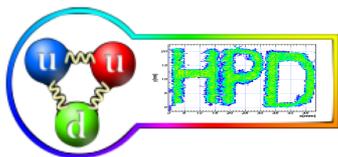


ALICE / IFIN-HH



- *Activities and achievements in the past year*
- *Remarks on additional activities*
- *2016-2018 perspectives*

HADRON PHYSICS DEPARTMENT

Highlights of accomplishments in the last year

• Physics

- comparison of pp, p-Pb and Pb-Pb systems in terms of collision geometry and its selection using experimental observables spectra shapes, yields and average p_T
- inclusion of the present analysis (with the extension of the p_T range of kaons from 1.4 GeV/c to 2.5 GeV/c) in an instrumentation paper: “Particle identification in ALICE: a Bayesian approach”, which is now ready to be sent for publication
- extension of charged particle p_T spectra up to 20 GeV/c taking into account the results of the detailed study of the pile-up effects on the spectra, as a function of multiplicity
- all analysis done using three types of charge particle multiplicity selectors based also on Monte Carlo studies
- extension of the existing codes to other phenomenological models fit formulas of the spectra
- significant contributions in preparing presentations at QM2015
- members in a PC
- significant contribution to proposals for a PRL and a PRC papers

• TRD tracking and QA activities

• ALICE upgrade

- preparing the infrastructure for starting the assembling and tests of ALICE-TPC OROCs based on GEM technology
- design, assembling and tests of OROC housing box for in-house and in-beam tests
- design and partial construction of the OROCs protection for the transportation to CERN

• Computing

- maintaining NIHAM in a leading position among Tier2s ALICE GRID centres, NAF efficient management

• ALICE shifts

- shifts in ALICE experiment

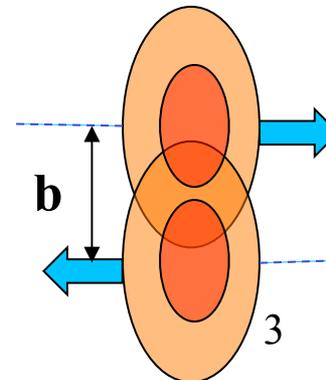
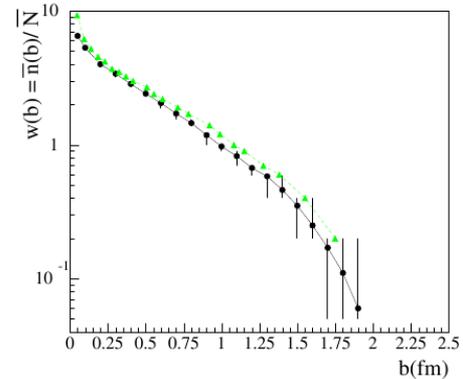
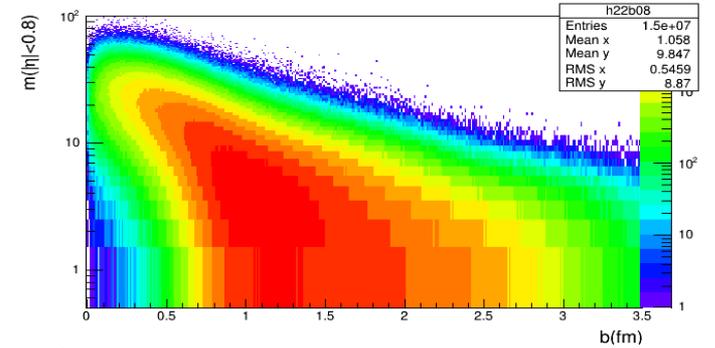
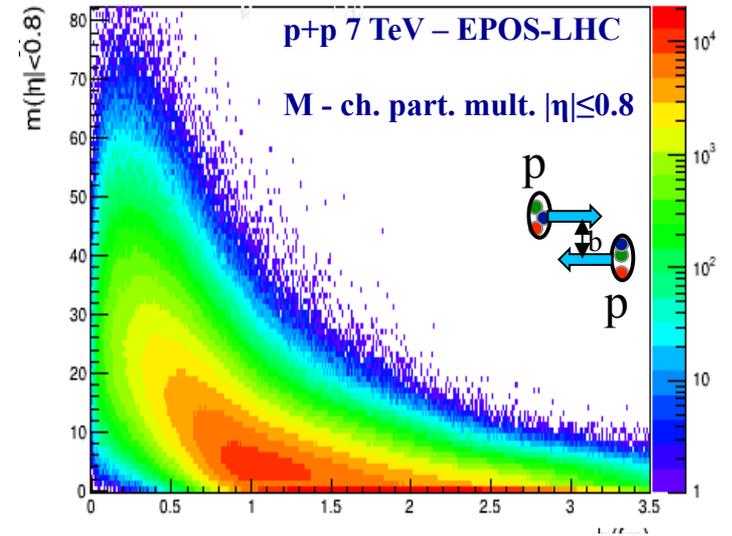
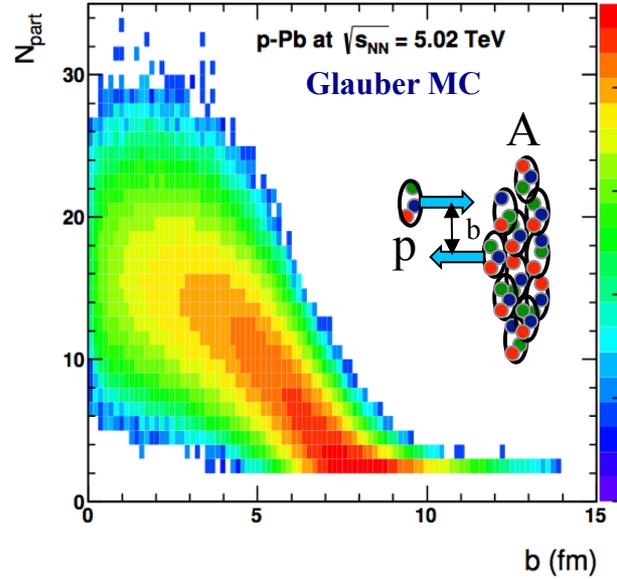
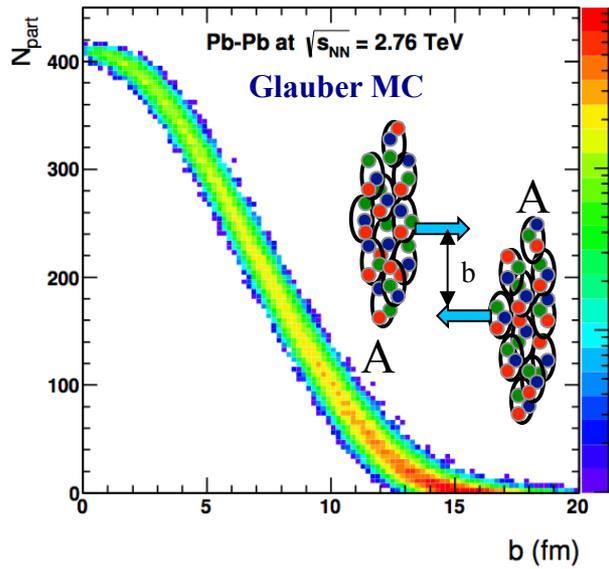
• Teaching & Outreach

- summer student program and outreach activities

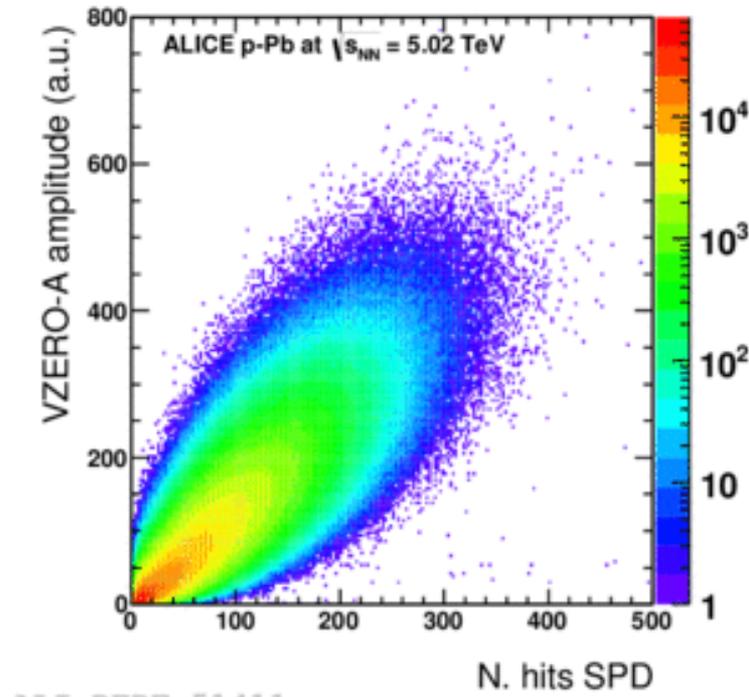
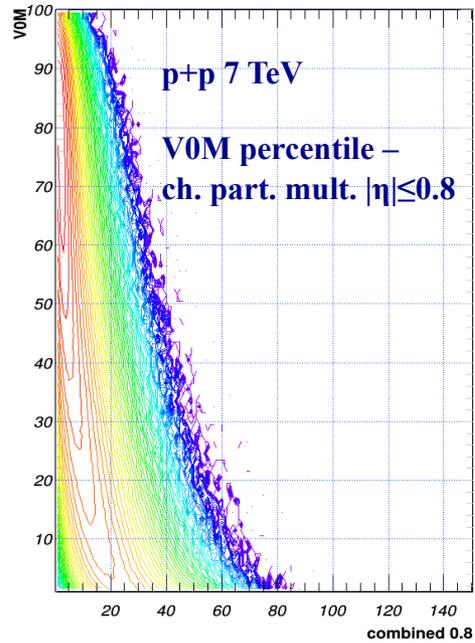
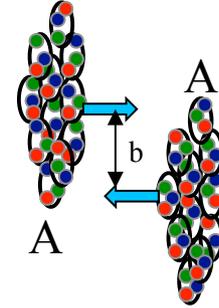
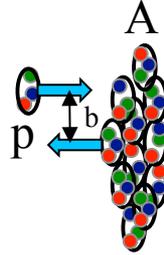
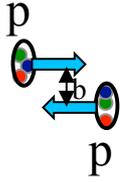
- 12 Presentations in ALICE Meetings and 4 ALICE Internal Notes

Collision geometry – $A+A$, $p+A$, $p+p$

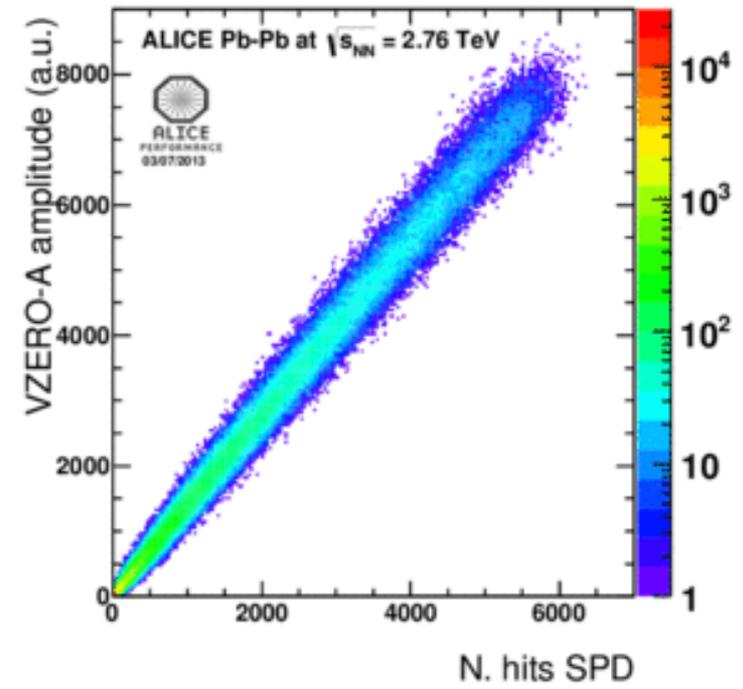
N_{part} ($mult_{ch}$) – b correlation



Collision geometry – $A+A$, $p+A$, $p+p$ based on measured observables



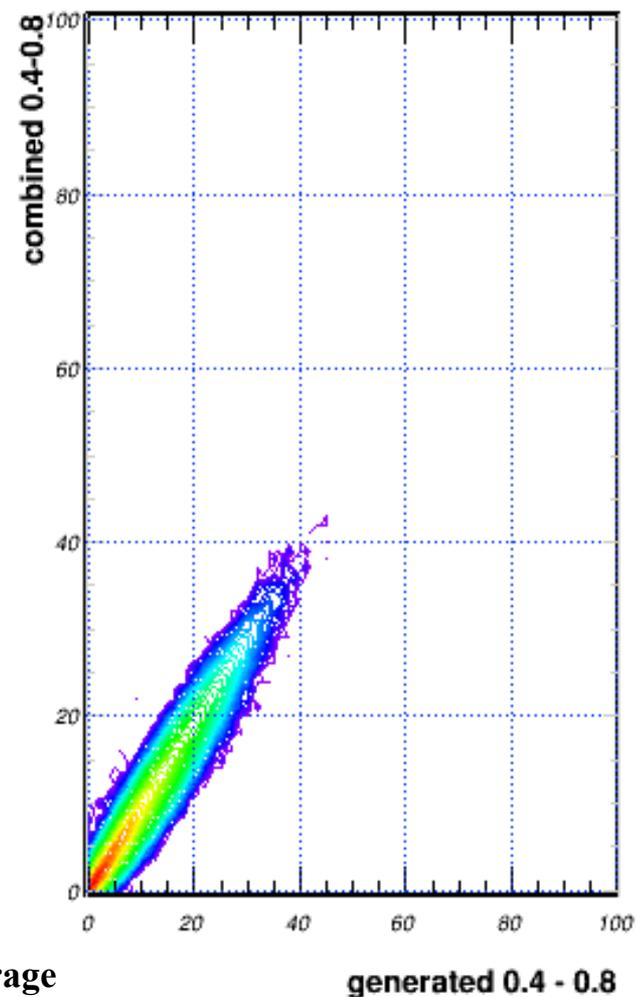
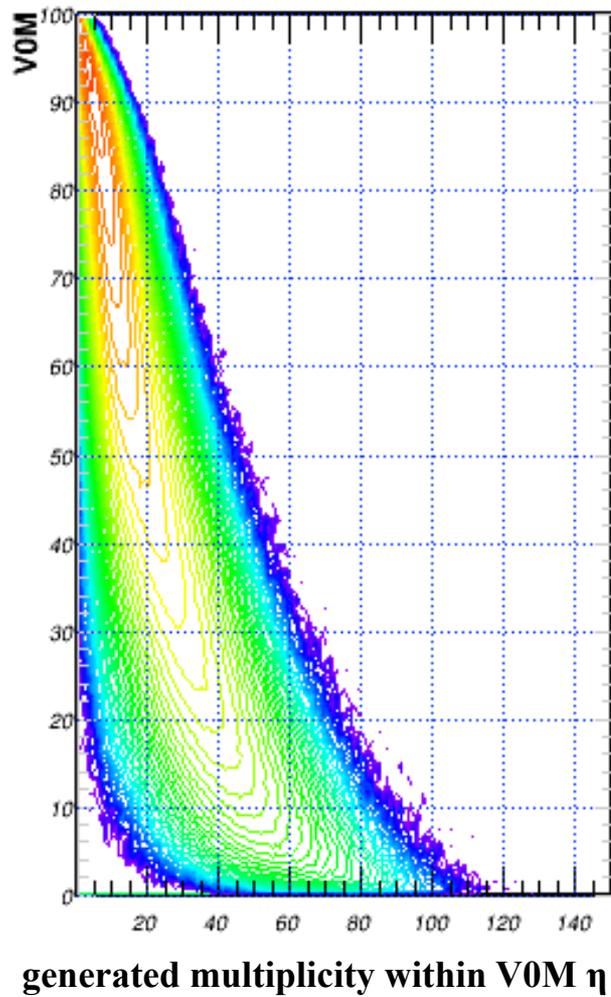
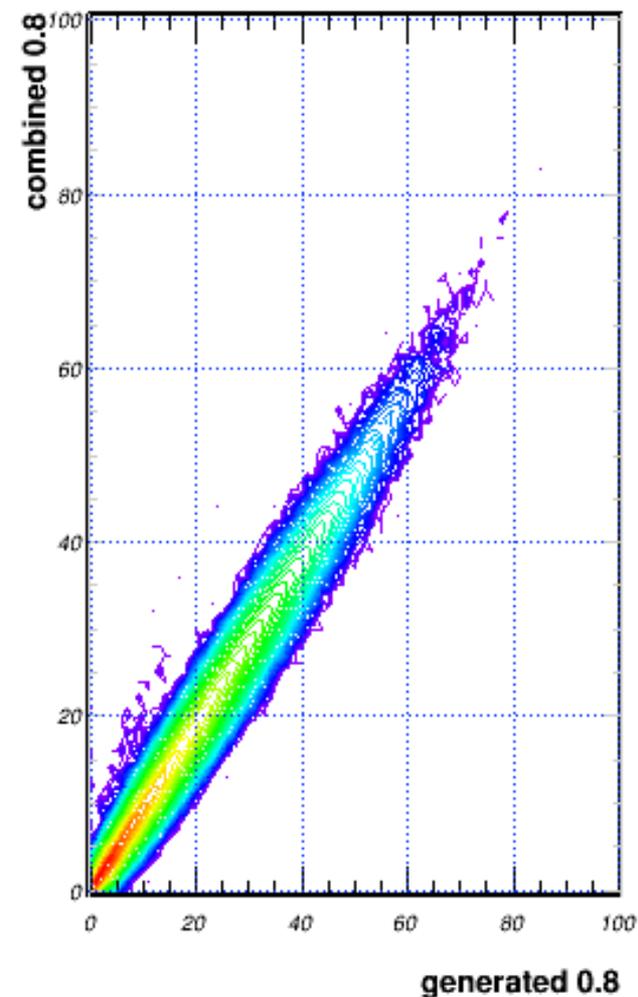
ALI-PERF-51411



