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www.ifin.ro

- *Activities and achievements in the past 2 years*
- *Remarks on additional activities*
- *2018 perspectives*
- *2017 financial status*
- *2018 financial status*

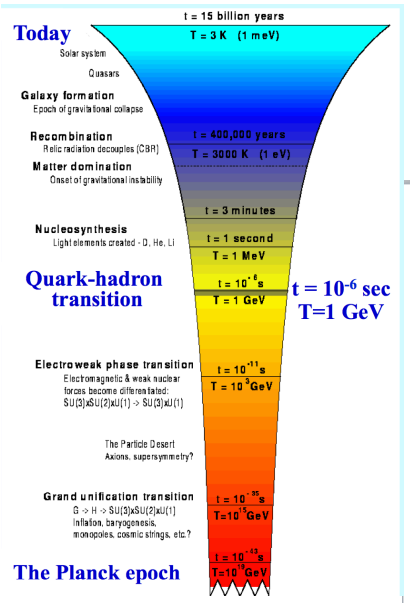
HADRON PHYSICS DEPARTMENT

Natinal Institute for Physics and Nuclear Engineering – IFIN-HH

http://niham.nipne.ro

ISAB Meeting, January 23, 2018

Motivation



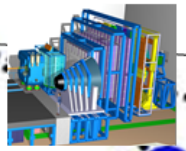
Expectations based on QCD

QCD Critical Points

T

H

μ_H=350 -400 MeV,
T_H = 150-160 MeV



Their meeting point
Triple point
H – remnant for finite N_c

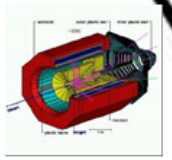
- large N_c QCD phase diagram:
- three regions, i.e.:
- confined
- deconfined
- quarkionic phase
- separated by
1st order phase transition

Statistical model:
- for μ_B << m_N the thermal degrees of freedom dominated by mesons
- for higher μ_B more baryons are excited

E

Large N_c limit of QCD
- quarks loops are suppressed by $1/N_c$ relative to gluon contribution
⇒ cold dense matter in the N_c=∞ world for μ_B >> m_N quarkyonic matter

Chiral transition:
μ_B > μ_E - first order
μ_B < μ_E - crossover
realistic u,d,s masses



Quark-Hadron continuity:

F

G

Liquid-gas phase transition:
μ_{NM} ≅ 924 MeV
n_0 = 0.17 fm^{-3}

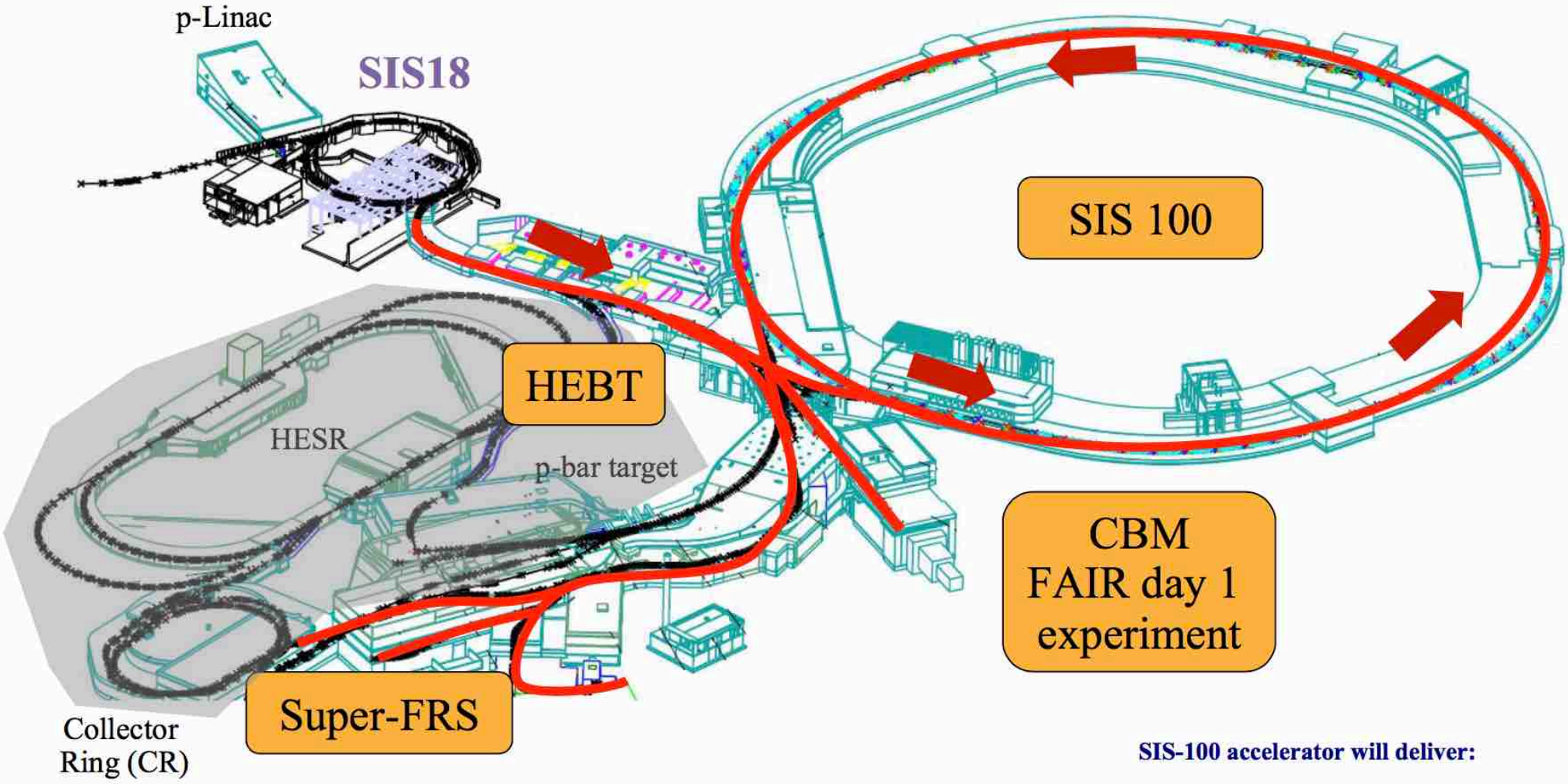
Superfluid nuclear matter

⇒

Superconducting quark matter

μ_B

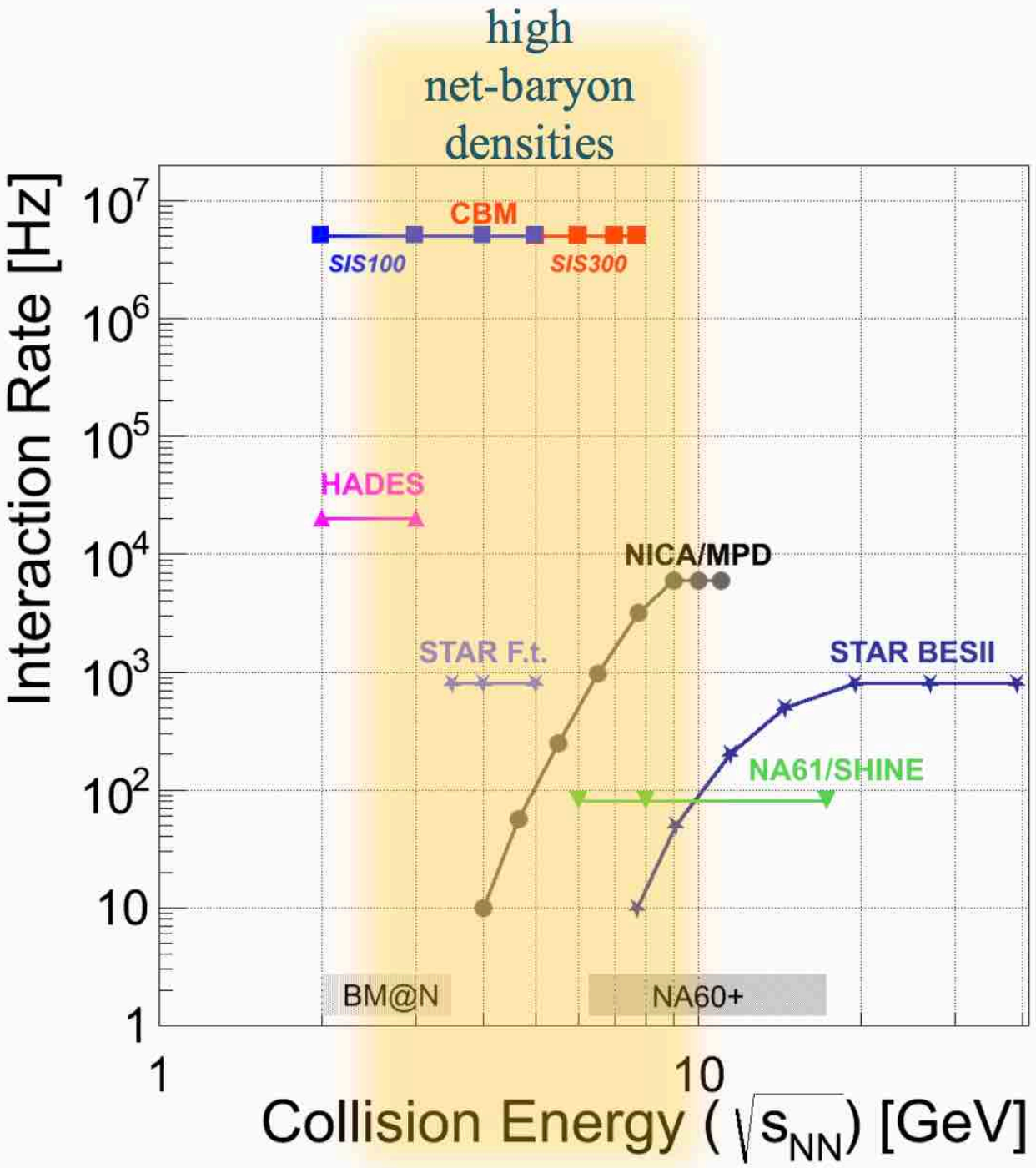
GSI/FAIR strategy:
Staged realization along the beam towards MSV



