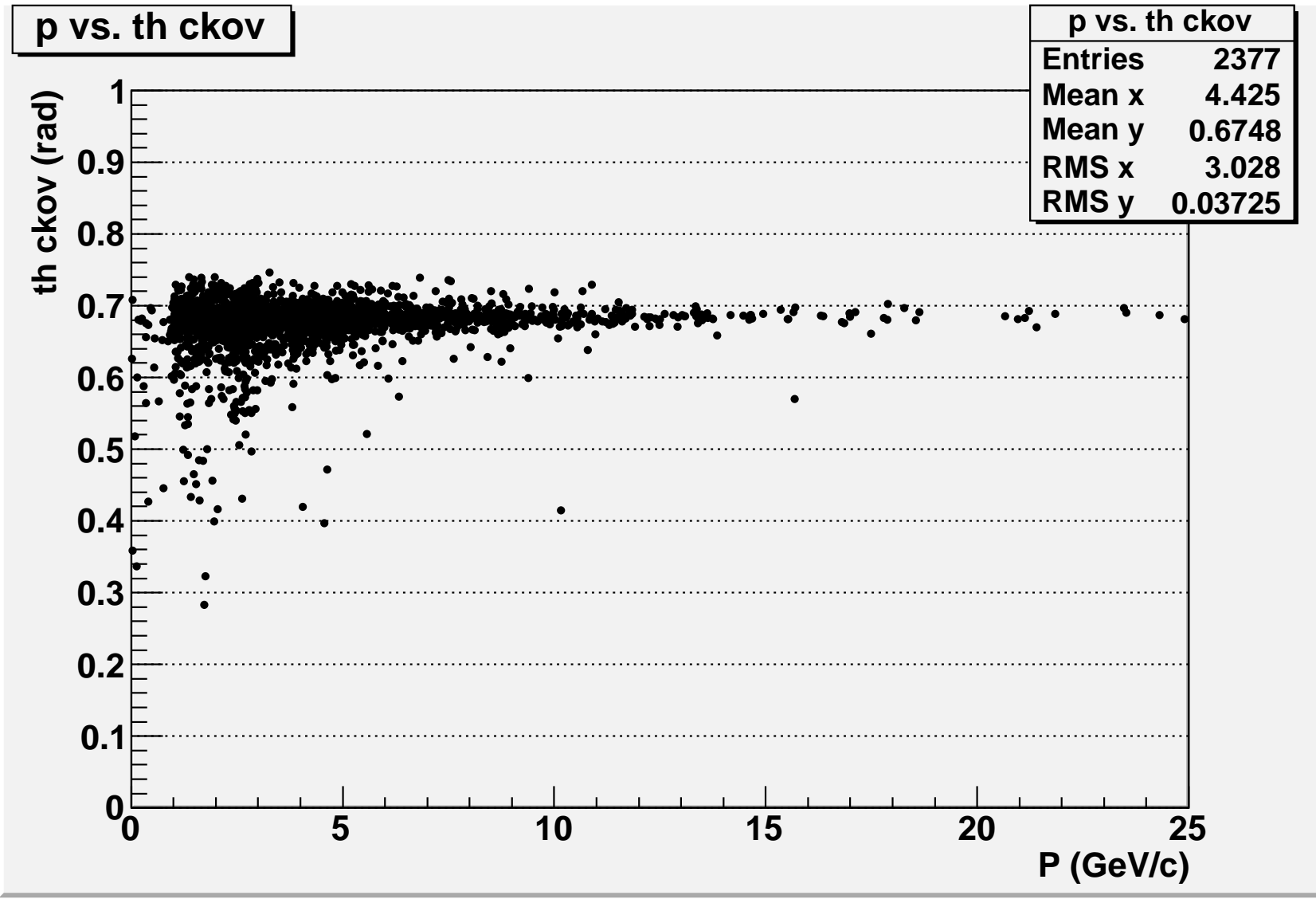
# HMPID – detector monitoring



## ring reconstruction – not easy



# HMPID – simulation, reconstruction



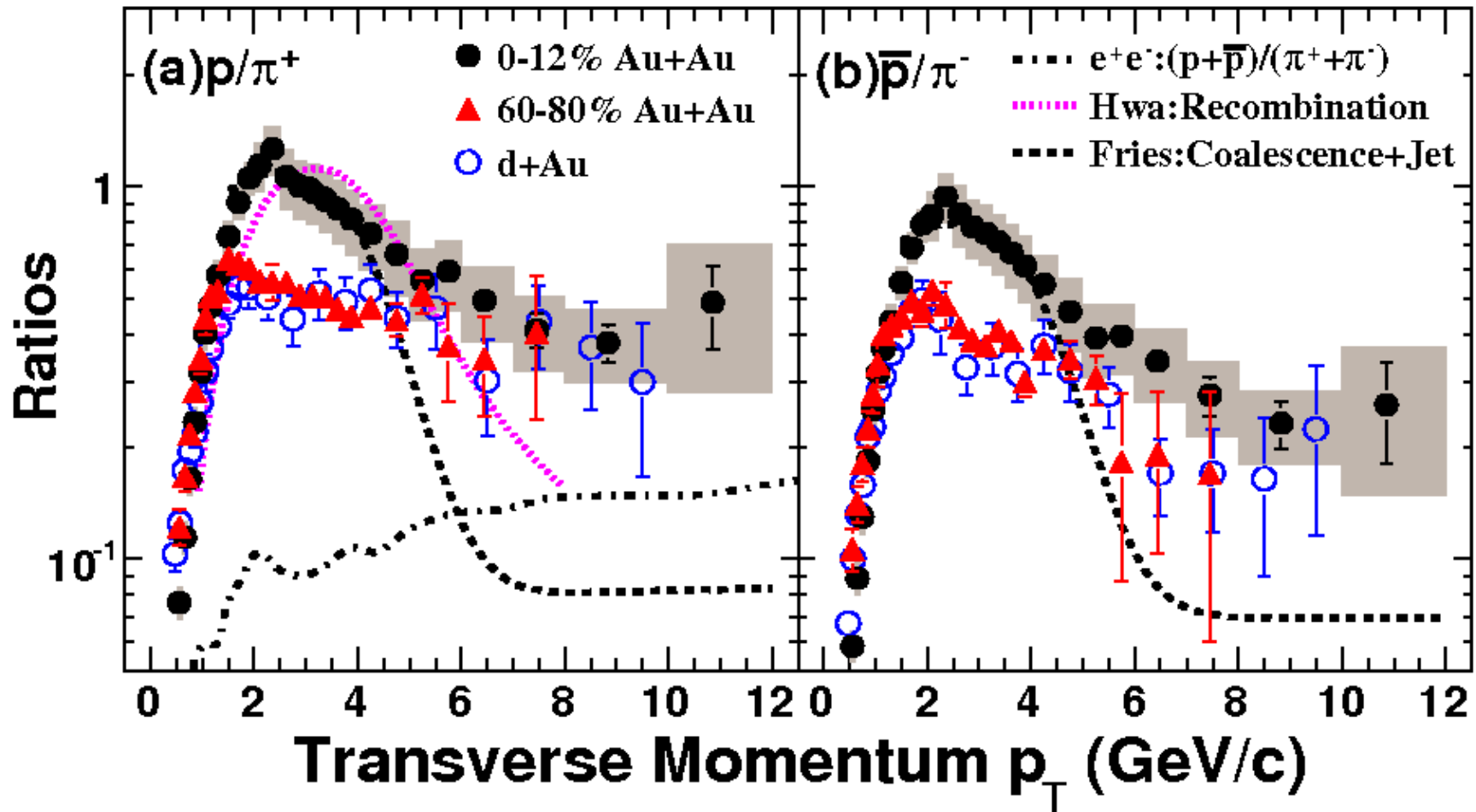


HMPID can identify the type of hadrons in the middle and high  $p_T$  regions (1–5 GeV/c) for  $pp$  and  $PbPb$  collisions.

Possible physics topics could/should investigate by HMPID:

- ❖  $\phi(1020)$  meson measurement in the  $\phi(1020) \rightarrow K^+K^-$  decay channel, in the middle (2–5 GeV/c)  $p_T$  region, (interesting in point of view of hadronization processes because of the similar mass to proton)
- ❖ measurement barion/meson ratios in the (1–5 GeV/c)  $p_T$  region, (compare to RICH results)
- ❖ study of jet properties, for jet reconstruction, identify the leading particle, study of the jet fragmentation in  $pp$  and  $PbPb$  collisions, material effects in parton propagation...
- ❖ other: elliptic flow, ridge...