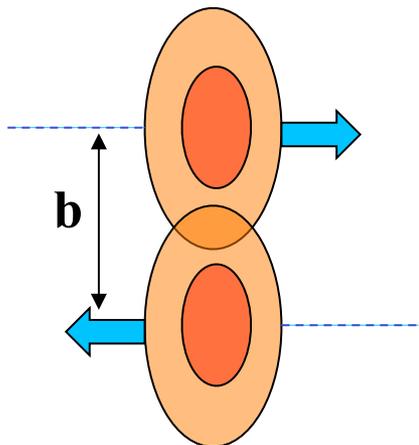
Collision geometry – p+p

correlation between measured and real observables

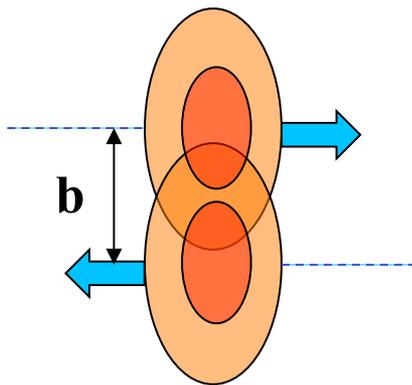
PYTHIA



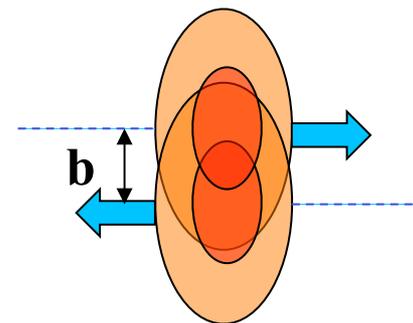
A few considerations on multiplicity selectors in $p+p$ collisions



Large impact parameter
soft partons overlap

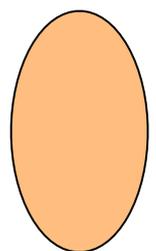
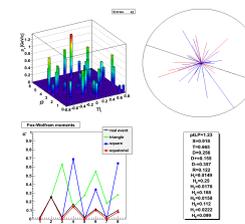
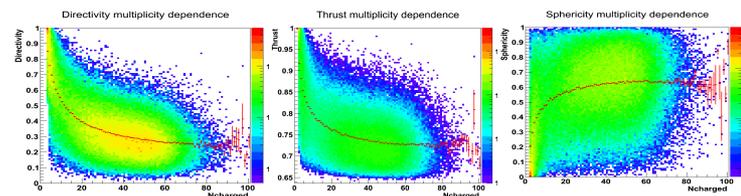
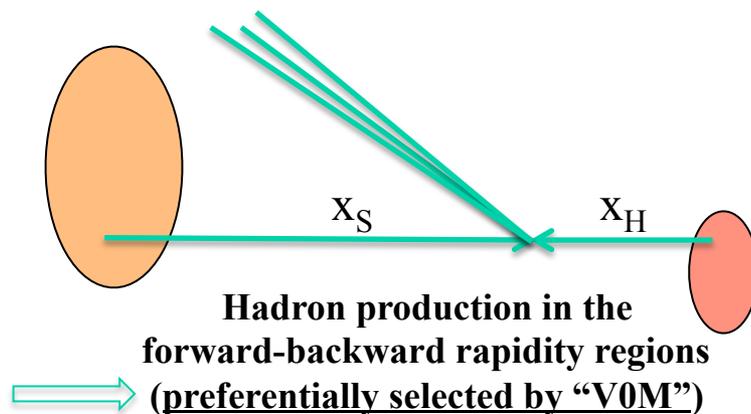


Intermediate impact parameter
soft & soft-hard partons overlap



Small impact parameter
soft, soft-hard and hard partons overlap
The largest no. of parton interactions (MPI)
&
re-scatterings

How to select them?
=> multiplicity & event shape



Transverse spatial distributions
of the soft partons ($x \ll 10^{-2}$)



Transverse spatial distributions
of the hard partons ($x \geq 10^{-2}$)

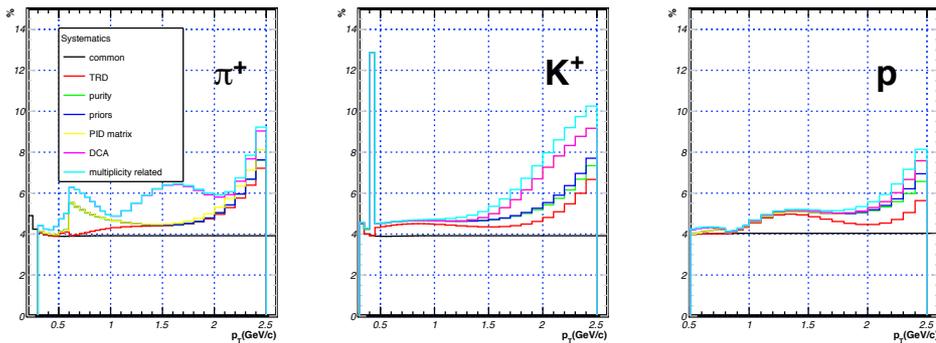
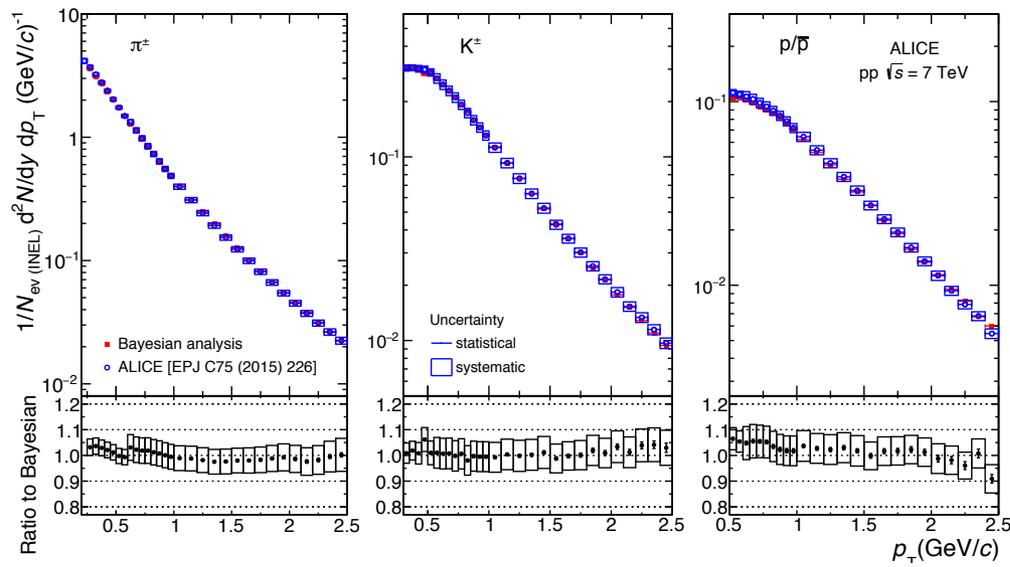
Light flavor hadron spectra at low p_T

Search for collective phenomena in high multiplicity pp

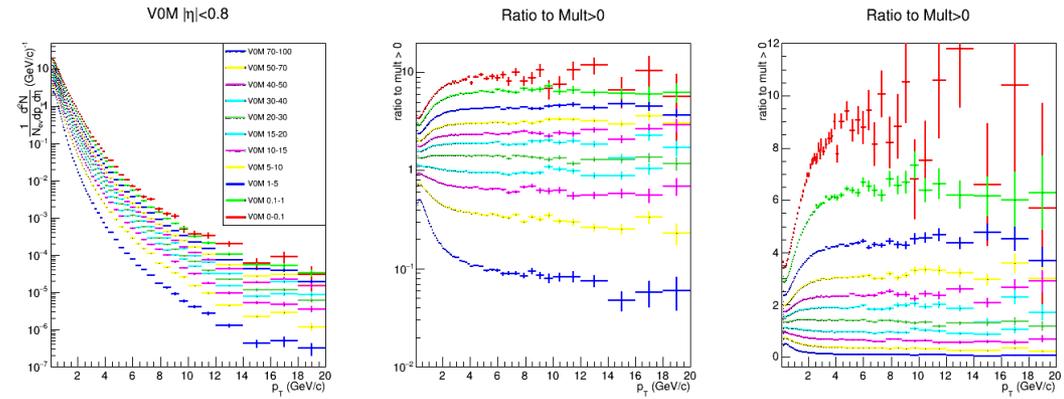
Identified charged hadrons

$$\varepsilon_{ij} = \frac{N_{id}(i; j)}{N(j)} \quad \text{Eff}_{PID} = \begin{pmatrix} \varepsilon_{\pi\pi} & \varepsilon_{\pi K} & \varepsilon_{\pi p} \\ \varepsilon_{K\pi} & \varepsilon_{KK} & \varepsilon_{Kp} \\ \varepsilon_{p\pi} & \varepsilon_{pK} & \varepsilon_{pp} \end{pmatrix}$$

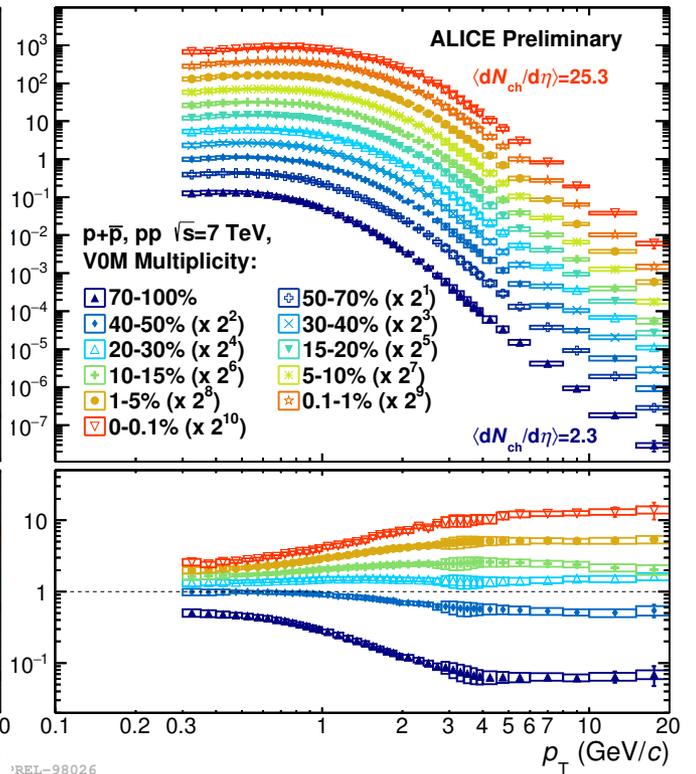
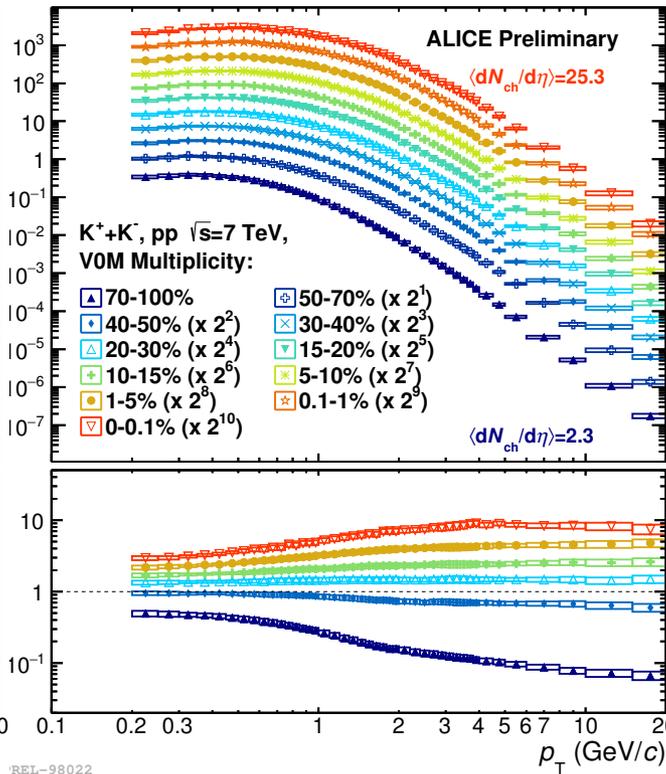
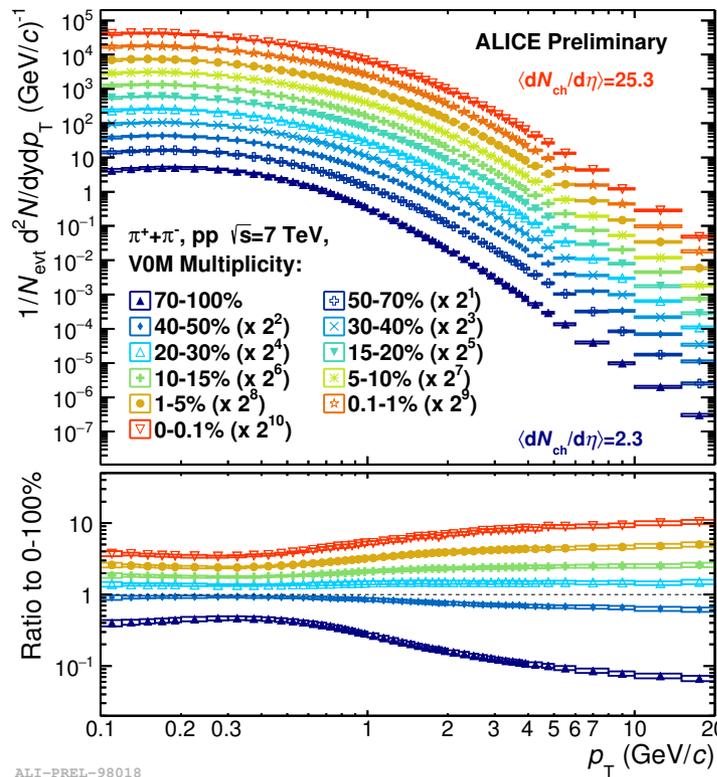
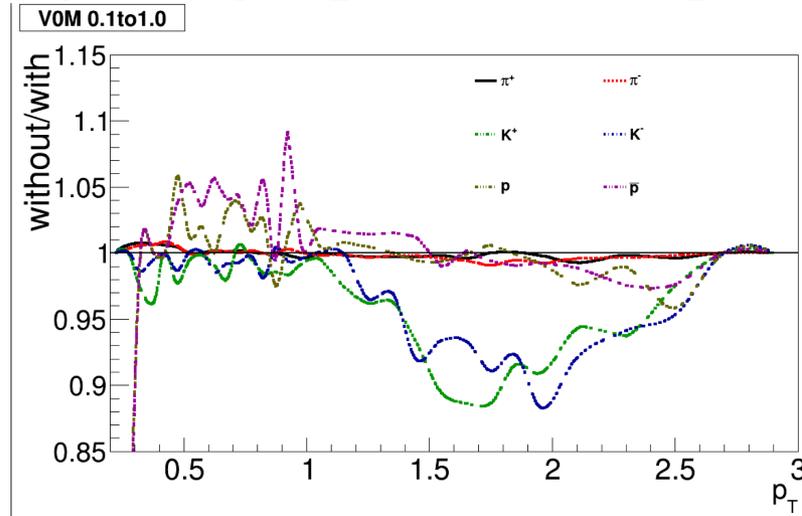
$$(Eff_{PID})^{-1} \times (dN/dydp_t)_{raw}$$