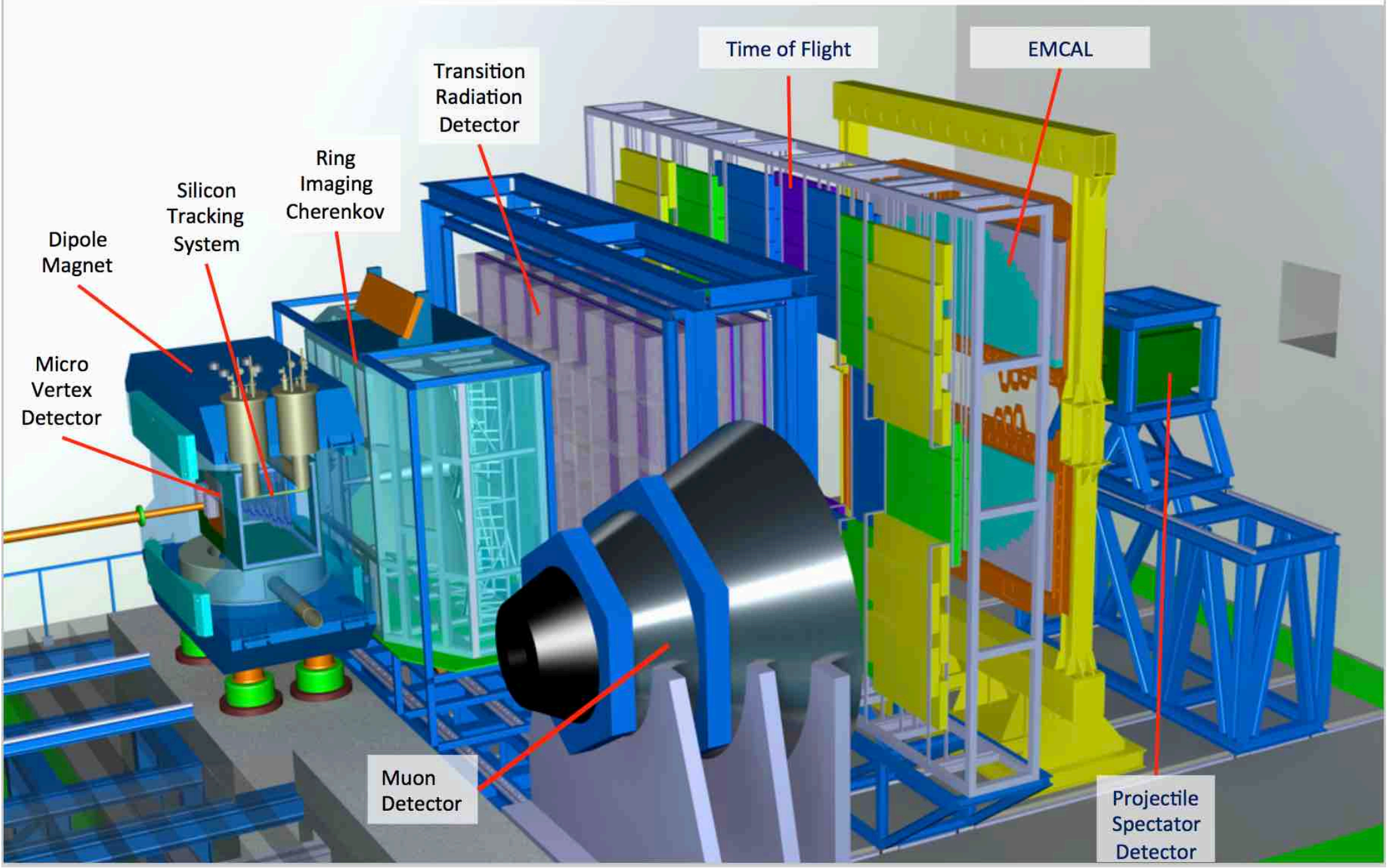
SIS-100 accelerator will deliver:

- **heavy ions (Au) up to 11A GeV**
  $\sqrt{s_{NN}}$ = 4.7 GeV
- **light ions (e.g. Ca) up to 14A GeV**
  $\sqrt{s_{NN}}$ = 5.3 GeV
- **protons up to 29 GeV**
  $\sqrt{s_{NN}}$ = 7.5 GeV)

Experiments exploring dense QCD matter



CBM at SIS 100



CBM requirements & challenges

Requirements:

Tracking: STS, TRD

Vertexing: STS

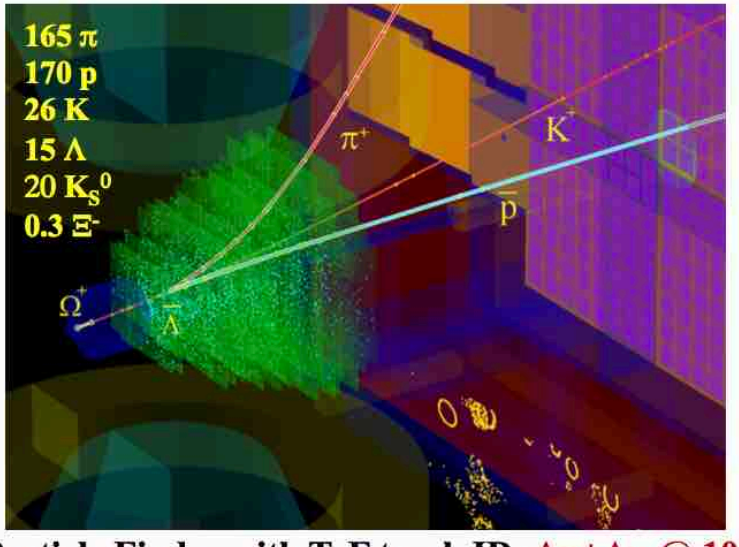
Hadron ID : TOF

Electron ID: RICH, TRD, ECAL

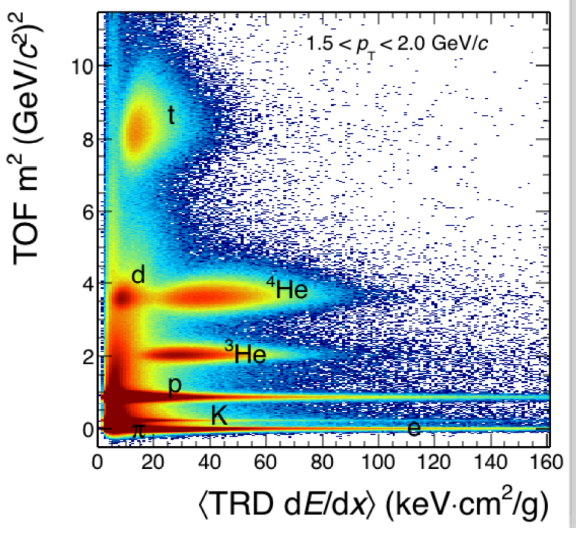
γ, n: ECAL

The Challenges:

- **very rare probes in Au+Au at reaction rates up to 10^7events/sec**
  - *Rates from 1 kHz/cm² (27) to 20 -100 kHz/cm² (3) at the detector level*
- **~ 1000 charged particles/event**
  - *Hit density from 6 10^{-2}/dm² to 1/cm²*
- ***fast and radiation hard detectors***
- ***free-streaming readout electronics***
- ***online event selection***