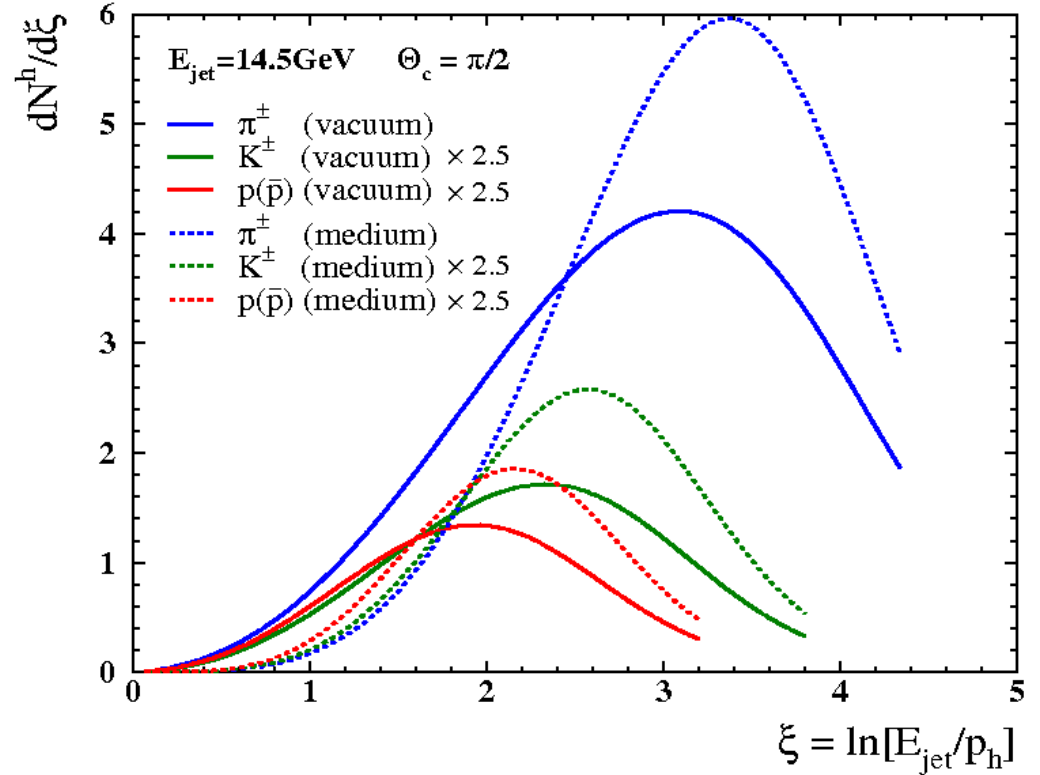
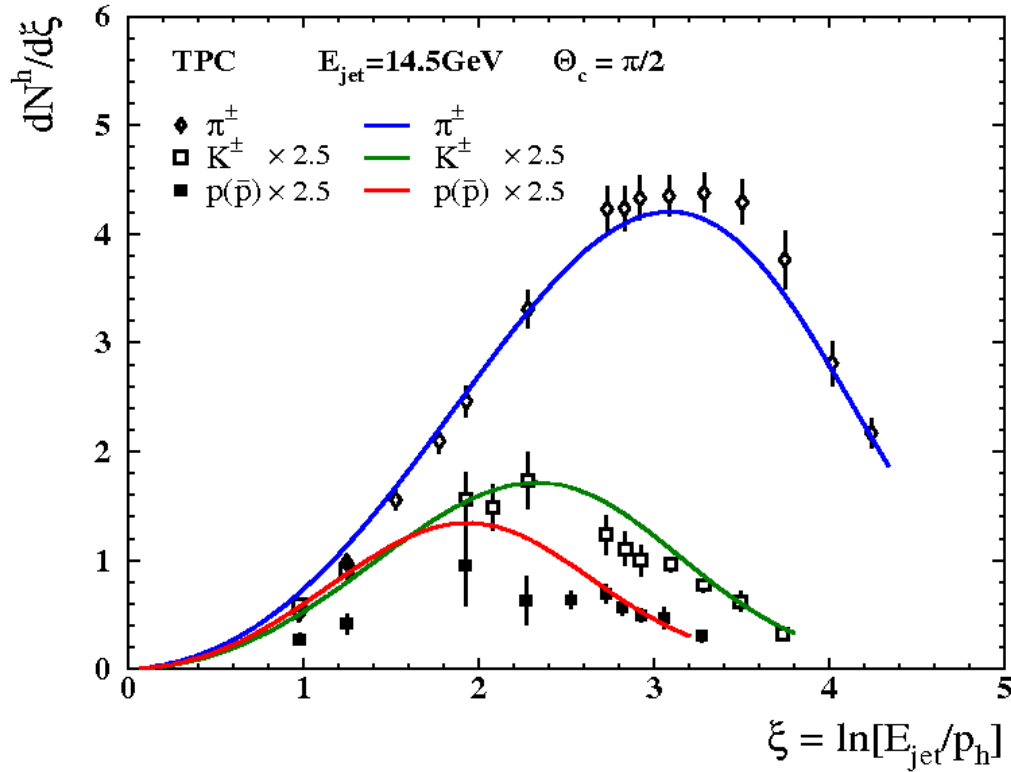
## barion/meson ratios in central and peripheral $AuAu$ collisions, 200 GeV, STAR experiment