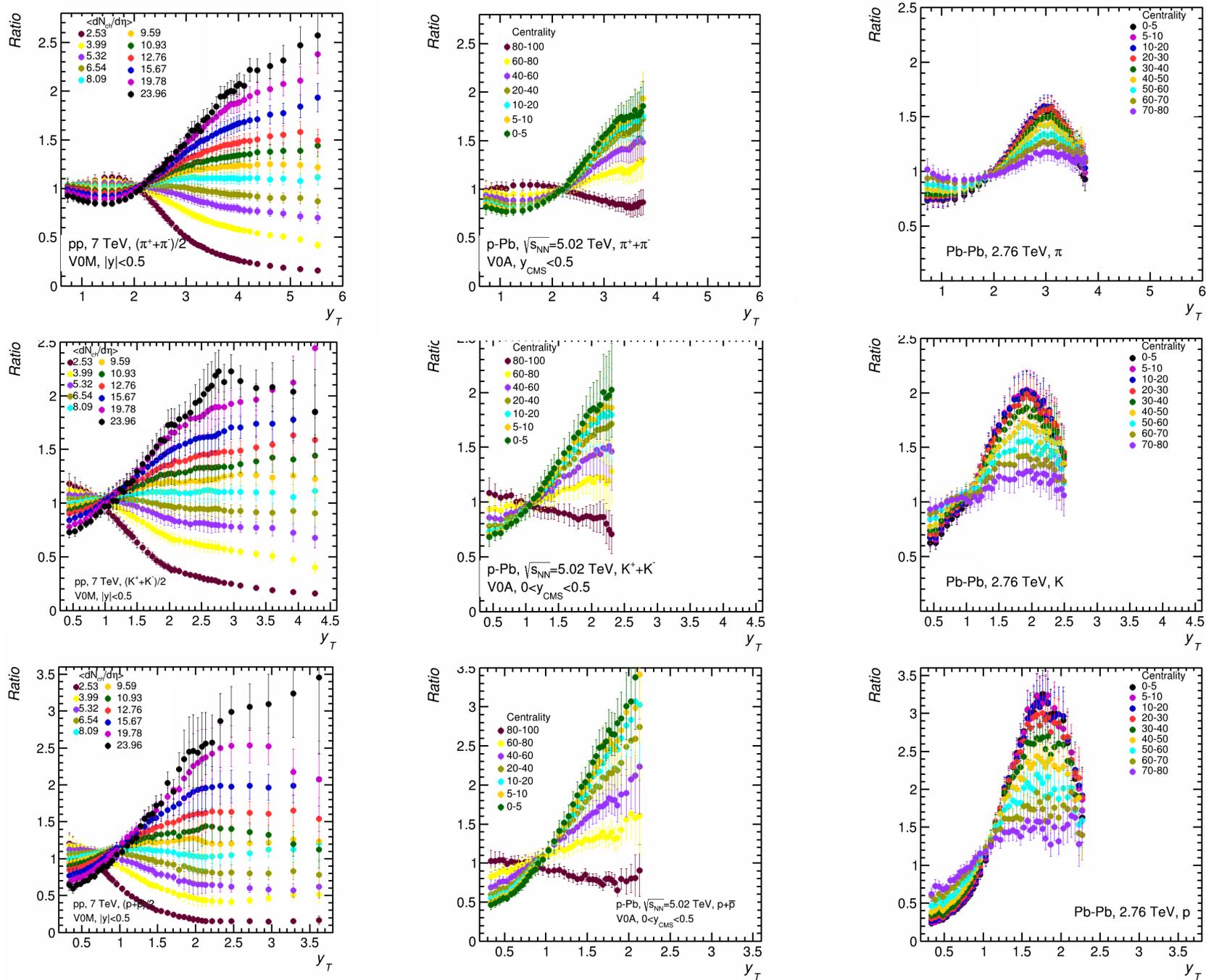
Extended p_T range & pile-up studies charged particles



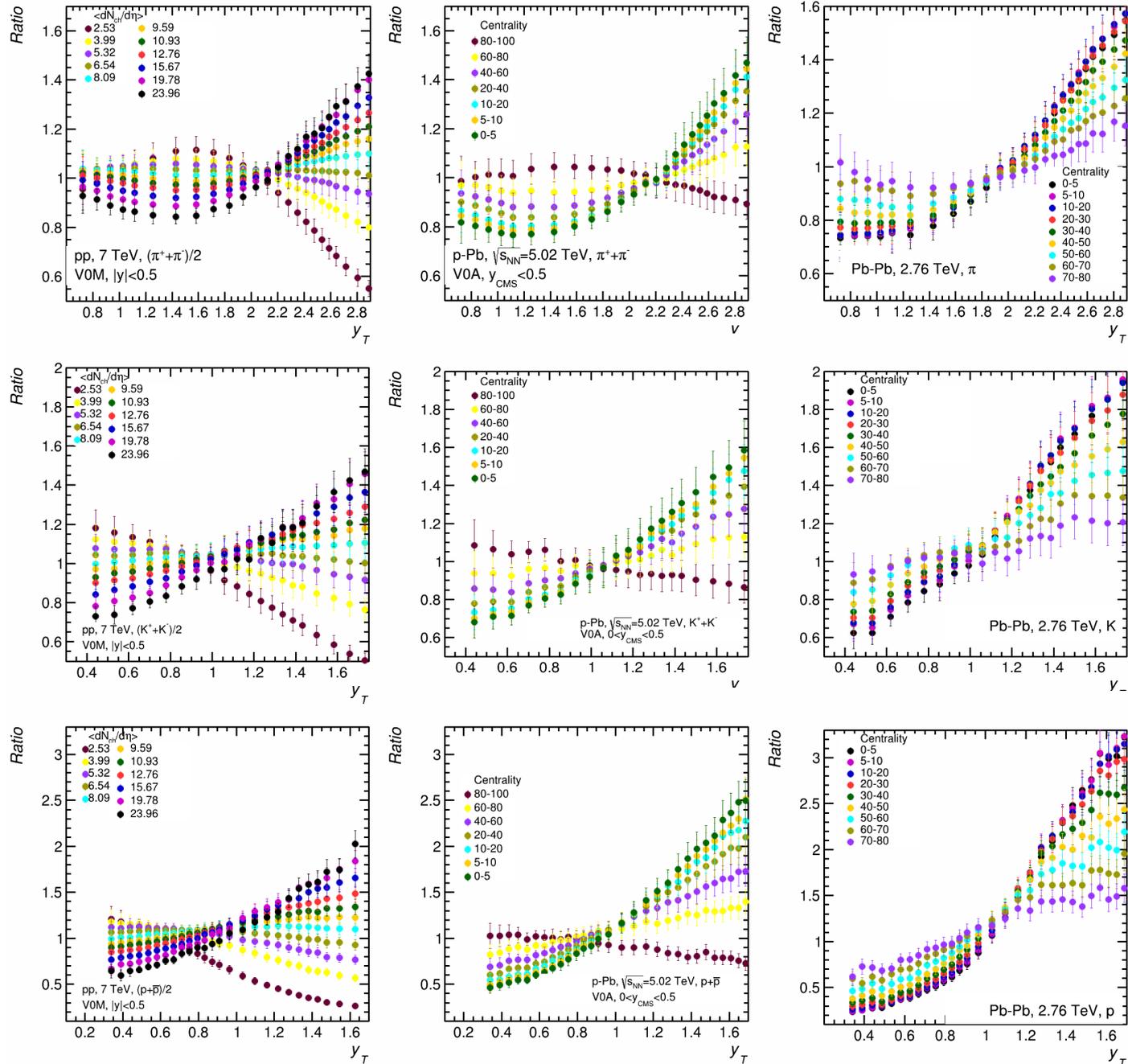
p_T distributions & their ratios to $V0M>0$ as a function of charged particle multiplicity ($V0M$ %)



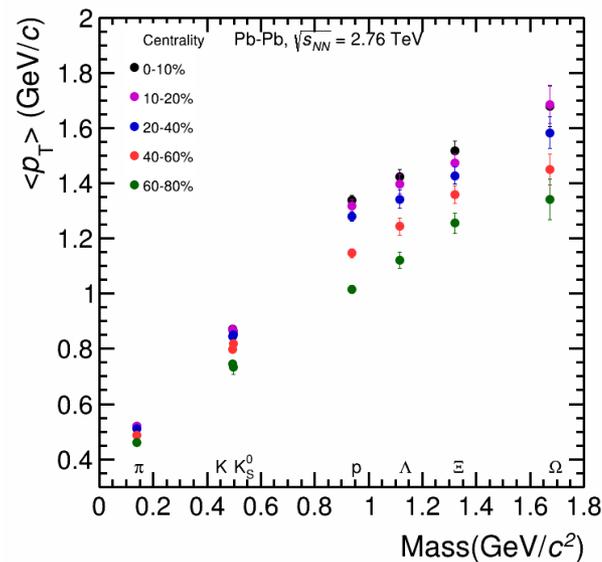
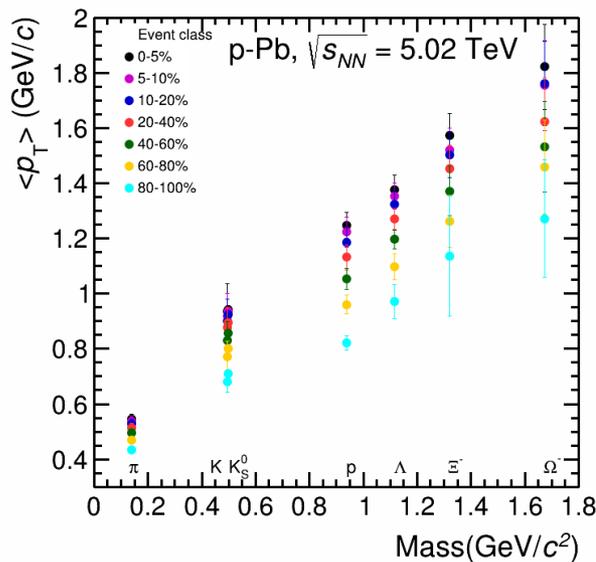
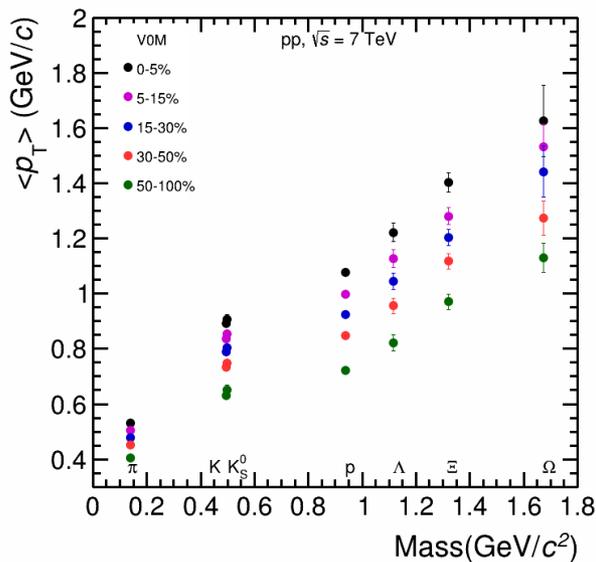
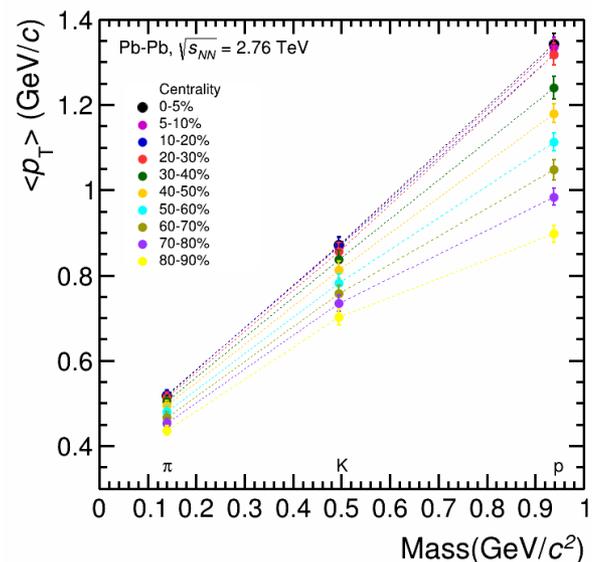
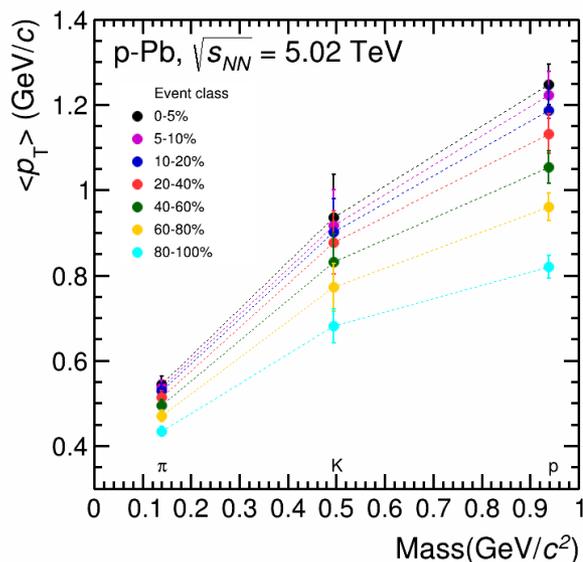
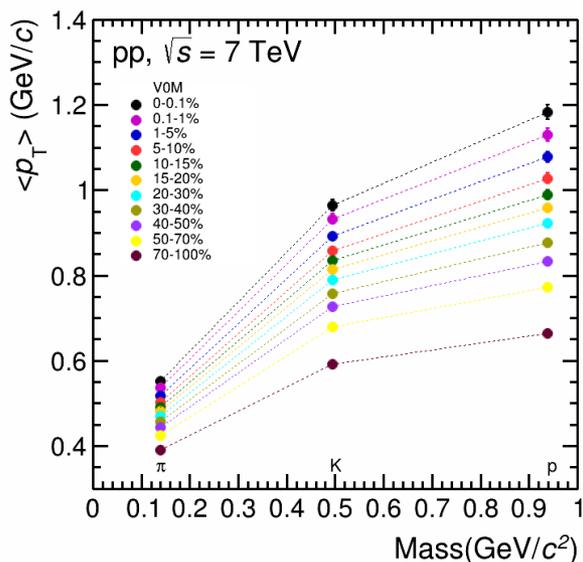
Normalized y_T distributions relative to MB $p+p$ as a function of charged particle multiplicity-centrality for $p+p$ (7 TeV), $p+Pb$ (5.02 TeV) and $Pb+Pb$ (2.76 TeV)