KF Particle Finder with ToF track ID: Au+Au @ 10AGeV SIS100

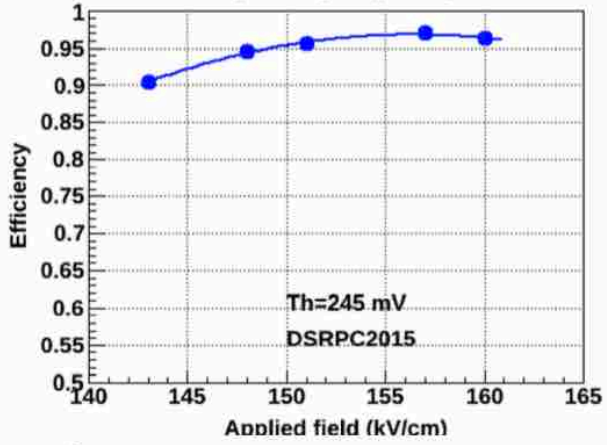


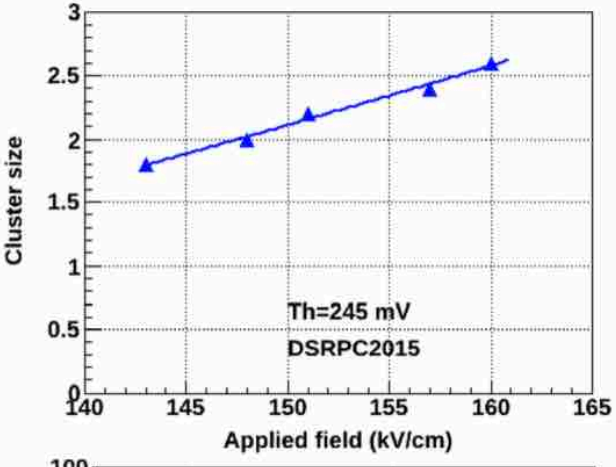
R&D

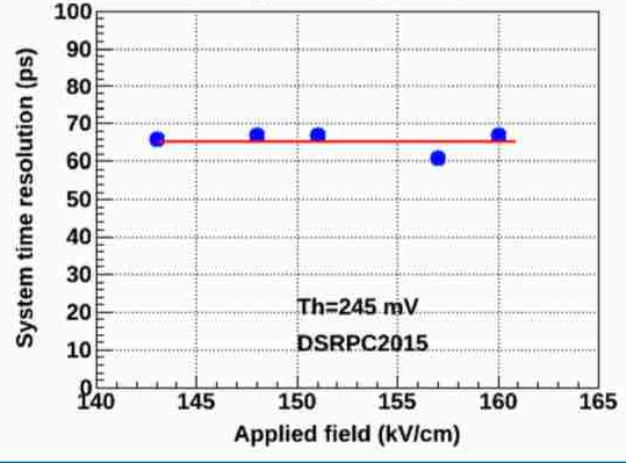
Calibration & analysis of November-December 2015 in-beam tests @ SPS