[STAR Coll.: Identified baryon and meson distributions at large transverse momenta from Au+Au collisions at  $\sqrt{S_{NN}} = 200$  GeV, arXiv:nucl-ex/0606003v3 13 Oct 2006]

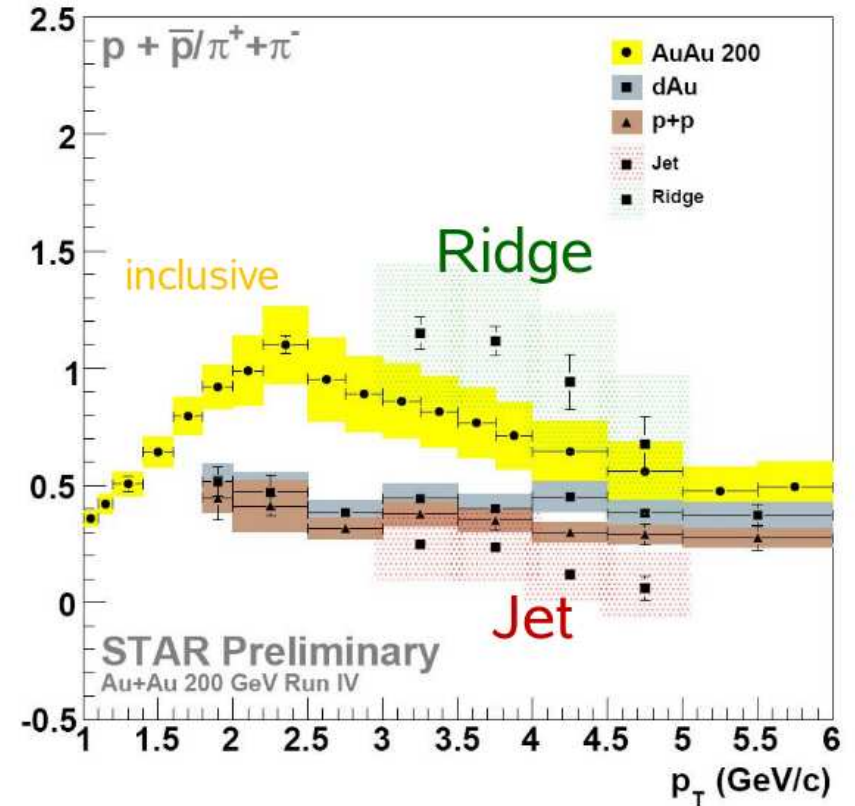
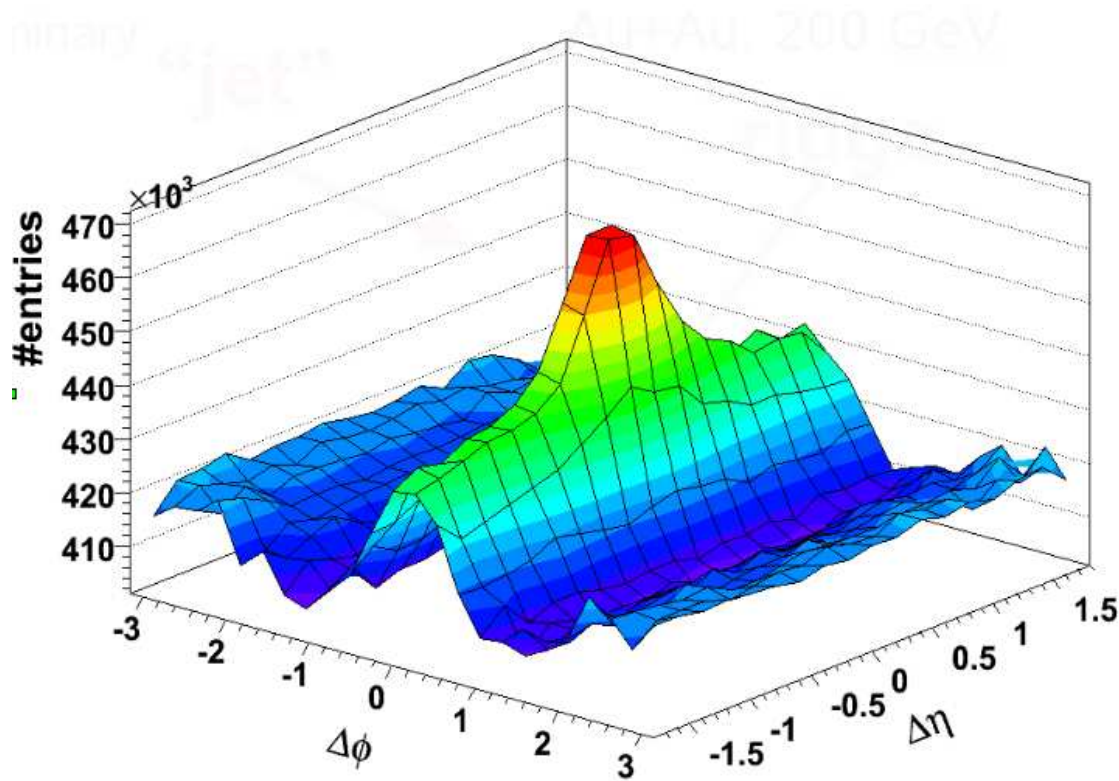