Normalized y_T distributions relative to MB $p+p$ as a function of charged particle multiplicity-centrality for $p+p$ (7 TeV), $p+Pb$ (5.02 TeV) and $Pb+Pb$ (2.76 TeV)

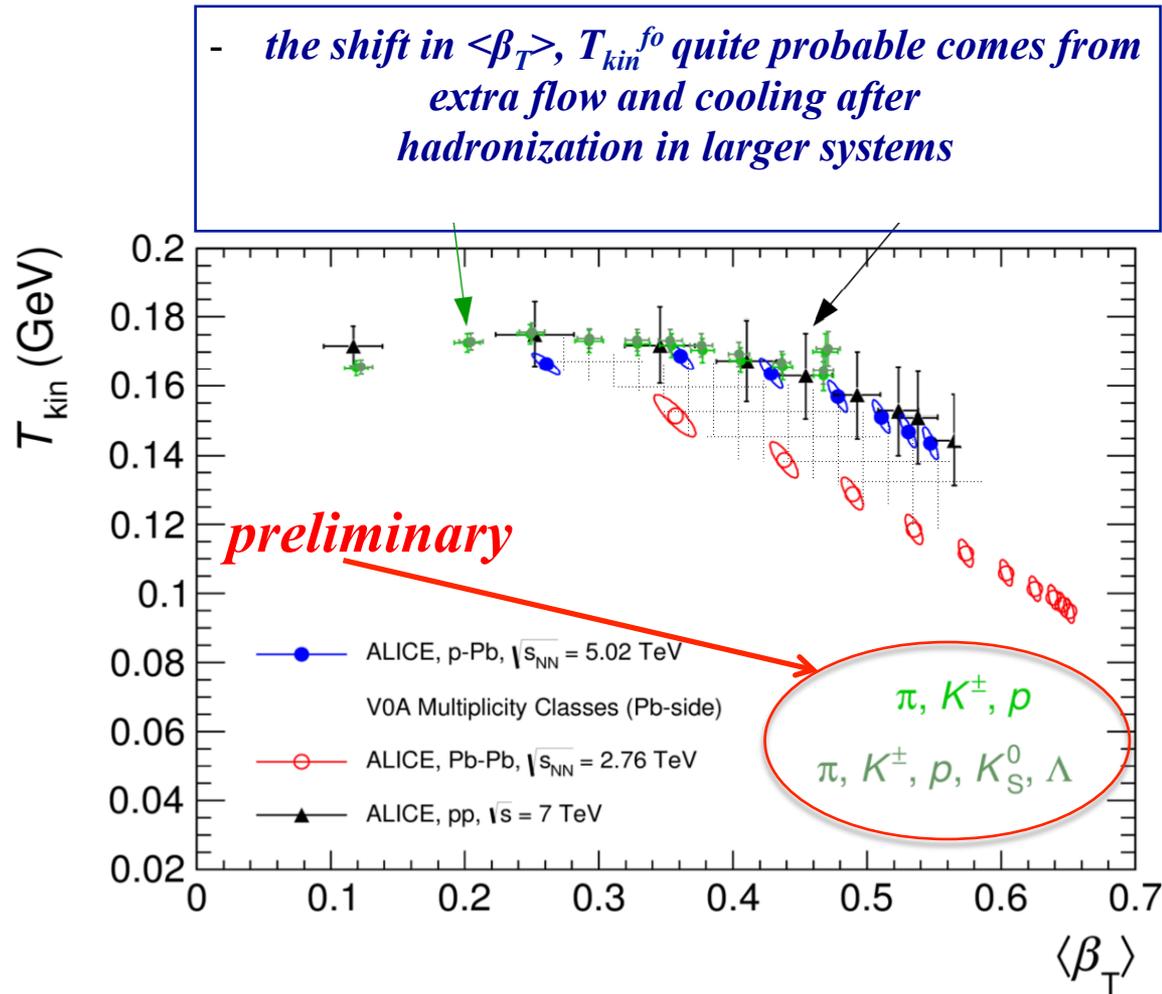


$\langle p_T \rangle$ as a function of mass – different charged particle multiplicities (centralities) for p+p (7 TeV), p+Pb (5.02 TeV) and Pb+Pb (2.76 TeV)



Comparison with p+Pb and Pb+Pb - based on models

BGBW

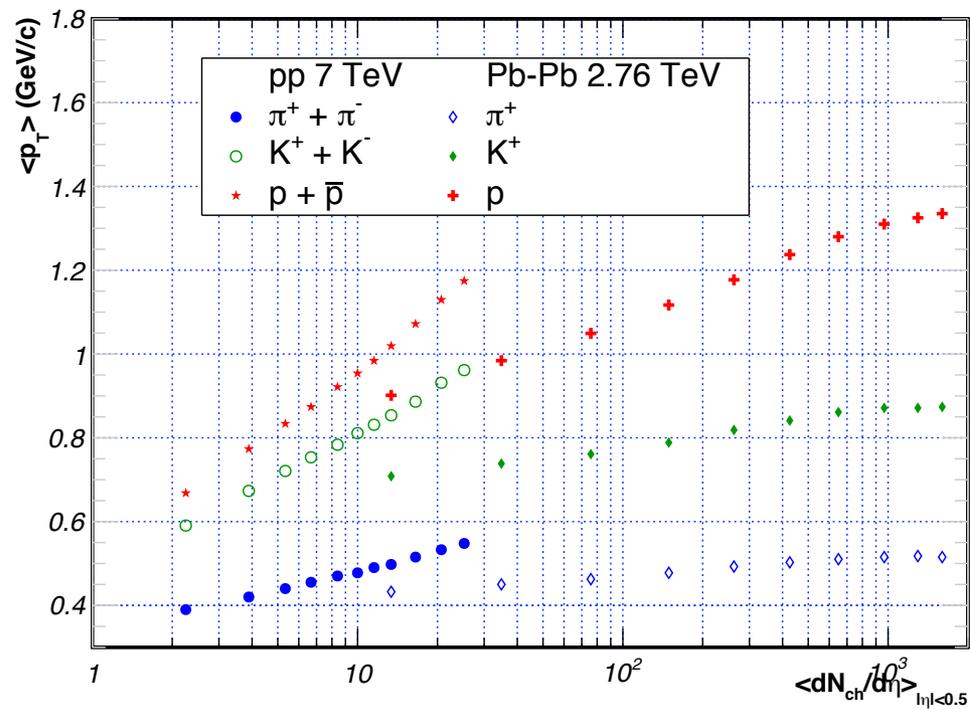


TBW

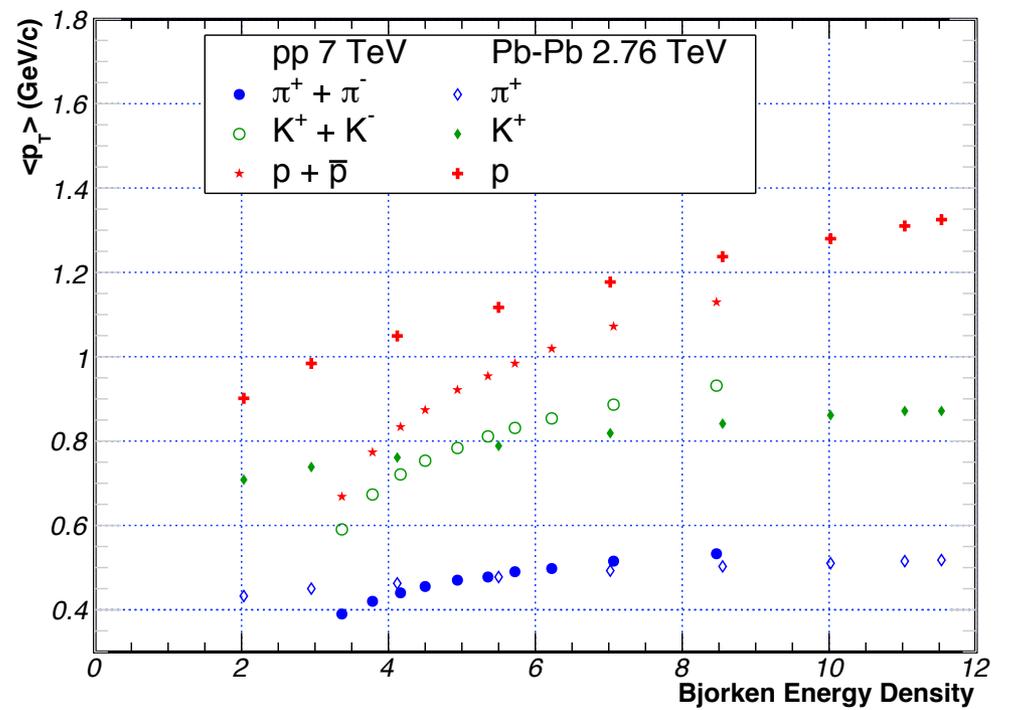
Will come !!!

A-A, p-A, pp collision geometry

Graph



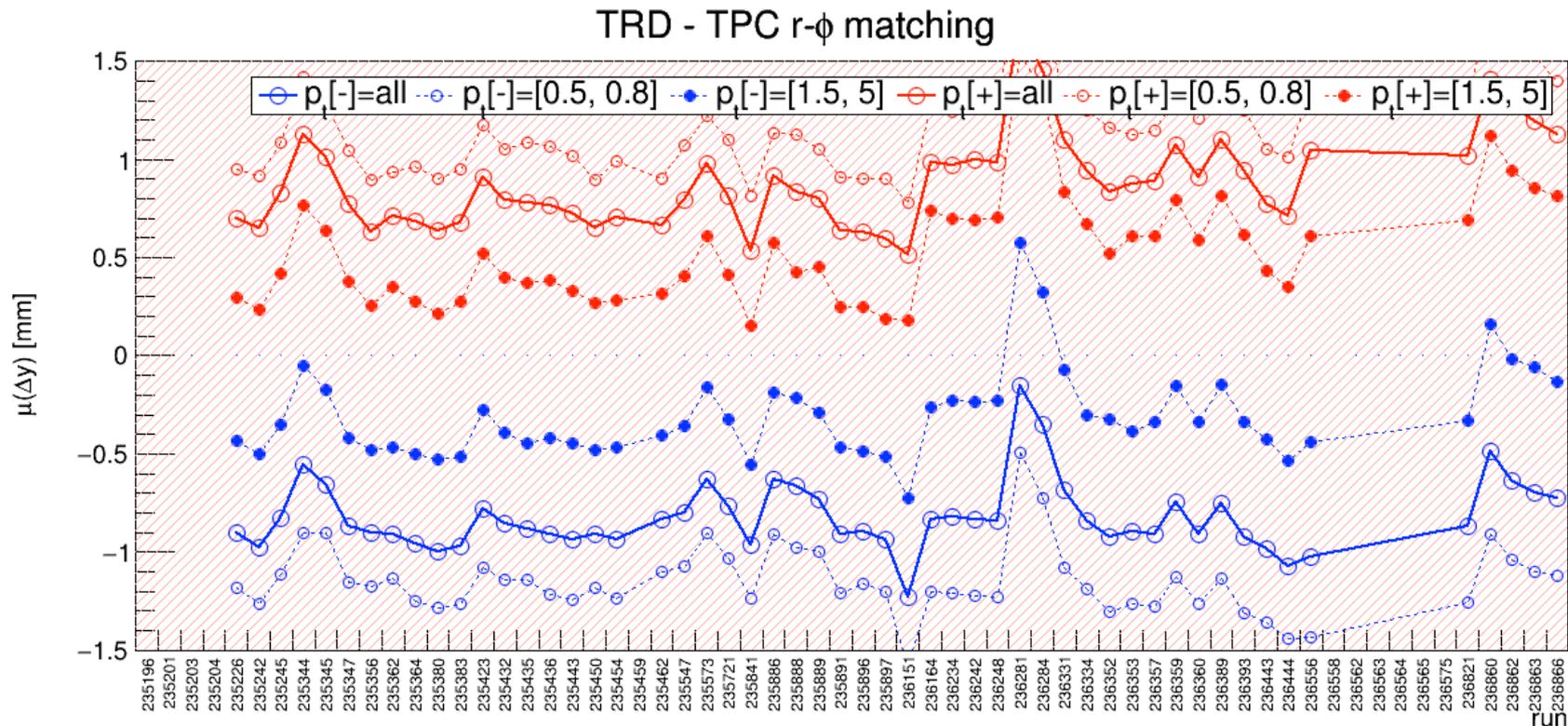
Graph



TRD-tracking

TRD QA

- Prepare the TRD-QA for running as a regular production on GSI servers and have the results published on the public domain of CERN (<http://aliqatrd.web.cern.ch/aliqatrd>)
 - Train a PhD student for TRD-QA service task and regular reports on the dedicated ALICE QA meetings.
- http://aliqatrd.web.cern.ch/aliqatrd/data/2015/LHC15i/pass1/TPC-TRD_matching_yshift.png



Computing

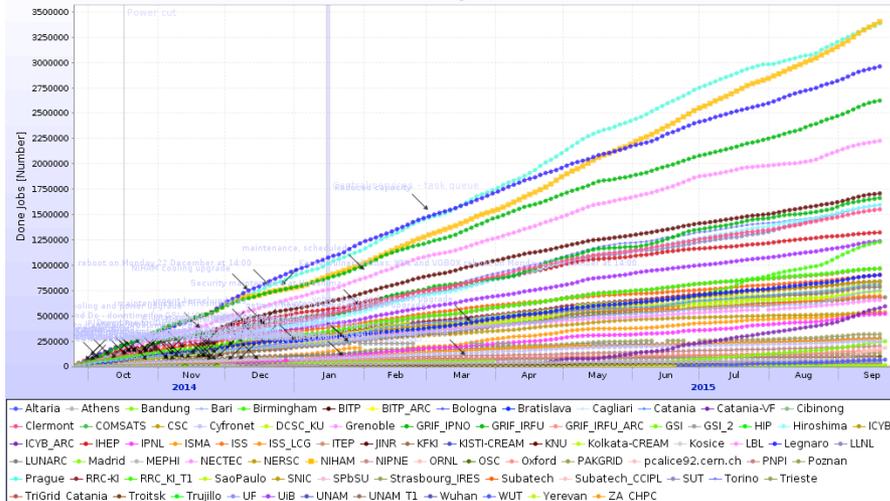
NIHAM

Tier2 component of ALICE GRID



NAF (Niham Analysis Facility)