Pb beam of 30A GeV on a Pb target

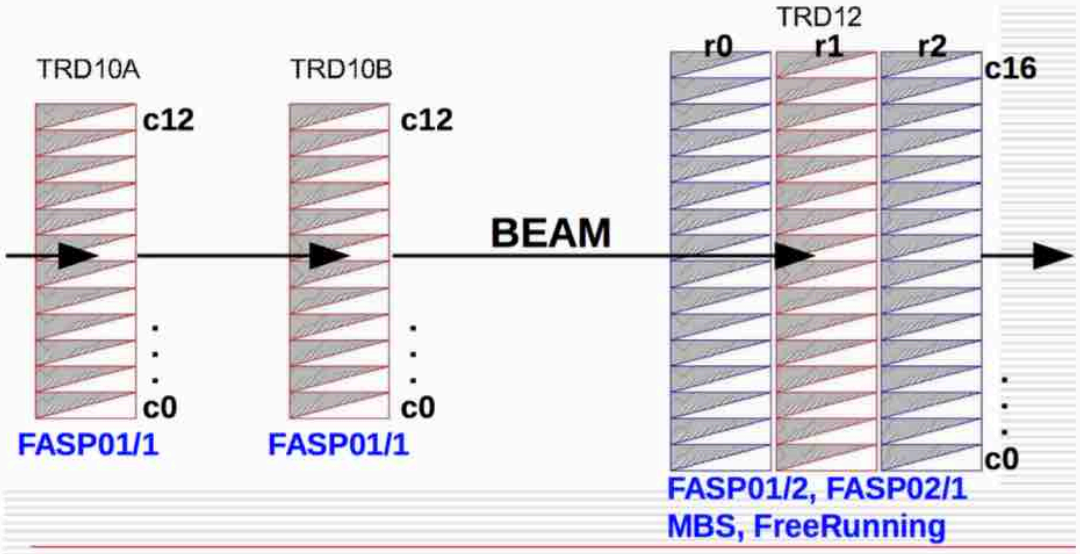
HCRMGMSRPC



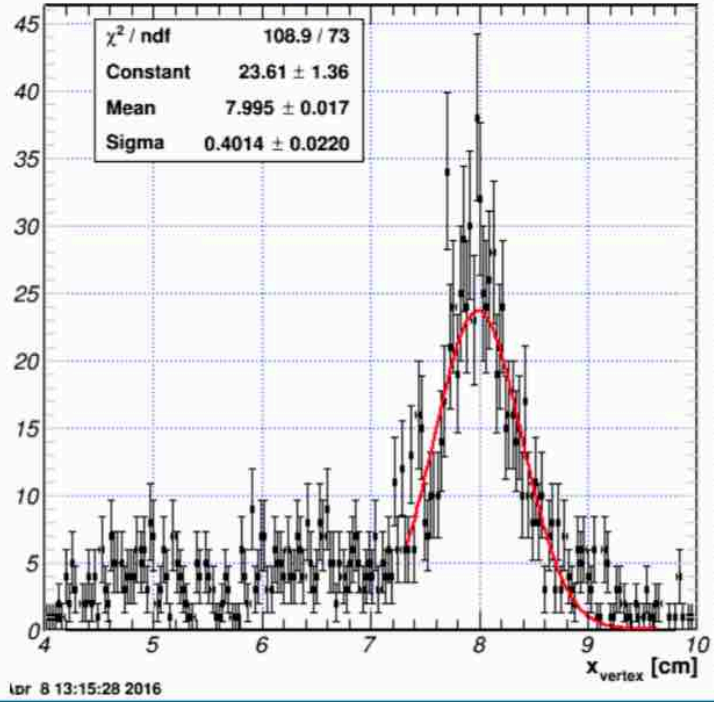




HCRTRD

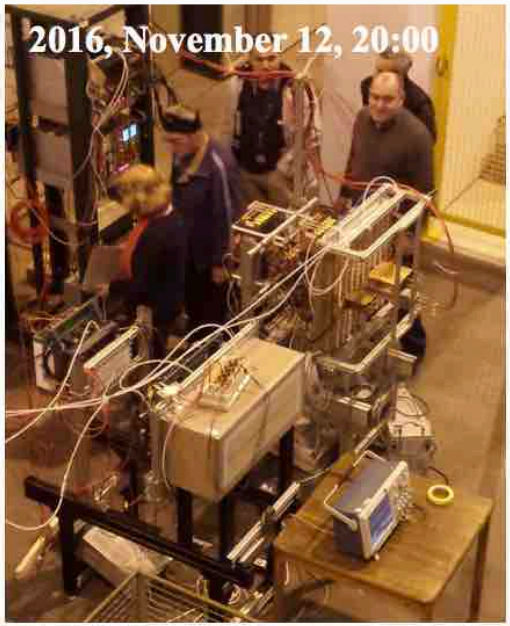


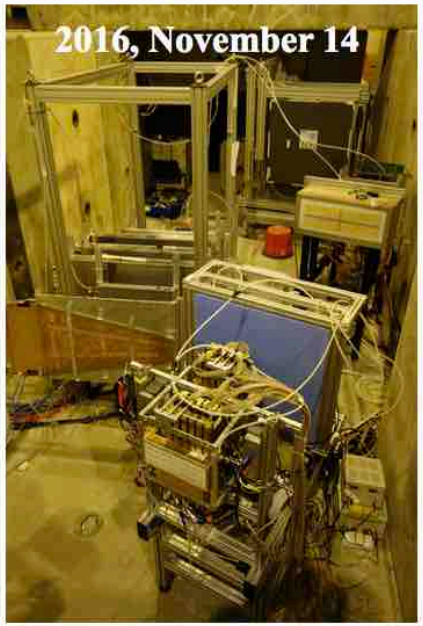
Interaction point reconstruction

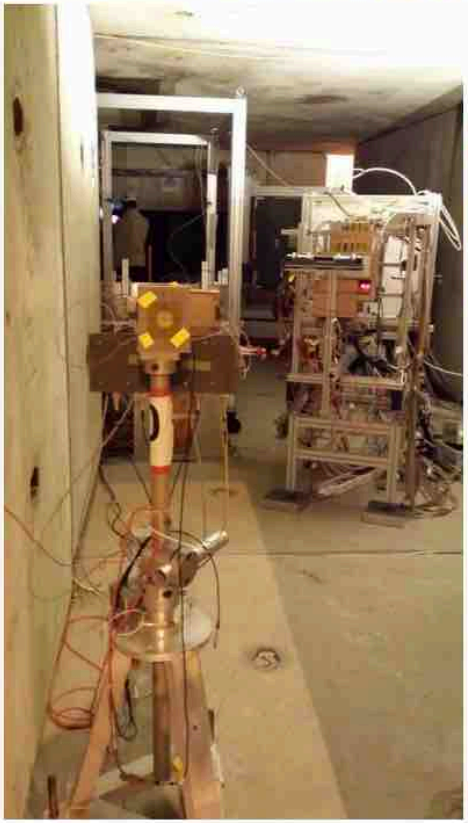


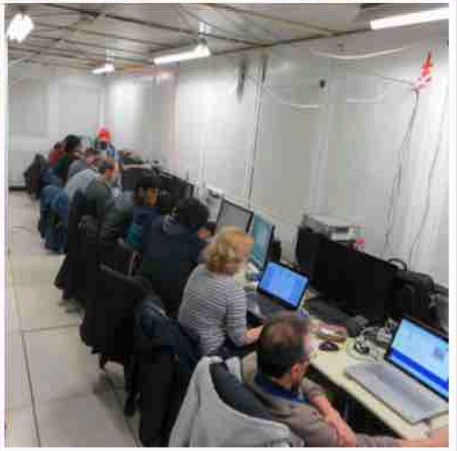
R&D

November-December 2016 in-beam tests @ SPS



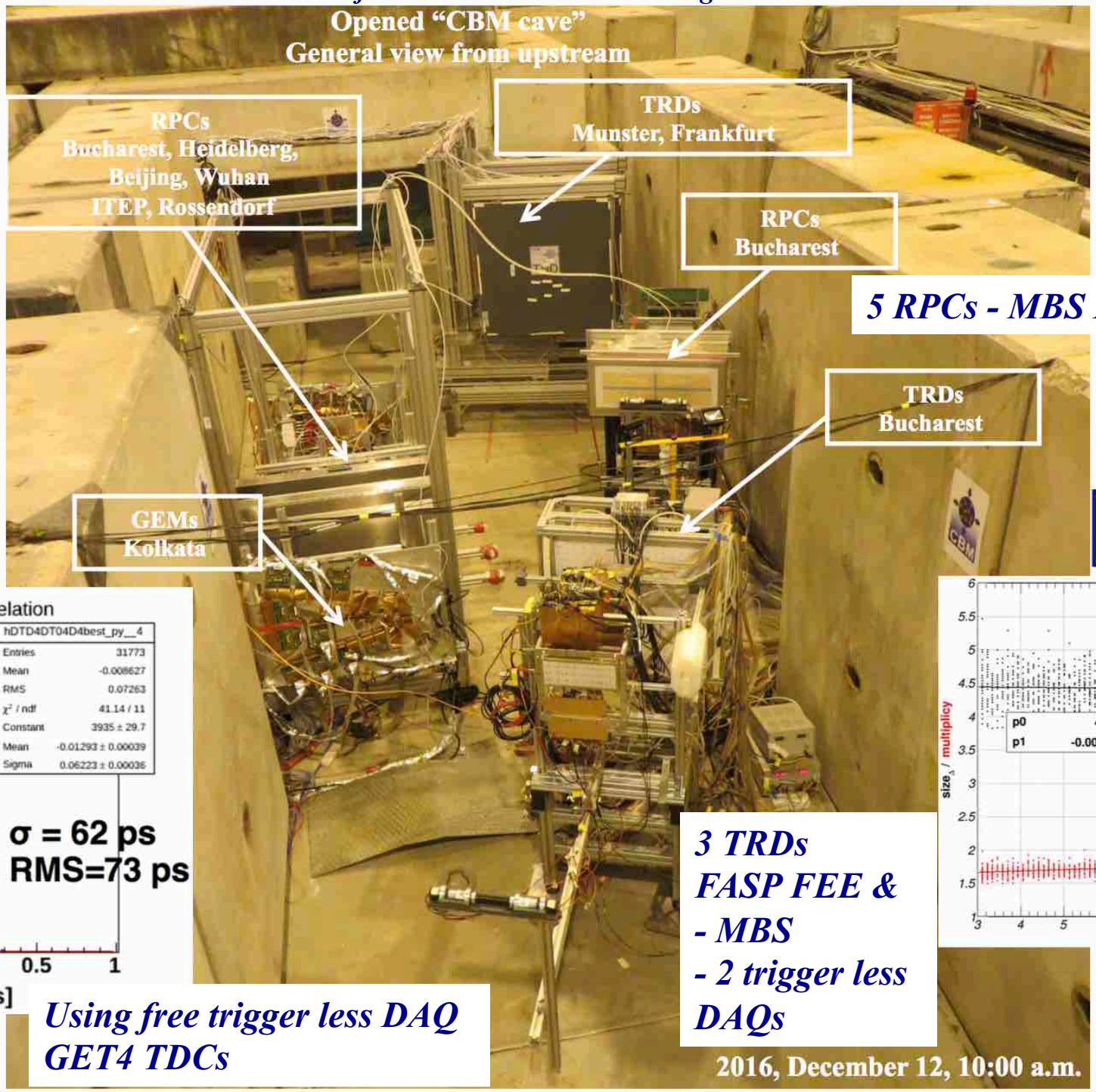






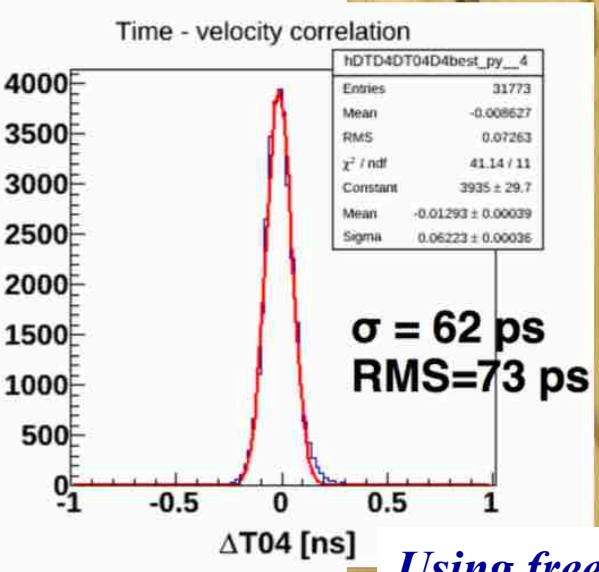
R&D

November-December 2016 in-beam tests @ SPS
Pb beam of 13/30/150 AGeV on a Pb target