*left:* TPC data ( $e^+e^-$ ) and MLLA+LPHD model  
 (inclusive spectra inside a jet vs.  $\ln$  of the hadron momentum fraction)  
*right:* expected modification of spectra in matter



[S. Sapeta, U.A. Wiedemann: Jet hadrochemistry as a characteristics of jet quenching; hep-ph 24 Jul 2007, CERN-PH-TH/2007-111]

## barion/meson ratios in jet and ridge



[J. Bielcikova (STAR Coll.) High- $p_T$  results from STAR – what did we learn?, lecture in High- $p_T$  Physics at LHC 09 Workshop, Prague, Feb. 4-7. 2009.]





<p><b>2♥ The ALICE Solenoid Magnet</b></p>  <p>The world's largest worm solenoid is a legacy of the L3 experiment and the LEP era. Its 0.5 Tesla field provides the bending power for the thousands of particles emitted in heavy ion collisions.</p>	<p><b>3♥ The ALICE TPC</b></p>  <p>A spectacular view of the interior of the ALICE Time Projection Chamber (TPC), the world's largest! It measures the trajectories of the thousands of particles emitted in heavy ion collisions with sub-millimetre precision.</p>	<p><b>4♥ Optical Fibres for ALICE</b></p>  <p>The extremely high volumes of data coming from the detectors of the LHC (equivalent to the data throughput of the world's telecom networks) necessitate high bandwidth communication networks, based on optical fibres.</p>	<p><b>5♥ Electronics for ALICE</b></p>  <p>The ALTRO chip is a custom integrated circuit designed to be one of the building blocks of the front-end electronics for the ALICE Time Projection Chamber.</p>	<p><b>A♥ The ALICE Detector for LHC</b></p>  <p>A Large Ion Collider Experiment - ALICE. In addition to proton collisions, the LHC will also collide beams of heavy ions, in order to study the quark-gluon plasma. ALICE is dedicated to the study of this phase of matter that existed not only for just a fraction of a second after the Big Bang.</p>
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**Péter Csizmadia (my classmate at ELTE)**

**LOST this October, on Ren Zhong Feng (6079m), Himalaya, Sichuan**