Done Jobs



7.9% of Tier2 contributions

Software development for an efficient and flexible local data analysis

Analysis - Bayesian PID

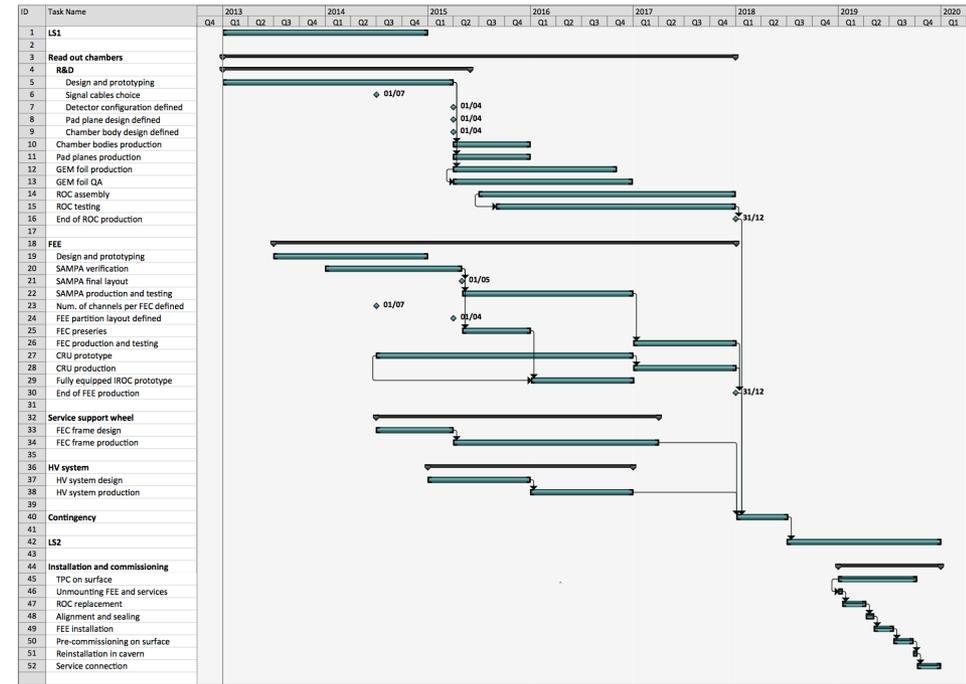
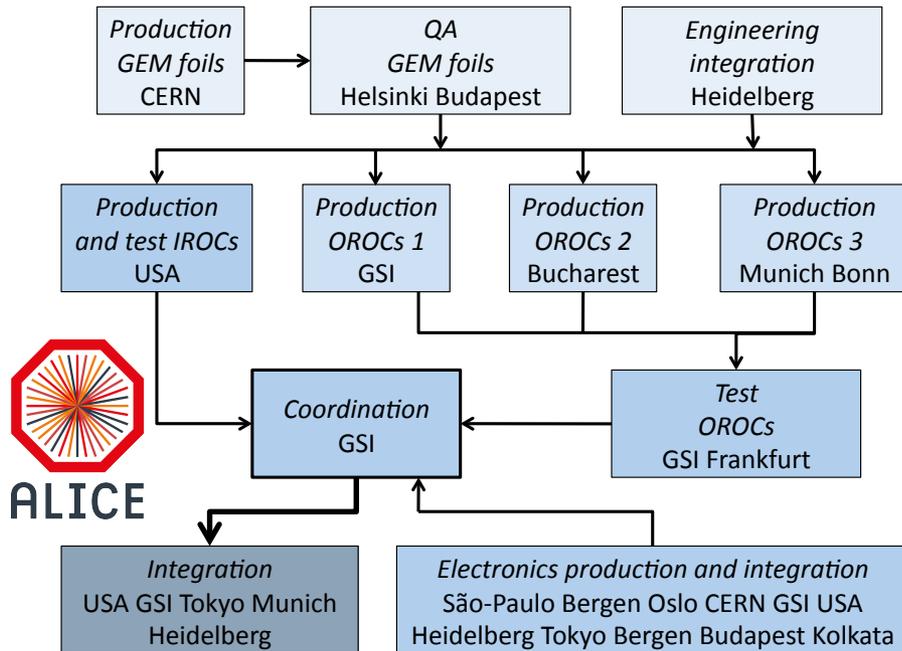
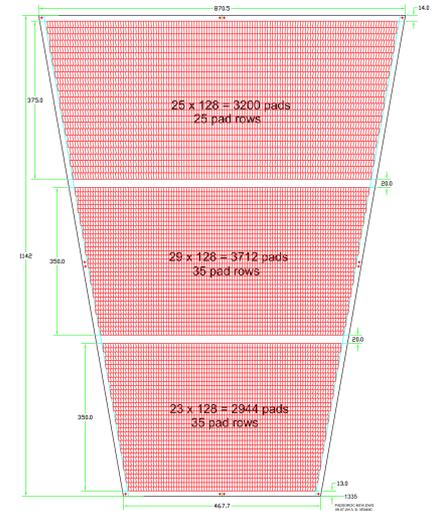
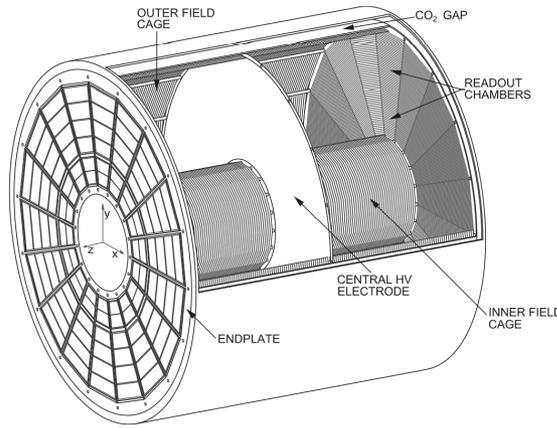
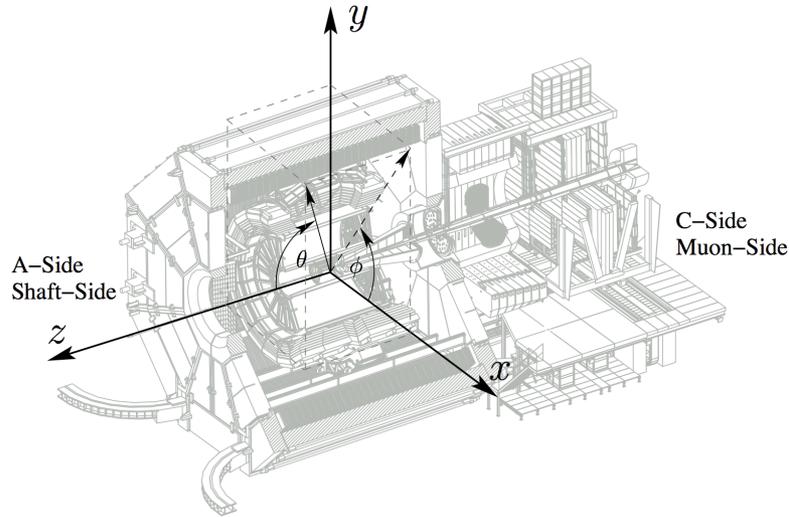
*- efficiencies, contaminations
multiplicity dependence*

- event shape global variables

- two-particle correlations - multi dimensional analysis

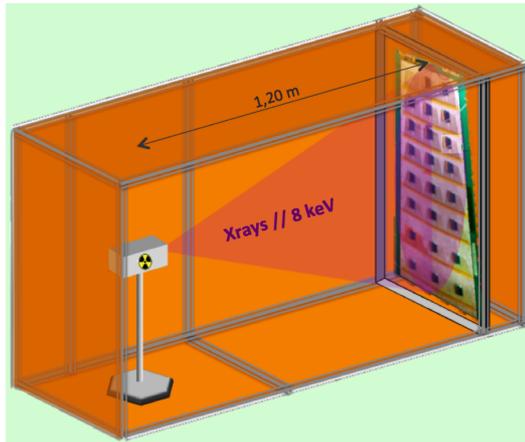
Large scale model calculations

ALICE-TPC upgrade

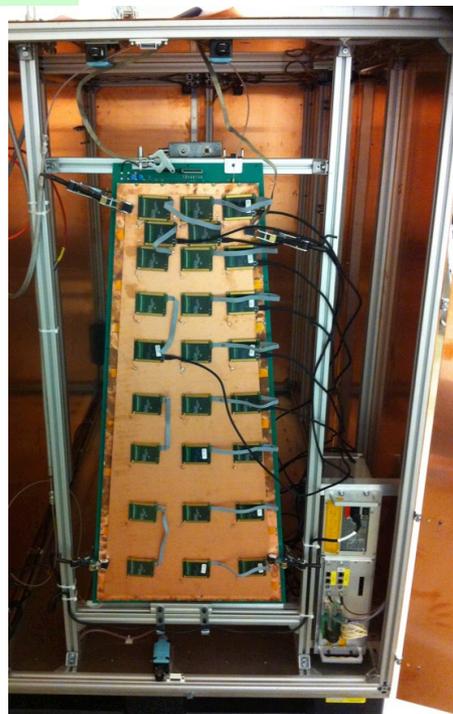
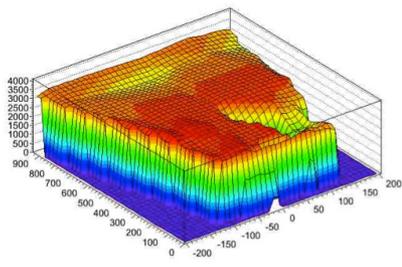
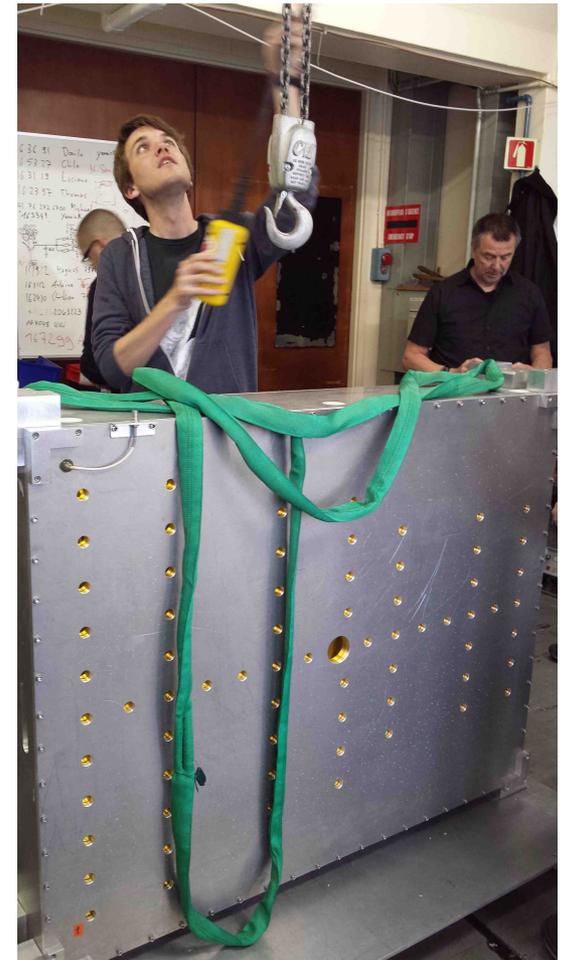
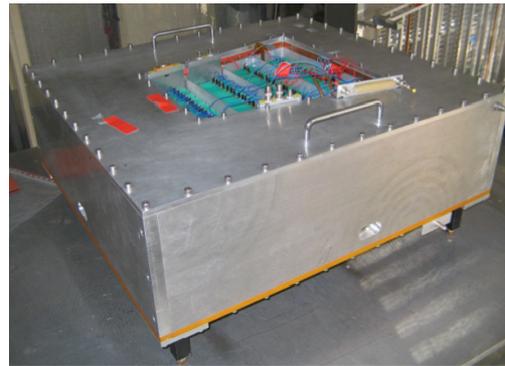


Housing box for in-house & in-beam tests

J.A.Merlin for CMS RD51 Miniweek, 18.06.14



Test boxes used for the MWPC ALICE TPC ROCs



Proposed OROC - housing box for in-house & in-beam tests

January 2015

Al - bars for handling

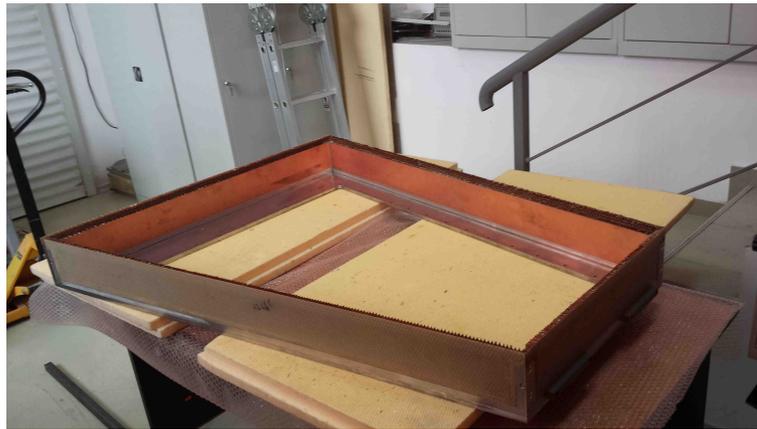
Al - back flange

Lateral walls
(honeycomb sandwiched by PCB layers)

Top cover
(honeycomb sandwiched by carbon layers)

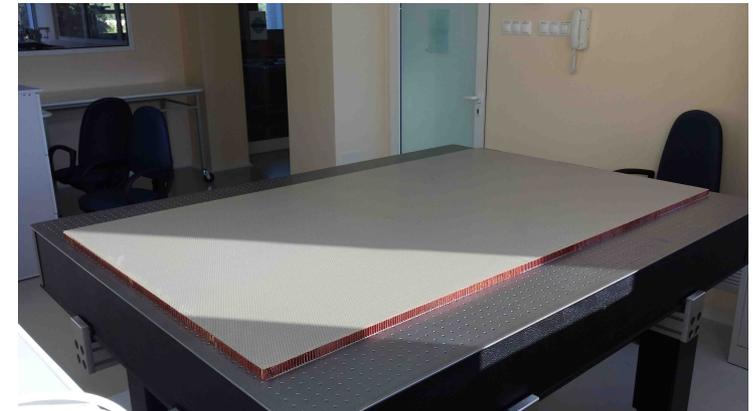
OROC - Al body

GEM stack

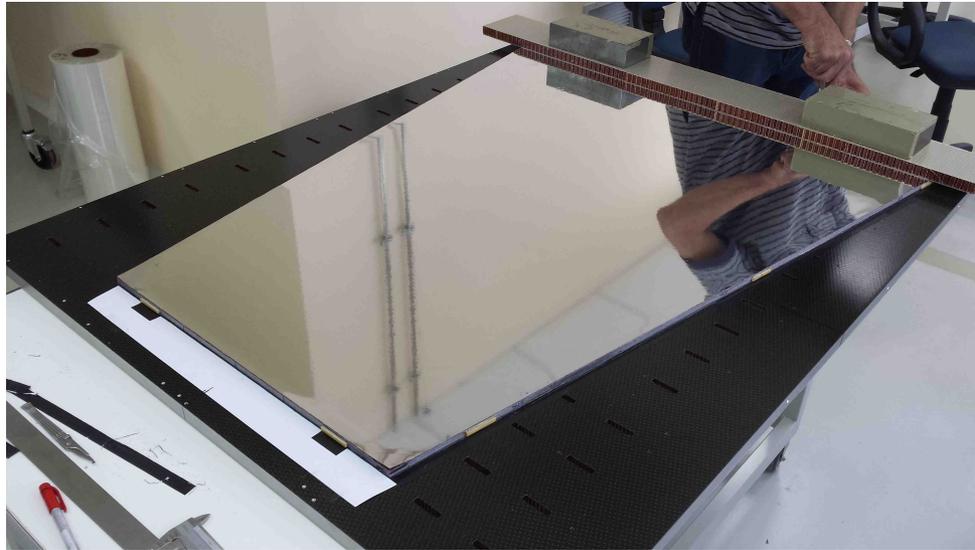


Honey comb & carbon fiber sheets - in house
Top cover construction will start
once the lateral walls will be assembled