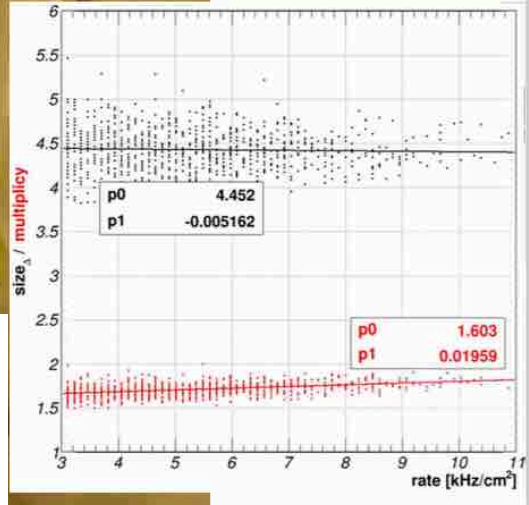
5 RPCs - MBS DAQ

RPCs Bucharest



Using free trigger less DAQ GET4 TDCs

TRDs Bucharest



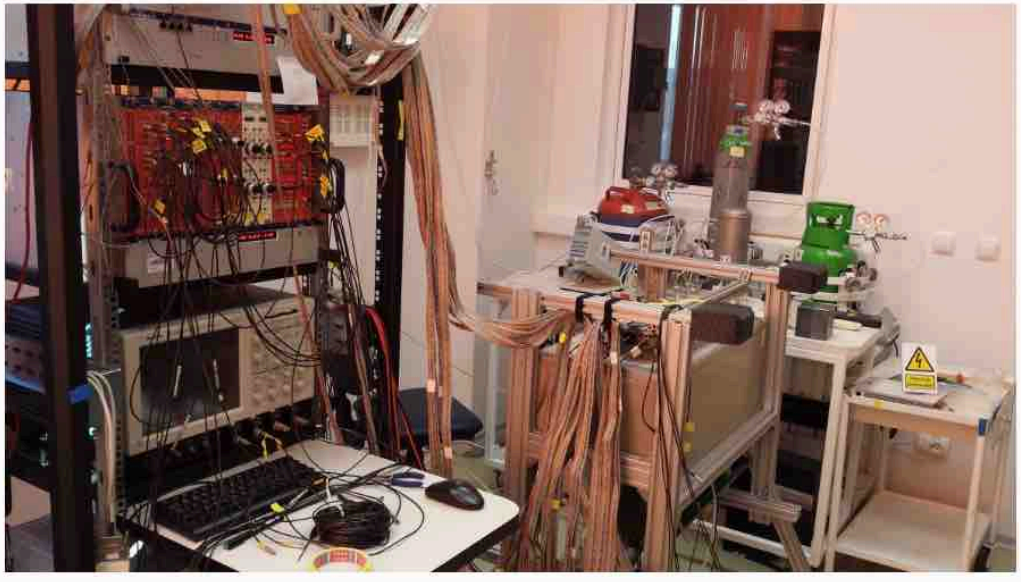
3 TRDs
FASP FEE &
- MBS
- 2 trigger less DAQs

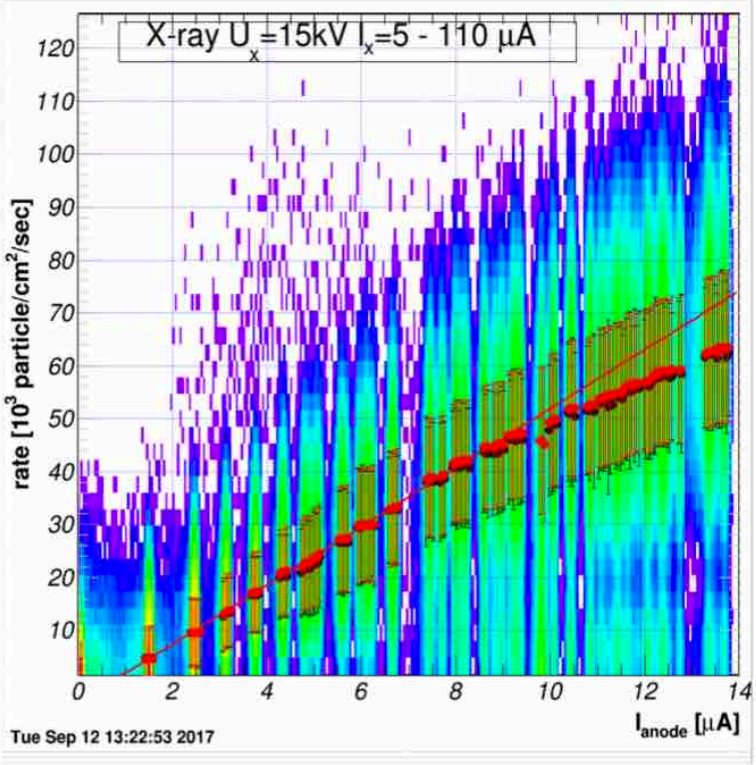
R&D

In-house tests

TRD

RPC



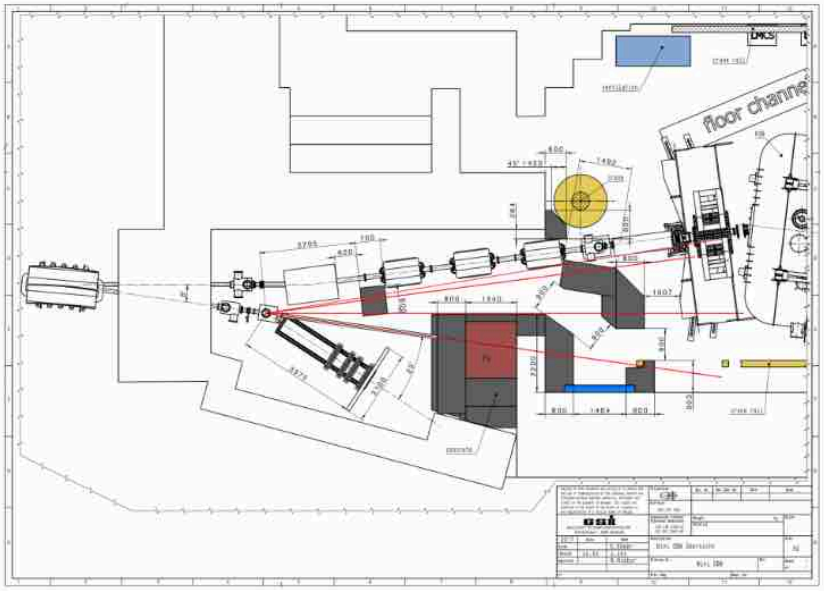


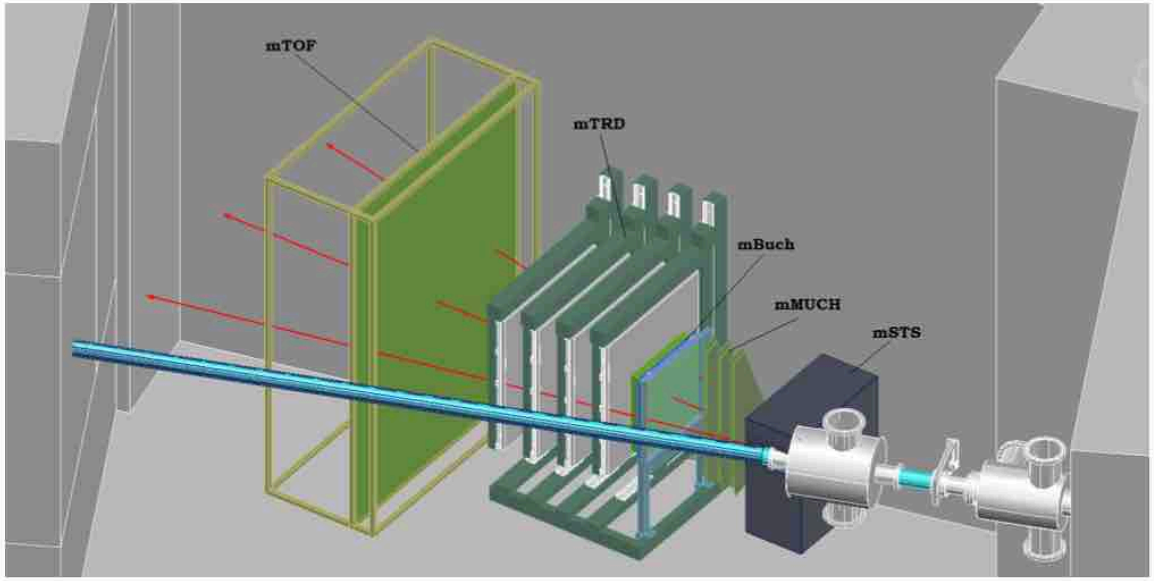
$$eff = \frac{RPC\ \&\ PMT(1\&2)\&\ PMT(3\&4)}{PMT(1\&2)\&\ PMT(3\&4)}$$

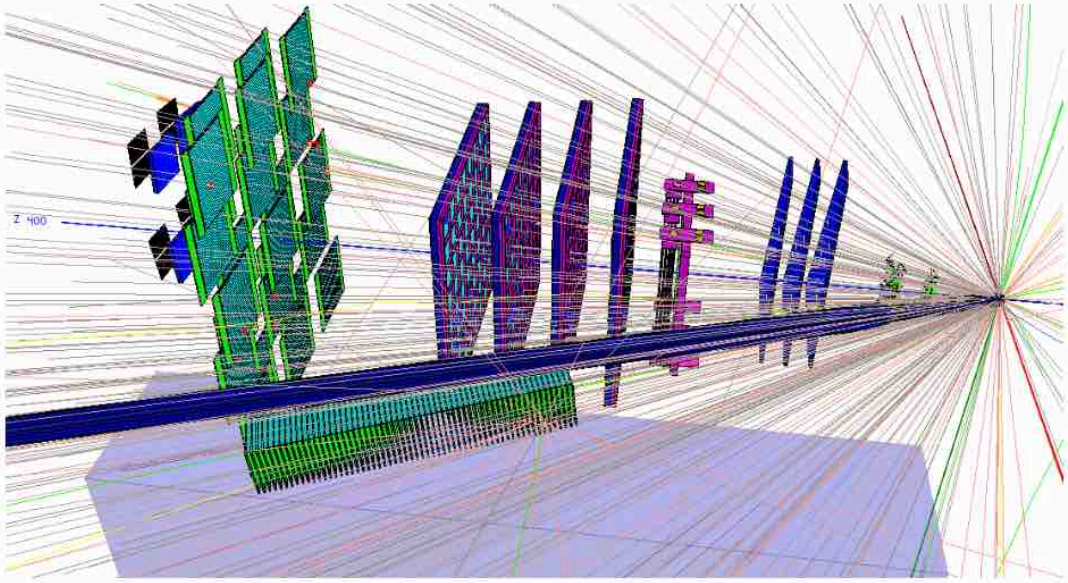
$$eff = \frac{84\ events}{90\ events} = \mathbf{93.3\ \%}$$