Present



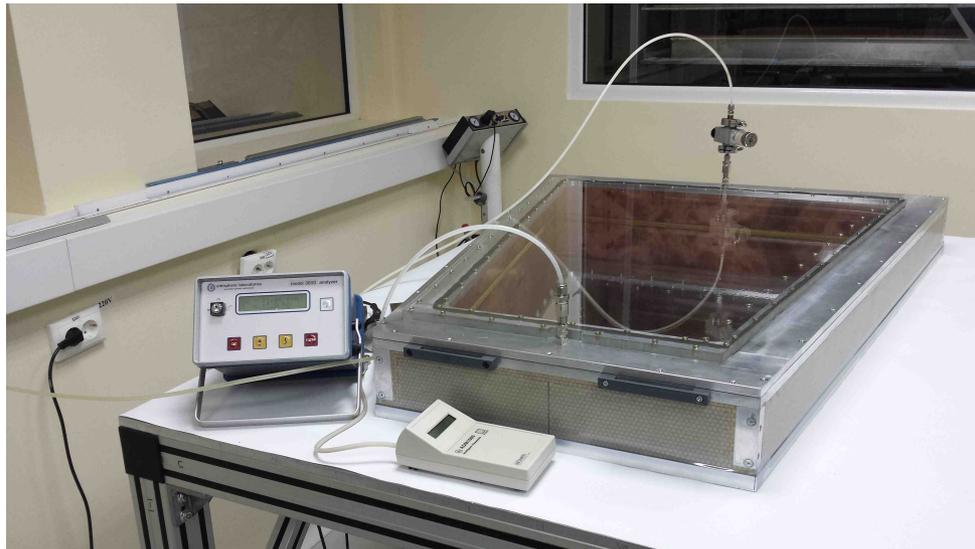
Top cover assembly



Top cover glueing

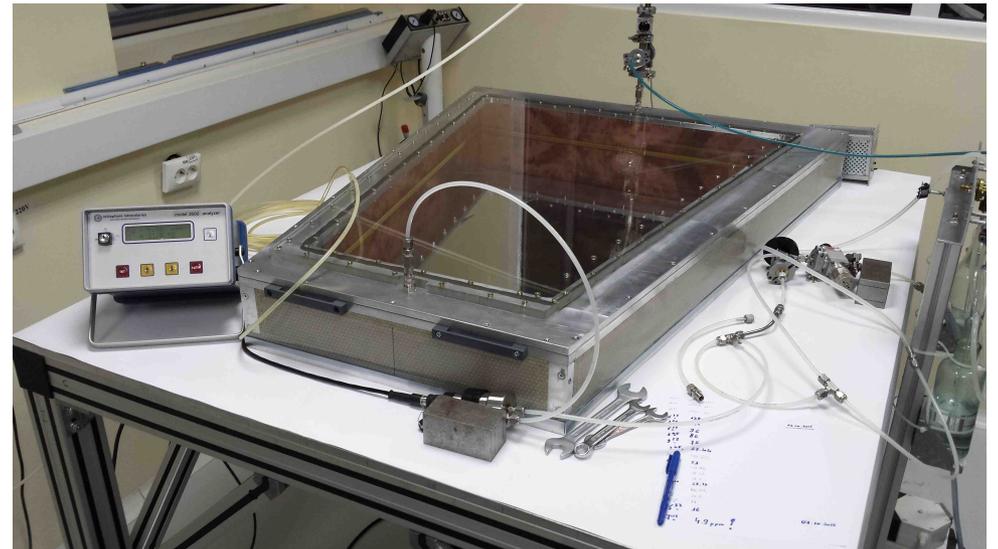


Tightness test – overpressure flow 6l/hour



~ 10 ppm Oxygen

Tightness test – underpressure flow 6l/hour

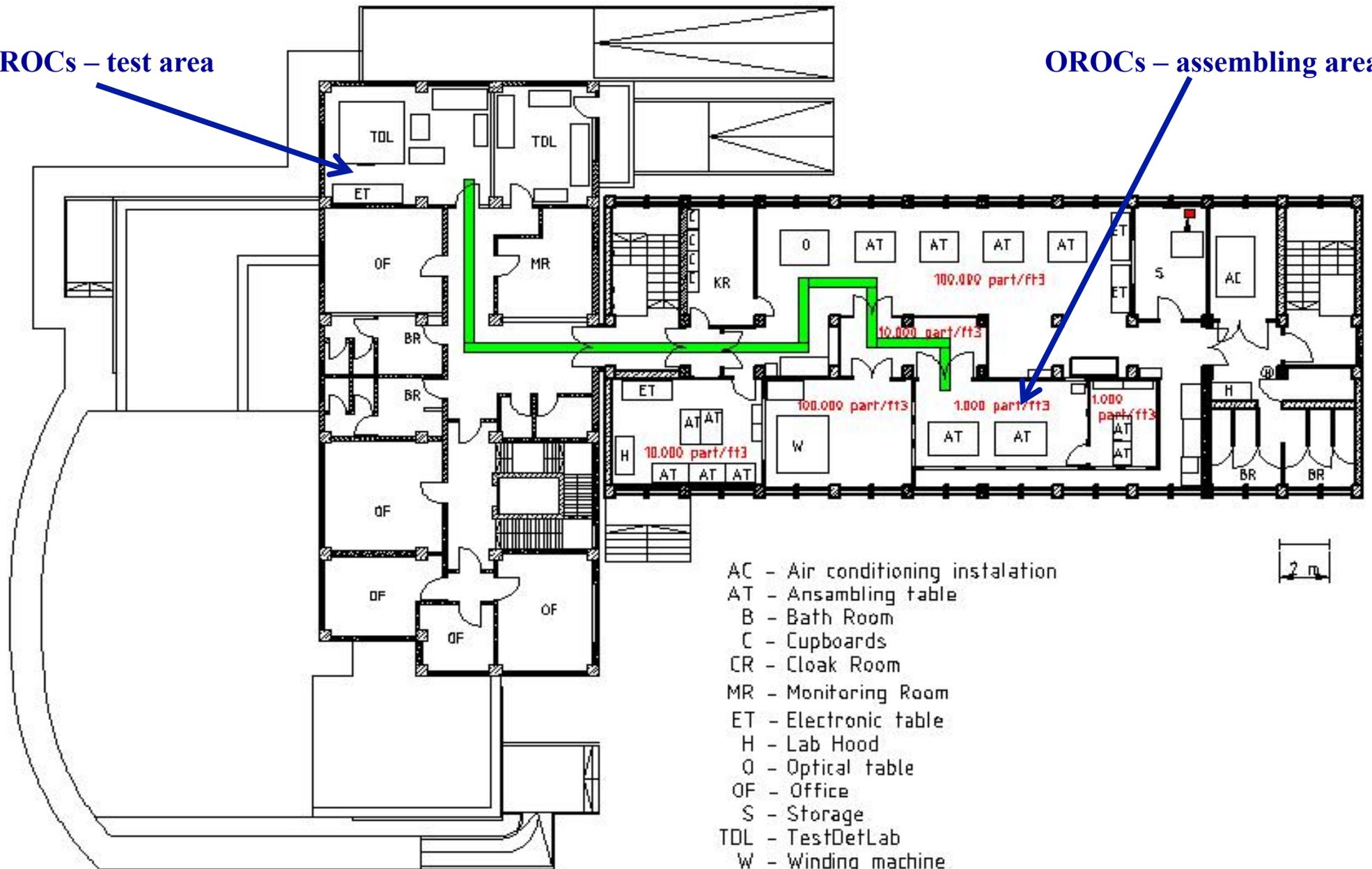


~ 5 ppm Oxygen

OROC assembling and test Labs.

OROCs – test area

OROCs – assembling area

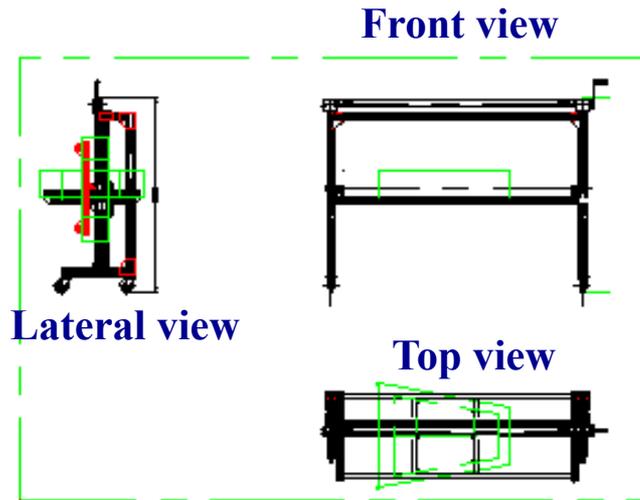


OROC transport and positioning device

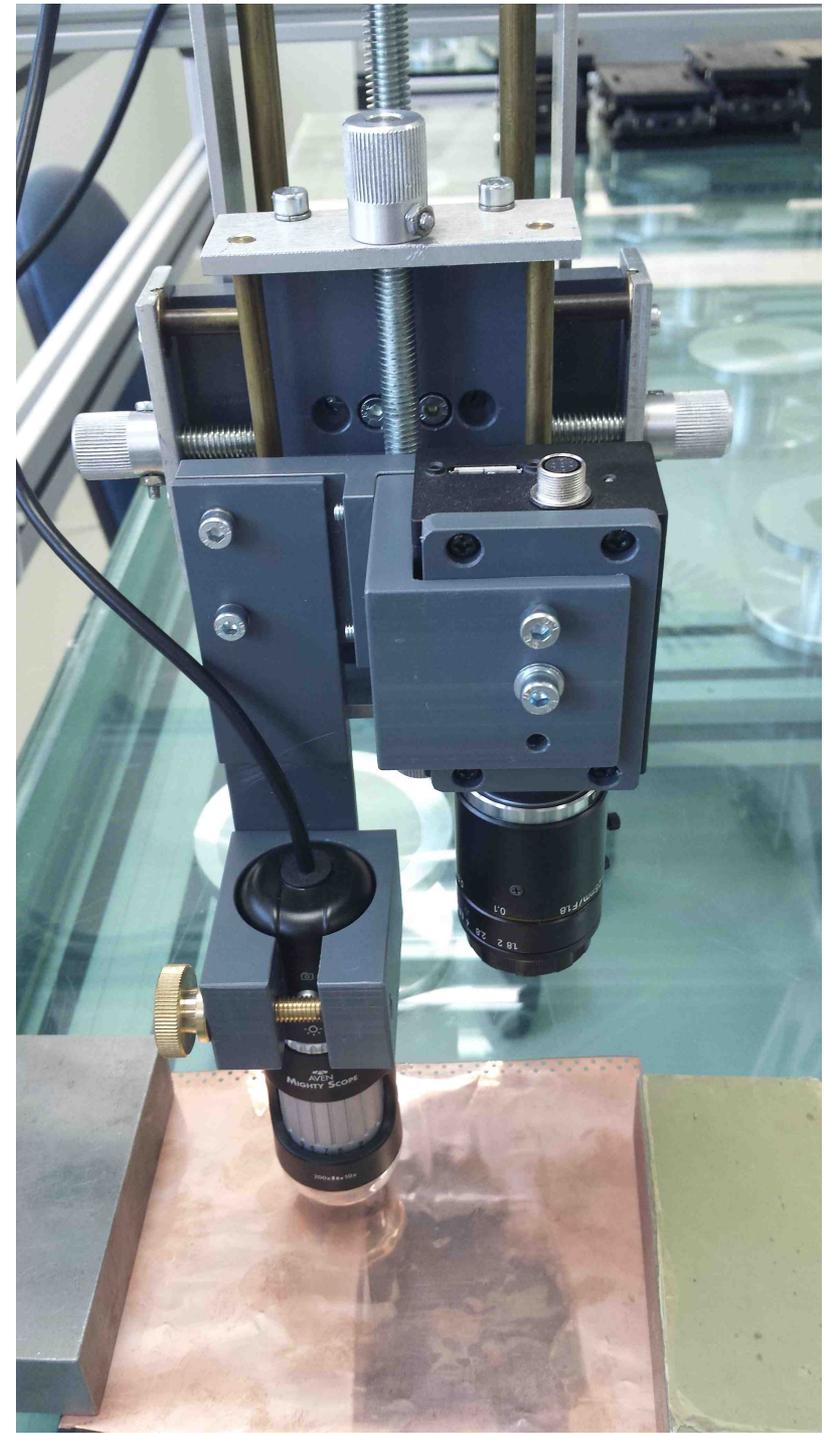
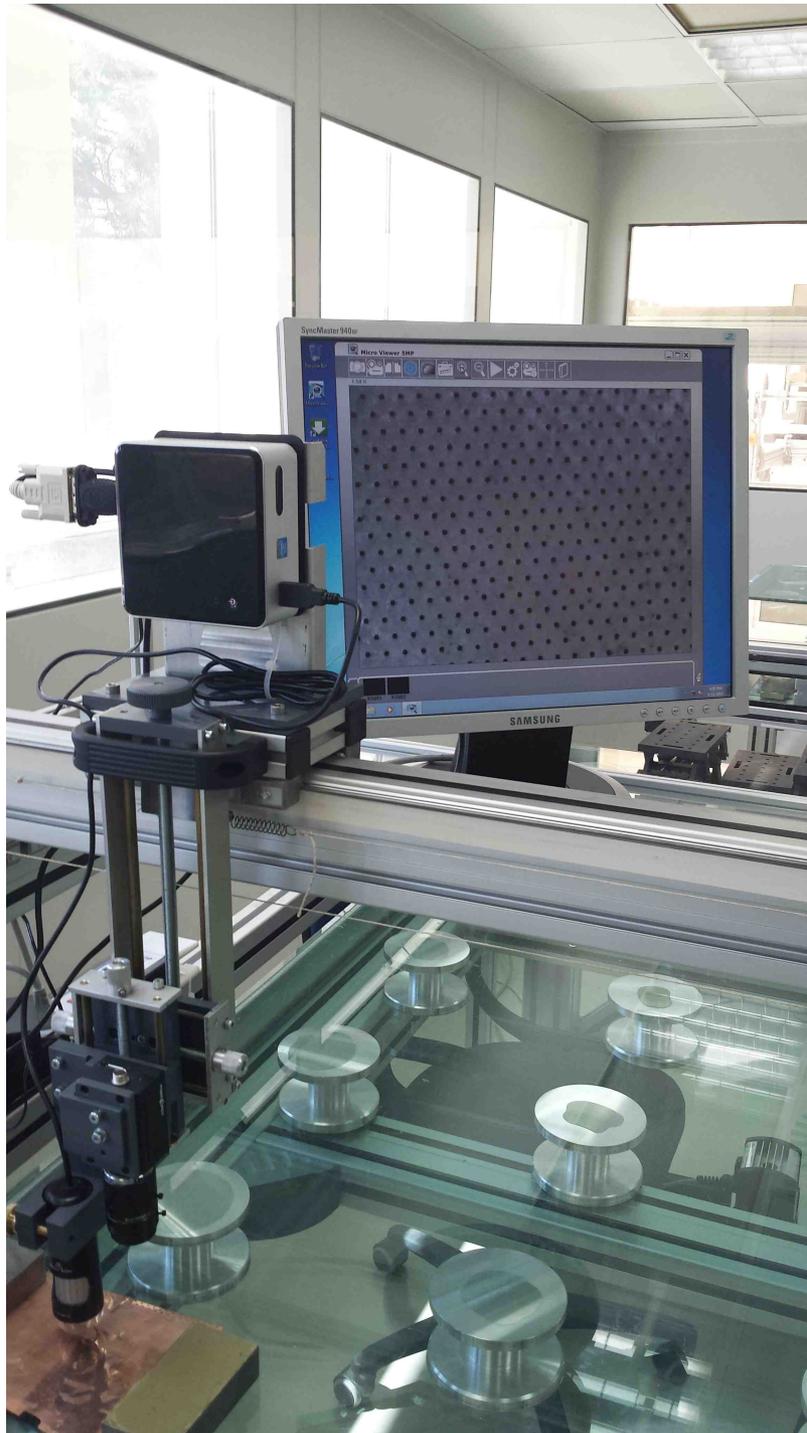
January 2015

Present

(most of the components in house)



OROC assembling room – 1,000 part/ft³ - Present



OROC assembling room – 1,000 part/ft³

January 2015

Present

Dry cupboard
searching
for the best
configuration & offer



Airborne Particulate Cleanliness Classes (by cubic meter)

CLASS	Number of Particles per Cubic Meter by Micrometer Size					
	0.1 um	0.2 um	0.3 um	0.5 um	1 um	5 um
ISO 1	10	2				
ISO 2	100	24	10	4		
ISO 3	1,000	237	102	35	8	
ISO 4	10,000	2,370	1,020	352	83	
ISO 5	100,000	23,700	10,200	3,520	832	29
ISO 6	1,000,000	237,000	102,000	35,200	8,320	293
ISO 7				352,000	83,200	2,930
ISO 8				3,520,000	832,000	29,300
ISO 9				35,200,000	8,320,000	293,000

Lab

```

***** COUNT ALARM *****
DATE 05/03/15 TIME 22:48:19
LOCATION 2 PERIOD 00:10:00
SIZE CUMULATIVE DIFFERENTIAL
0.3um 1041499 1019631
0.5um 21868 19490
0.7um 2378 1688
1.0um 690 690
5.0um 0 0
    
```

Inside cabinet

```

---- AVERAGE FOR 5 CYCLES ----
SIZE CUMULATIVE DIFFERENTIAL
0.3um 41626.4 39743.2
0.5um 1883.2 1517.0
0.7um 366.2 245.2
1.0um 121.0 121.0
    
```

Relative humidity ≈ 6%

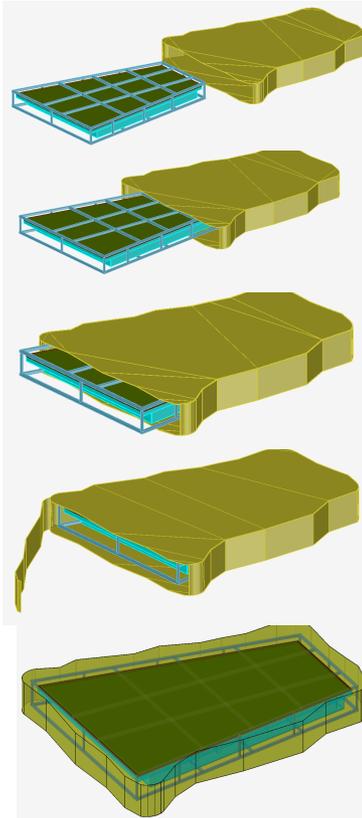
Proposed OROC – transportation & storage housing box

January 2015

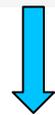
Present

We do not have yet a cheap & safe solution for individual ROCs housing for transport & storage

**Multilayer metalized foil Bag
- Oxygen & moisture tight**

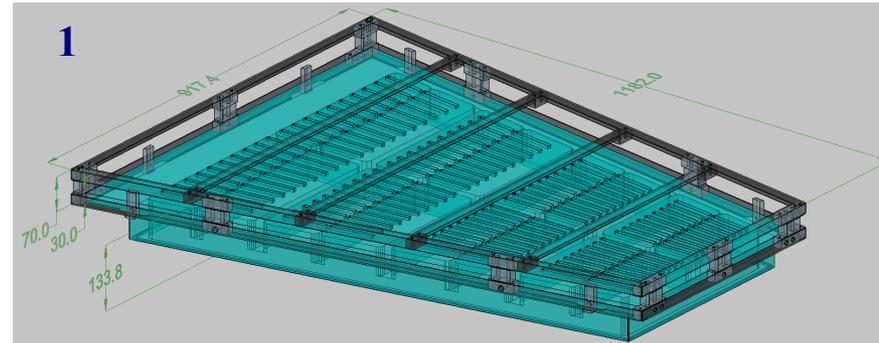


Price ≈ ???



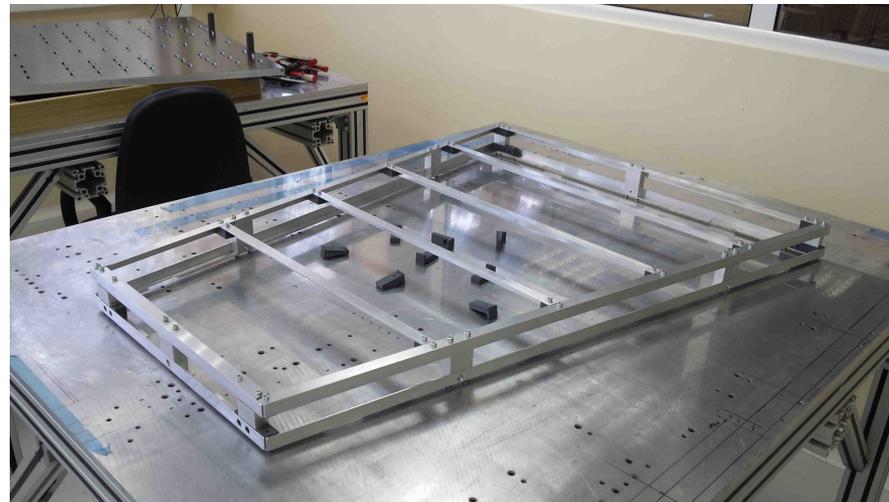
**Wooden or foam type box
- Offers in progress**

Price ≈ ???

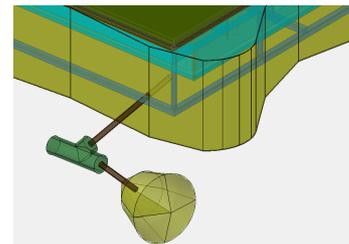
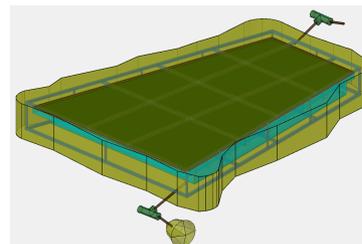


Weight - 4.5 Kg
Price ≈ 150 EUR

The first prototype ready



Negotiations with the company close to final



Papers and talks in the last year

Papers

Comparison between different PID analyses at MB with the Bayesian procedure:

- Measurement of pion, kaon and proton production in proton-proton collisions at $\sqrt{s} = 7$ TeV, EPJC 75 (2015) 226

GRID (computation and storage) and detector operation support:

- Measurement of charm and beauty production at central rapidity versus charged-particle multiplicity in proton-proton collisions at $\sqrt{s} = 7$ TeV, JHEP 09 (2015) 148
- Measurement of jet quenching with semi-inclusive hadron-jet distributions in central Pb-Pb collisions at $\sqrt{s} \sqrt{s_{NN}} = 2.76$ TeV, JHEP 09 (2015) 170
- Coherent q_0 photoproduction in ultra-peripheral Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, JHEP 09 (2015) 095
- Precision measurement of the mass difference between light nuclei and anti-nuclei, Nature Physics 11, 811–814 (2015)
- Measurement of charged jet production cross sections and nuclear modification in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, Phys. Lett. B 749 (2015) 68-81
- Inclusive, prompt and non-prompt J/Ψ production at mid-rapidity in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, JHEP 07 (2015) 051
- Elliptic flow of identified hadrons in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, JHEP 06 (2015) 190
- Charged jet cross sections and properties in proton-proton collisions at $\sqrt{s} = 7$ TeV, Phys. Rev. D 91 (2015) 112012
- Rapidity and transverse-momentum dependence of the inclusive J/Ψ nuclear modification factor in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, JHEP (2015) 55
- Centrality dependence of particle production in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, Phys. Rev. C 91 (2015) 064905
- Forward-backward multiplicity correlations in pp collisions at $\sqrt{s} = 0.9, 2.76$ and 7 TeV, JHEP 05 (2015) 097
- Measurement of dijet in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, Phys. Lett. B 746 (2015) 385
- Measurement of jet suppression in central Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, Phys. Lett. B 746 (2015) 1
- Inclusive photon production at forward rapidities in proton-proton collisions at $\sqrt{s_{NN}} = 0.9, 2.76$ and 7 TeV, EPJC 75 (2015) 146
- Two-pion femtoscopy in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, Phys. Rev. C 91 (2015) 034906
- $K^*(892)$ and (1020) production in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, Phys. Rev. C 91 (2015) 024609
- Production of $\Sigma(1385)^\pm$ and $\Xi(1530)0$ in proton-proton collisions at $\sqrt{s} = 7$ TeV, Eur. Phys. J. C 75 (2015) 1
- Measurement of electrons from semileptonic heavy-flavor hadron decays in pp collisions at $\sqrt{s} = 2.76$ TeV, Phys. Rev. D 91 (2015) 01200
- Multiplicity dependence of jet-like two-particle correlations in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, Phys. Lett. B 741 (2015) 38-50
- Production of inclusive Y(1S) and Y(2S) in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, Phys. Lett. B 740 (2015) 105-117

Conferences

Identified charged hadron spectra as a function of multiplicity:

- Strangeness production as a function of charged particle multiplicity in proton-proton collisions – oral presentation, Quark Matter 2015 - XXV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, 2015-09-27 – 2015-10-03, Kobe Fashion Mart, Kobe, Japan
- Search for collective phenomena in high multiplicity pp and p-Pb collisions with the ALICE experiment – poster, Quark Matter 2015 - XXV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, 2015-09-27 – 2015-10-03, Kobe Fashion Mart, Kobe, Japan
- Identified particle production as a function of charged particle multiplicity with ALICE, XXXVIII Reunião de Trabalho sobre Física Nuclear no Brasil, 2015-09-07 – 2015-09-11, Mangaratiba, RJ
- Soft particle production and study of collective phenomena with the ALICE detector at the LHC, Strangeness in Quark Matter (SQM 2015), 2015-07-06 – 2015-07-11, Dubna, Russia
- Transverse momentum spectra of pi, K and p in small collisional systems: search for collective phenomena, LHCC students poster sessions, 2015-03-04 – 2015-03-05, CERN
- ALICE results on light-flavour hadron production at the LHC, ICPAQGP-2015 - 7th International Conference on Physics and Astrophysics of Quark Gluon Plasma, 2015-02-02 – 2015-02-06, Kolkata, India

TPC upgrade contribution:

- ALICE TPC upgrade for High-Rate operations, ICPAQGP-2015 - 7th International Conference on Physics and Astrophysics of Quark Gluon Plasma, 2015-02-02 – 2015-02-06, Kolkata, India
- ALICE upgrades plans and potential, LHCP 2015 - 3rd Annual Conference on Large Hadron Collider Physics, 2015-08-31 - 2015-09-05

Talks of group members

Spectra - PAG:

- Status of identified charged hadrons pT spectra as a function of multiplicity in p+p collisions at 7 TeV, 4.02.2015

https://indico.cern.ch/event/370658/contribution/3/attachments/737290/1011500/CAndrei_Spectra_04022015.pdf

- A few considerations on multiplicity & event shape selectors in p+p collisions, 23.03.2015

https://indico.cern.ch/event/383037/contribution/0/attachments/763968/1048089/considerations_on_multiplicity_selector.pdf

- Update on the charged pT spectra vs multiplicity, 11.05.2015

<https://indico.cern.ch/event/393660/contribution/2/attachments/787801/1079871/AHerghelgin20150511.pdf>

Bayesian PID group:

- Status of identified charged hadrons pT spectra as a function of multiplicity in p+p collisions at 7 TeV - Flat priors crosschecks, 23.03.2015

https://indico.cern.ch/event/383195/contribution/0/attachments/764357/1048586/CAndrei_PID_23032015.pdf

High Multiplicity Task Force:

- Dependence of pT, mT and yT distributions on multiplicity selectors in p+p collisions @ 7 TeV (charged particles and identified charged hadrons), 28.07.2015

https://indico.cern.ch/event/435539/contribution/1/attachments/1133066/1620243/HMTF_presentation_July_2015.pdf

PWG-LF:

- [Paper Proposal] Multiplicity dependence of transverse momentum spectra of identified charged hadrons in proton-proton collisions at $\sqrt{s} = 7$ TeV, 12.10.2015

https://indico.cern.ch/event/452659/contribution/4/attachments/1168670/1686048/paper_proposal_121015.pdf

TPC upgrade:

- Status at HPD, ALICE-TPC Upgrade Meeting, 19.01.2015

https://indico.cern.ch/event/366050/session/1/contribution/5/attachments/727776/998642/HPD_status_OROC_assembling_tests_190115_2.pdf

- Status in Bucharest, ALICE-TPC Upgrade Meeting, 20.01.2015

Identified charged hadron spectra as a function of multiplicity:

- Strangeness production as a function of charged particle multiplicity in proton-proton collisions – oral presentation, Quark Matter 2015 - XXV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, 2015-09-27 – 2015-10-03, Kobe Fashion Mart, Kobe, Japan

- Search for collective phenomena in high multiplicity pp and p-Pb collisions with the ALICE experiment – poster, Quark Matter 2015 - XXV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, 2015-09-27 – 2015-10-03, Kobe Fashion Mart, Kobe, Japan

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- ALICE upgrades plans and potential, LHCP 2015 - 3rd Annual Conference on Large Hadron Collider Physics, 2015-08-31 - 2015-09-05

Internal Notes

- Identified charged hadrons pT spectra as a function of multiplicity in pp collisions at 7 TeV https://twiki.cern.ch/twiki/pub/ALICE/PWGLEPAGSPECTRAMultiplicityEventShapePP7/InternalNote_01062015.pdf

- Charged particles pT spectra as a function of multiplicity in pp collisions at 7 TeV https://twiki.cern.ch/twiki/pub/ALICE/PWGLEPAGSPECTRAMultiplicityEventShapePP7/AHerghelgin_ch_part_20150526.pdf

- Pion, Kaon, and Proton Transverse Momentum Spectra as a function of charged particle multiplicity in pp collisions at $\sqrt{s} = 7$ TeV

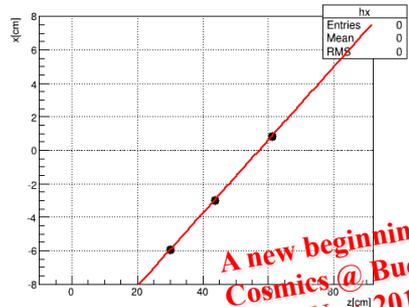
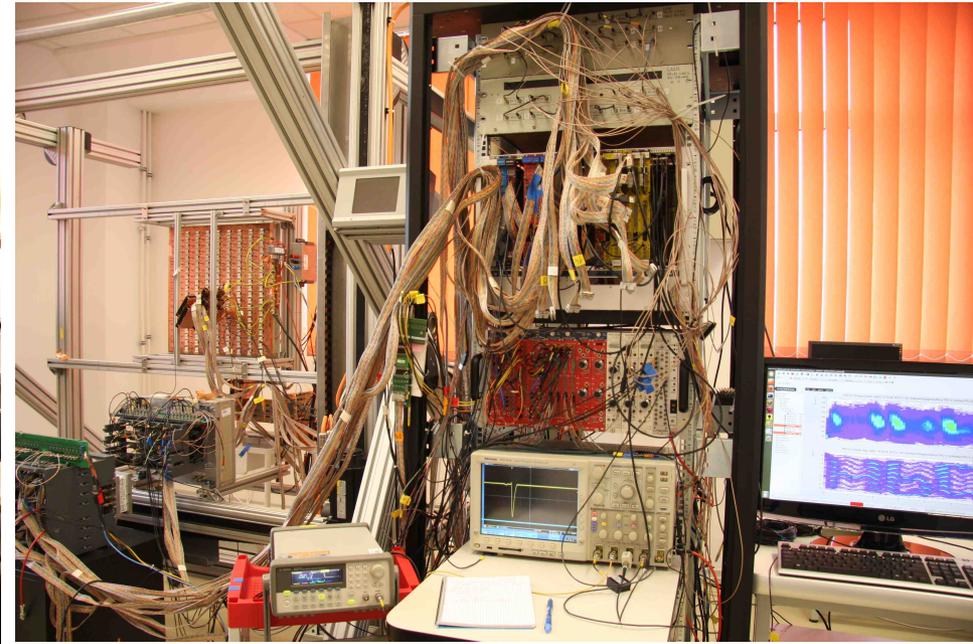
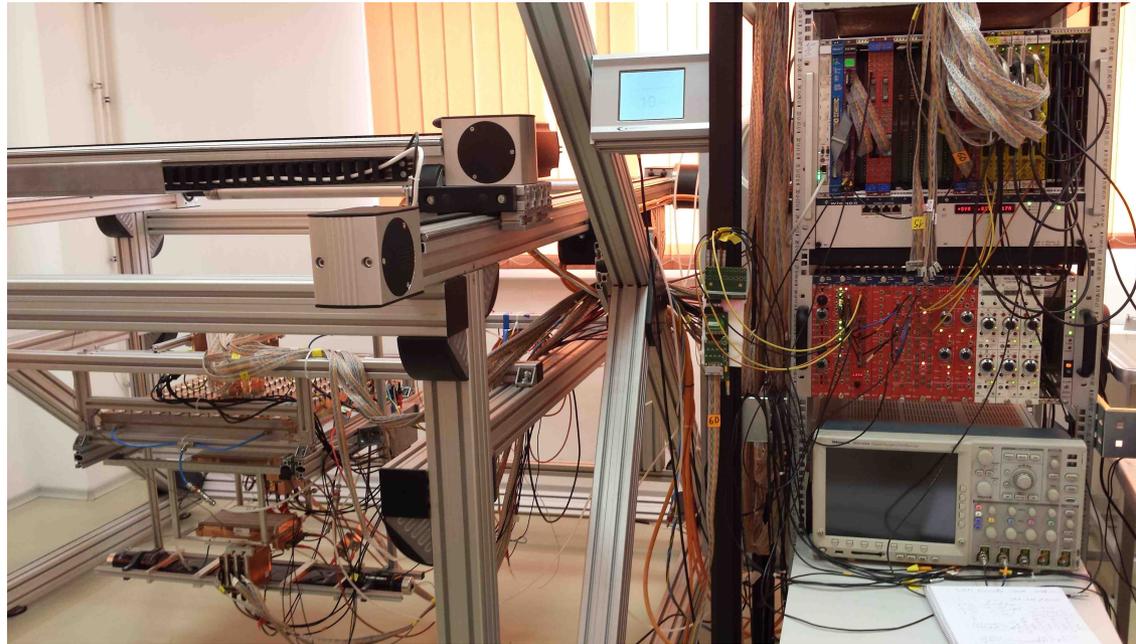
https://aliceinfo.cern.ch/Notes/sites/aliceinfo.cern.ch/Notes/files/notes/analysis/akalweit/2015-Sep-15-analysis_note-AnalysisNote.pdf