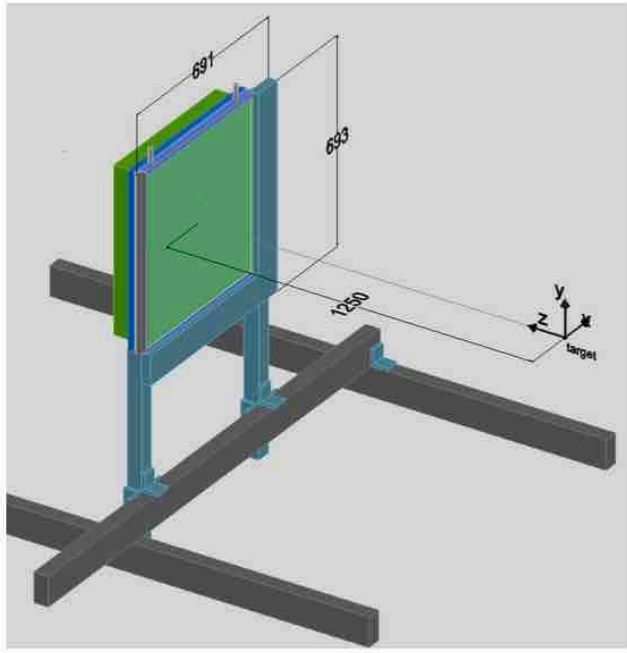
R&D

Integration of Bucharest TRD in mCBM Experiment @ SIS18
FAIR Phase0



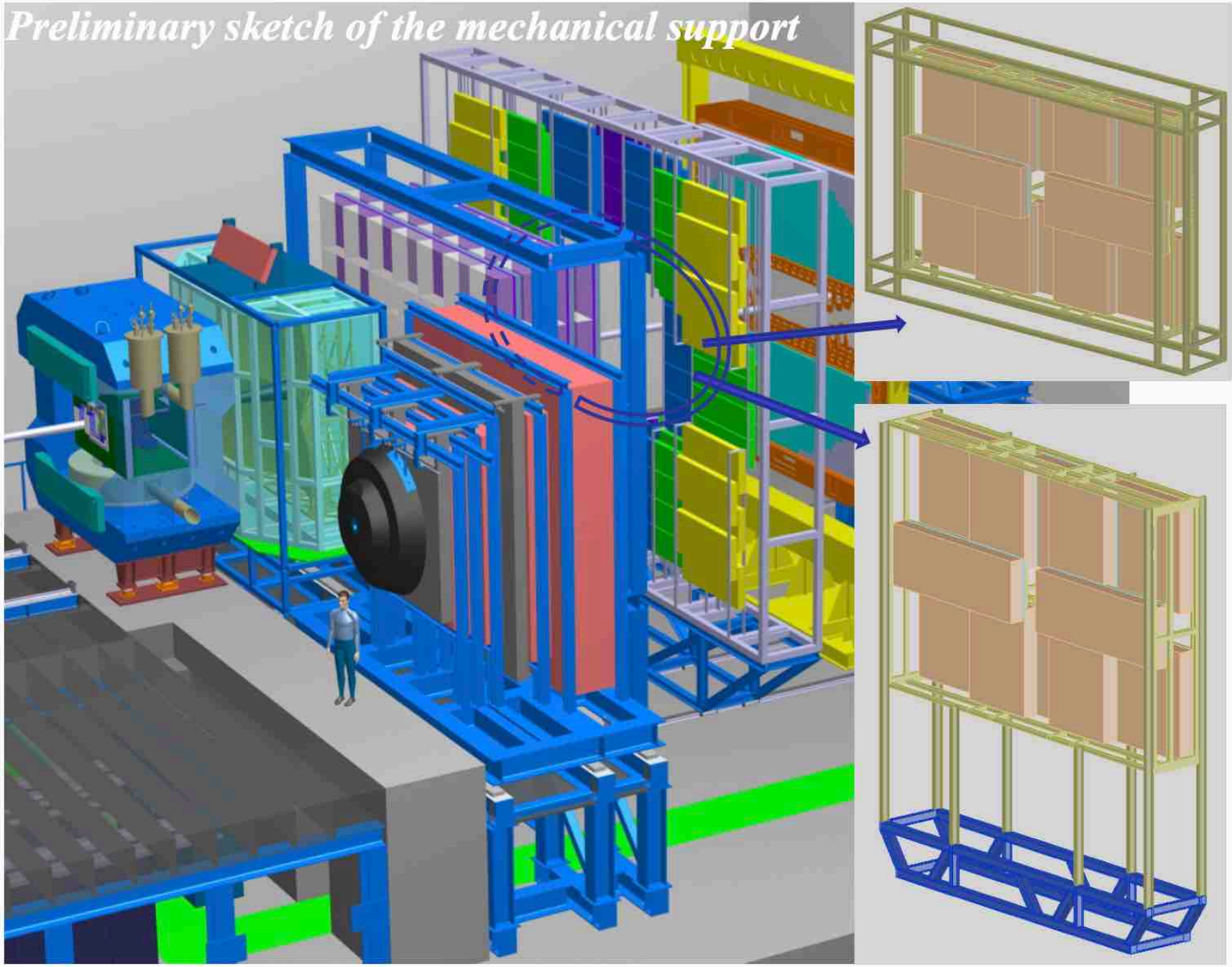






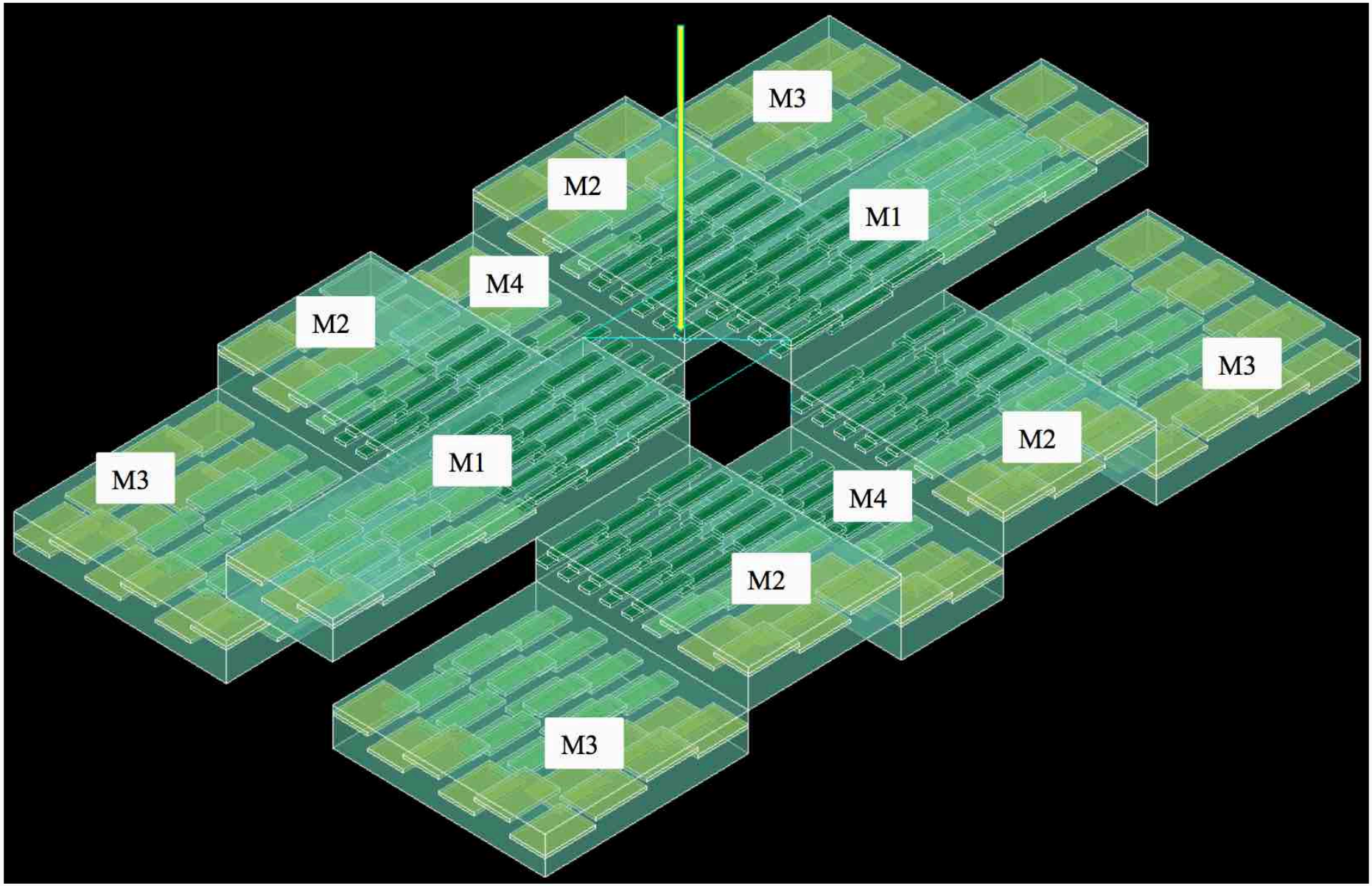
R&D

Inner zone of the CBM-ToF



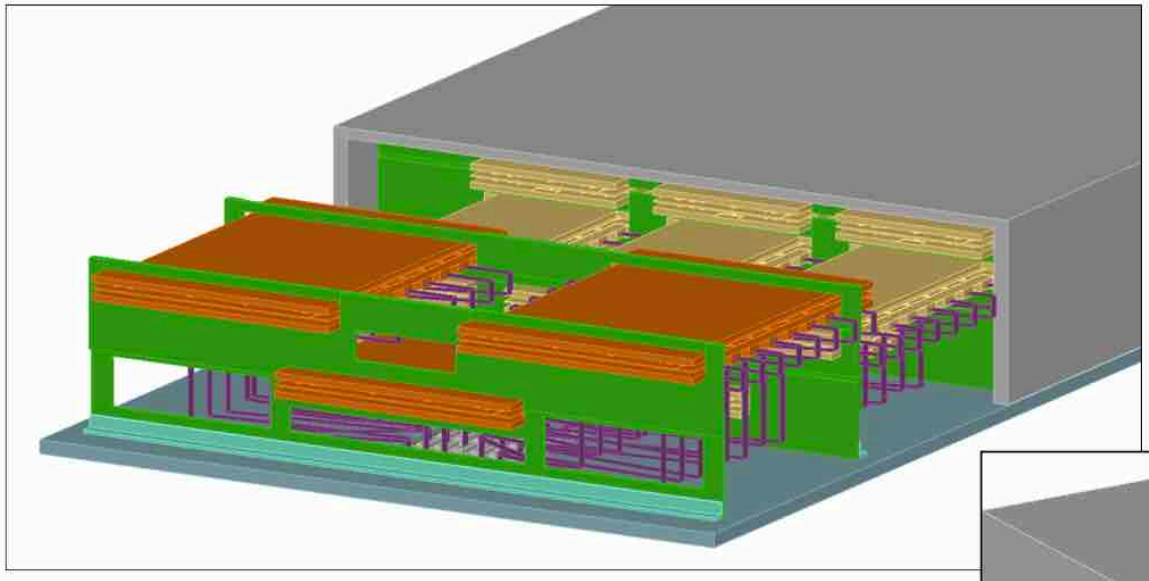
R&D

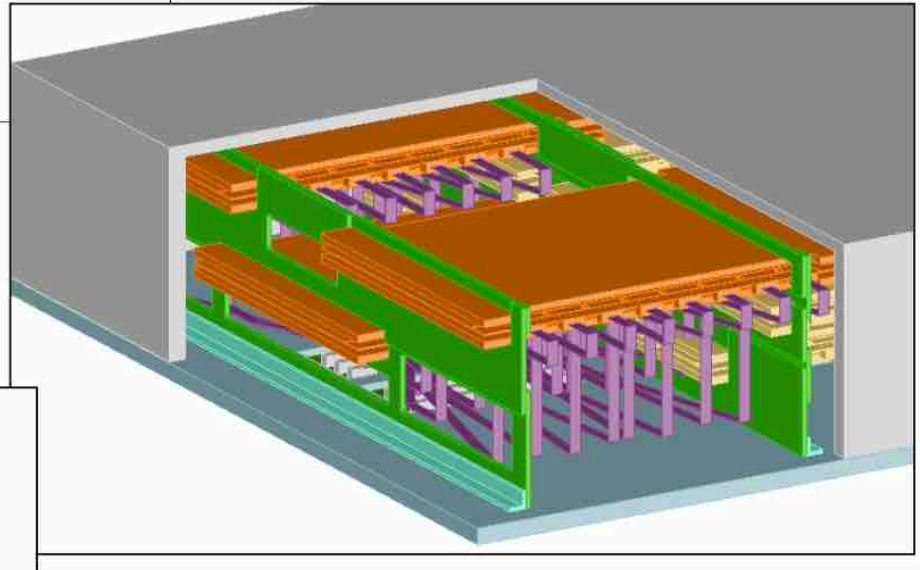