- [Paper Draft] Particle Identification methods in ALICE: a Bayesian approach – PC member from our group

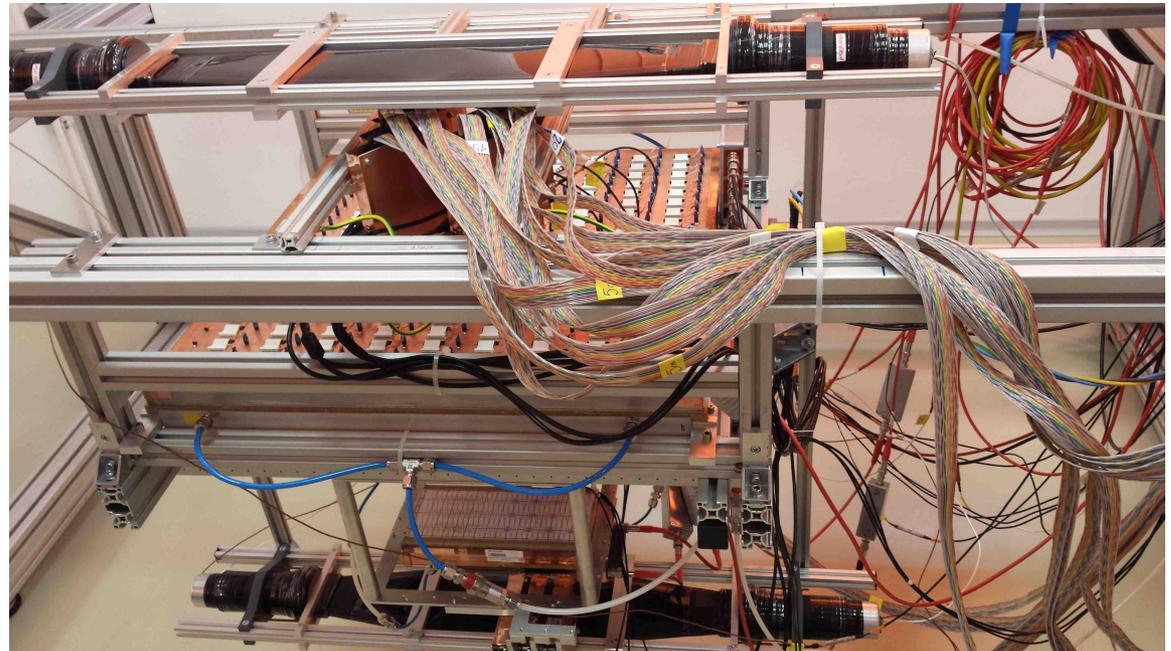
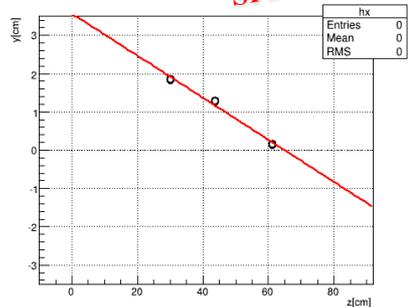
<https://aliceinfo.cern.ch/ArtSubmission/node/1495>

Further activities

TRD&RPC in-house test set-up ~ with the one for in-beam tests



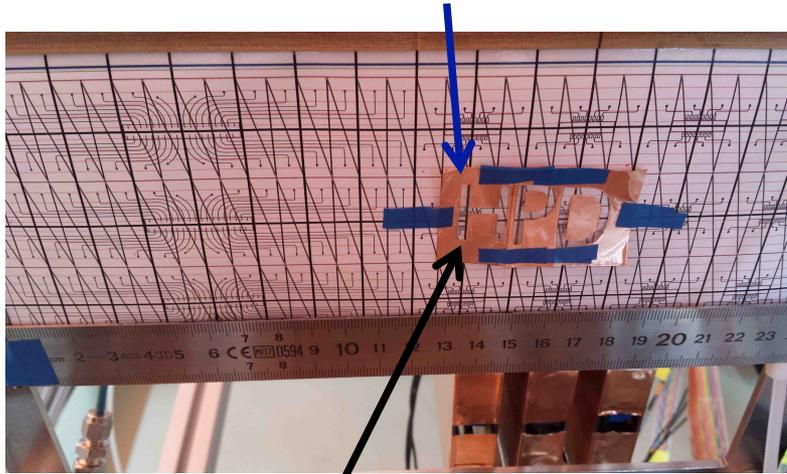
**A new beginning ...
Cosmics @ Bucharest
SPS - Nov. 2015**



TRD in-house test set-up ~ the one for in-beam tests

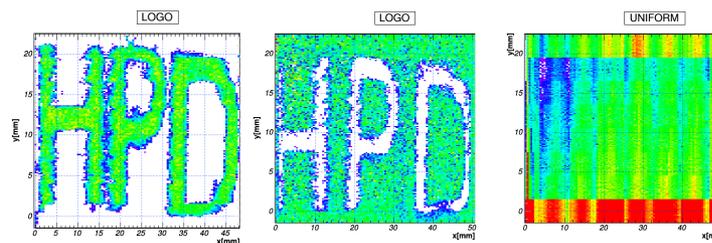
The Photo of the Week

Copper foil - absorber



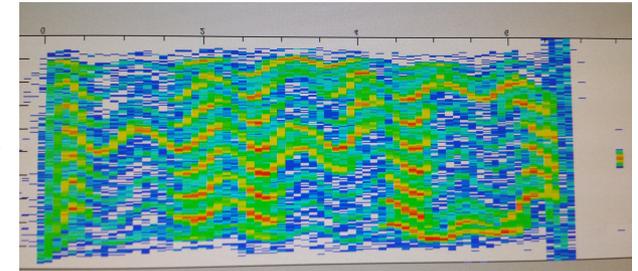
Letters cut on a
Copper foil

Glued on the two-dimensional position sensitive TRD
exposed to a uniform flux of ^{55}Fe source

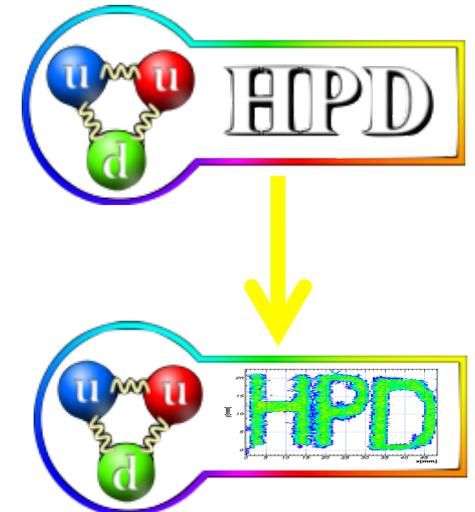


x-y position plot based on
the calibration and reconstruction worked-out
by Alexandru Bercuci

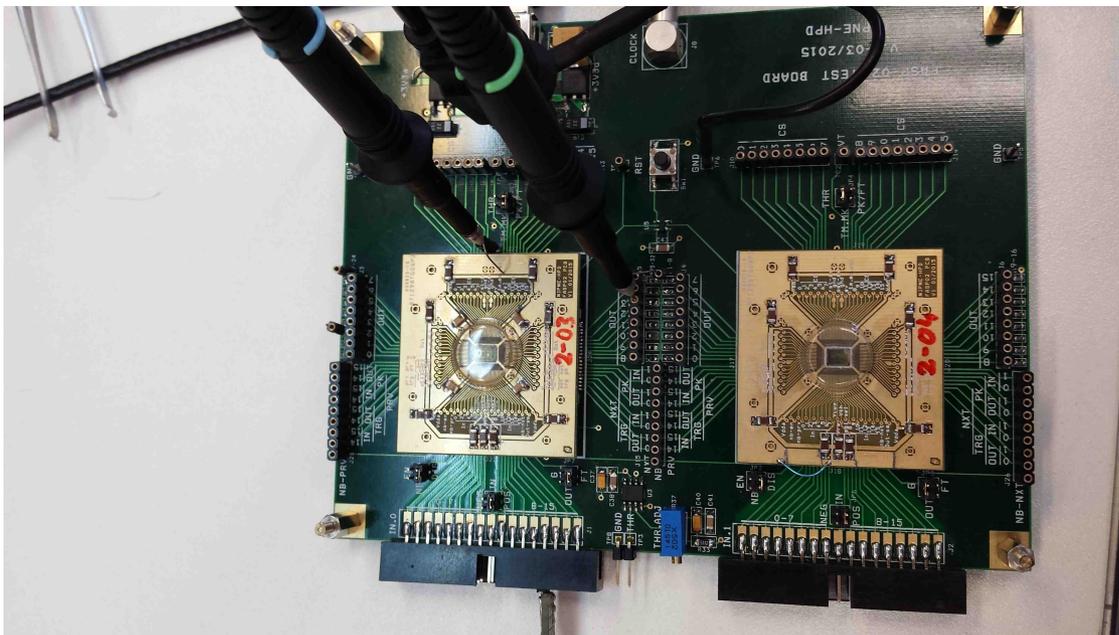
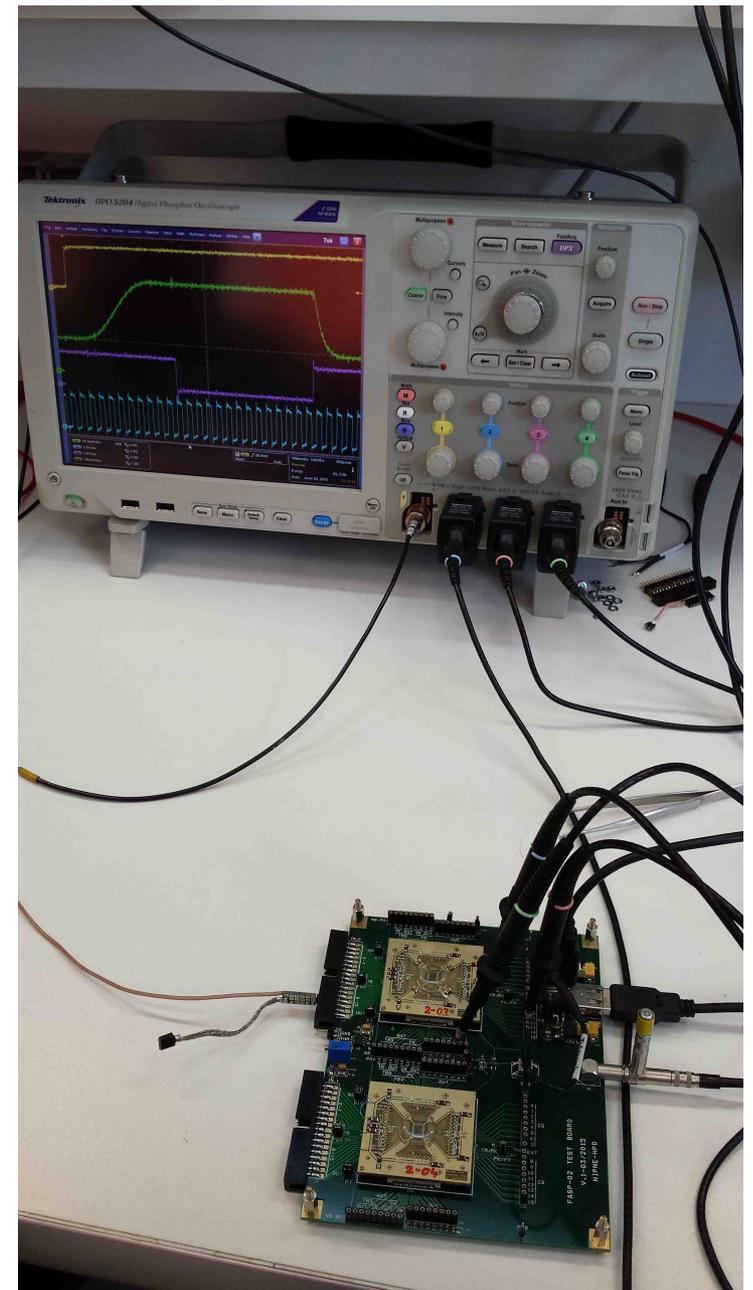
On-line result
without any corrections
or
image processing software



A photo of the DAQ display
taken by a handy



FASP-02 electronic tests



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- Numerous visits of students, local and foreign delegations
- Invited talks at the Faculty of Physics of Bucharest University and West
- Posters
- Update of HPD web page - <http://niham.nipne.ro>

Scientific objectives for the next year

- **The analysis along the physics topics proposed by us based on Run1 data will be finalized, proposal for a letter and an extended paper under discussion these days**
- **Substantial statistics will be generated based on EPOS3, EPOS-LHC, PYTHIA and HIJING models and compared with experimental results**
- **The influence of the phase space in which the charged particle multiplicity is selected on the obtained result**
- **Event shape selection based on different event shape global variables**
- **Two-particle correlations as a function of event shape**
- **Contribution to the detector operation in Run2**
- **TRD tracking & QA**
- **Operating NIHAM data centre – component of ALICE GRID at its standard efficiency + NAF**
- **Service task for PhD students**
- **Completion of Setting up the local infrastructure of the Detector Lab for ROC production and tests for ALICE - TPC upgrade**
- **Starting the construction and tests of OROCs based on GEM technology for ALICE-TPC upgrade**
- **Outreach activities**
- **Summer Student Program**
- **Similar analysis and studies at 13 TeV p+p collisions.**

Scientific objectives for the next three years

Scientific objectives

Transverse momentum distributions and their ratios for π^+ , K^+ and p at mid rapidity ($|y| < 0.5$) for different charged particle multiplicities in pp collisions at $\sqrt{s} = 7$ TeV show an enhanced depletion of heavier species relative to the lighter ones in the low p_T region with increasing charged particle multiplicity. The quality of simultaneous fits of the experimental spectra using a Boltzmann-Gibbs Blast Wave (BGBW) expression and the dynamics of the extracted kinetic freeze-out temperature T_{kin} , average transverse expansion velocity $\langle\beta_T\rangle$ and its profile (n) as a function of multiplicity have been shown to be similar with those obtained in heavy ion collisions. Preliminary estimates of the Bjorken energy density for high multiplicity events indicate values close to the ones estimated for the central Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV. Selection of high multiplicity events close to azimuthal isotropy based on event shape global observables seems to be feasible. A direct comparison among pp , p -Pb and Pb-Pb based on charged particle multiplicity has to be taken with care.

We will concentrate in the next period on:

- Estimates of the Bjorken energy density as a function of charged particle multiplicity
- The influence of the charged particle multiplicity phase space selection on the obtained results, biased and unbiased selections.
- Detailed studies of the dependence of corrections applied to raw spectra on the event shape global variables and their selection power
- Following the same type of analysis by applying two dimensional cuts in charged particle multiplicity and event shape
- Two-particle correlations as a function of event shape – multi-differential analysis
- A factor two in the collision energy enlarges the dynamical range of such studies and the expected higher statistics will give access to extend them at heavy flavor hadrons and compare with the results obtained in A-A collisions
- Detailed comparisons with PYTHIA, EPOS, HIJING and other model predictions