Inner zone of the CBM-ToF



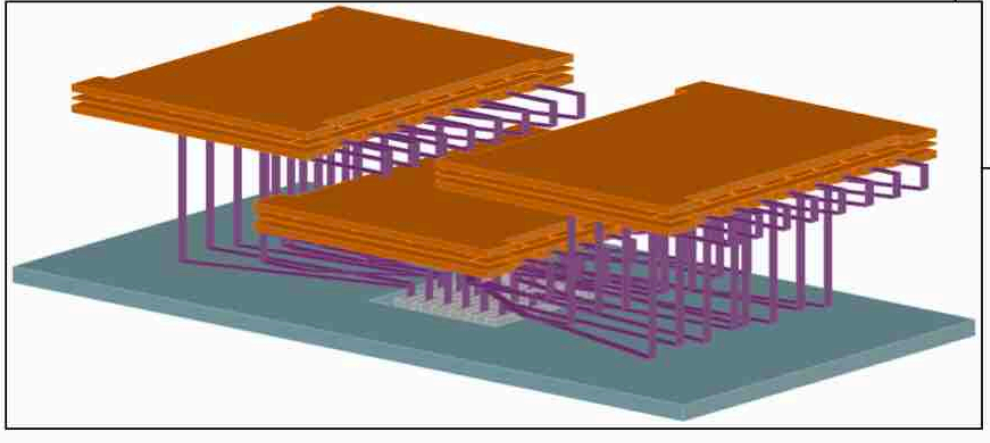
R&D

Inner zone of the CBM-ToF





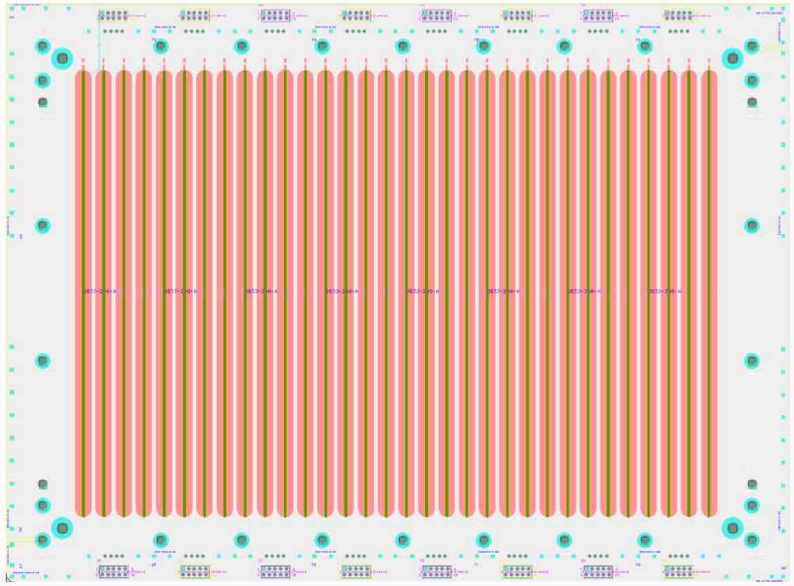
Signal cables routing



R&D

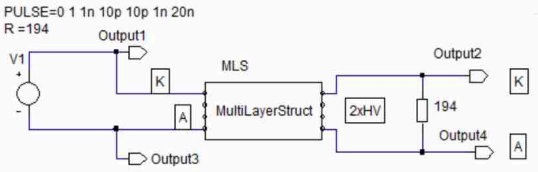
Integration of Bucharest RPC in mCBM Experiment @ SIS18
FAIR Phase0

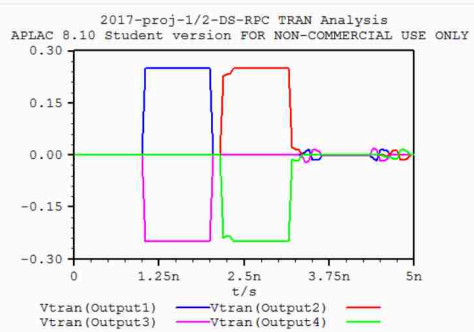
New RPC2017DS prototype design



Readout electrode: 9.02 mm pitch= 1.27 mm width + 7.75 mm gap
High Voltage electrode: 9.02 mm pitch= 7.37 mm width + 1.65mm gap

APLAC simulation of transmission line impedance





Input/Output signals are recorded for different values of the readout strips width

If R = Z_0= Z_L ➡ the transmission line is matched;

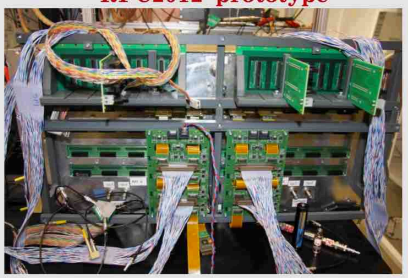
APLAC predicted 194 Ω for 1.27/7.4 mm readout/HV strip width

The two stacks in parallel will have an equivalent impedance of 97 Ω

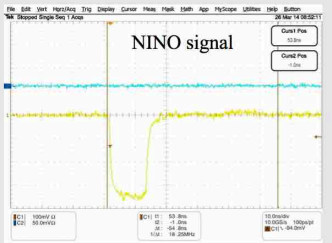
D. Bartos et al., arXiv:1708.02707v1

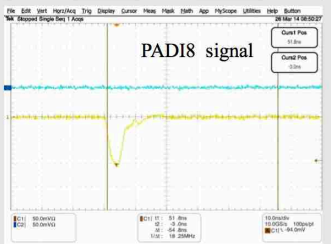
Signals delivered by NINO and PADI FEE (March 2014)

RPC2012 prototype



CAEN TDCs cannot process PADI signals for both leading and trailing edges.



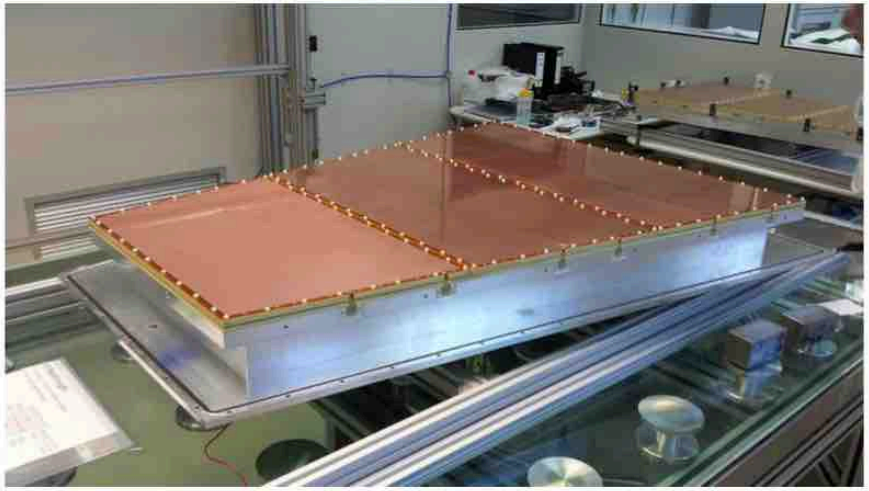


Assembling & Tests of important components of large scale experiments

Upgrading the DetLab ceiling

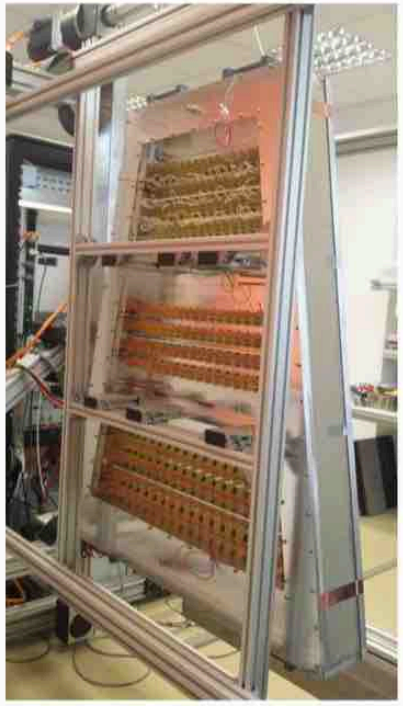
Assembling & Tests of important components of large scale experiments
ALICE-TPC Upgrade

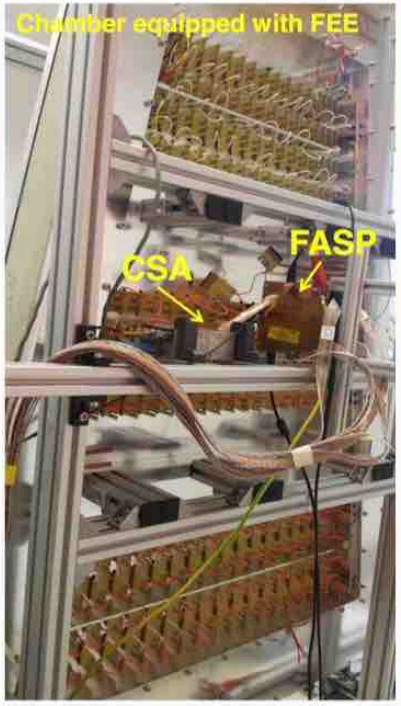
Assembled OROC



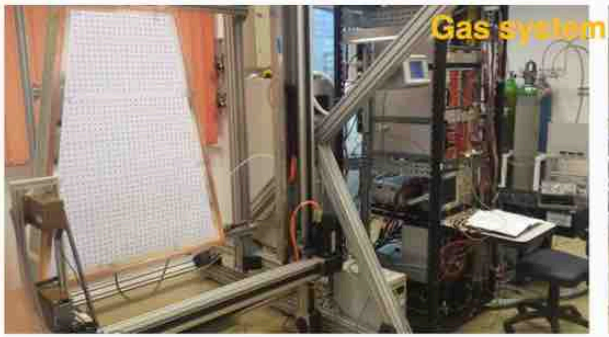
OROC Transport to the test laboratory

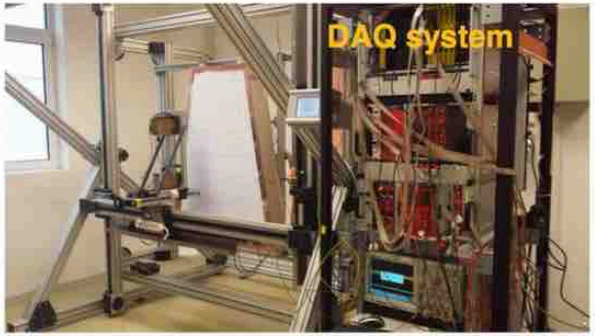
cabled OROC

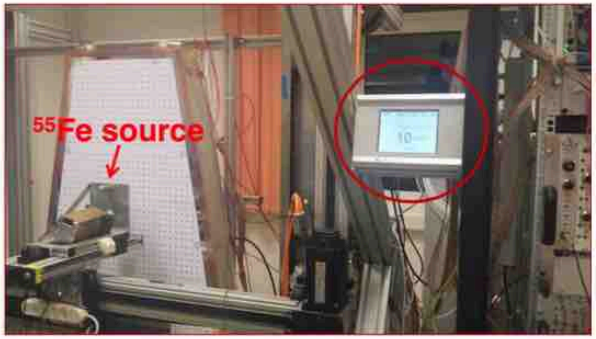




OROC testing insfrastructure

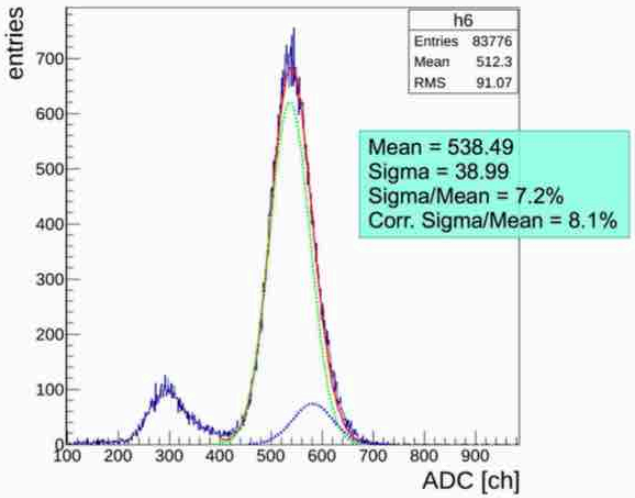




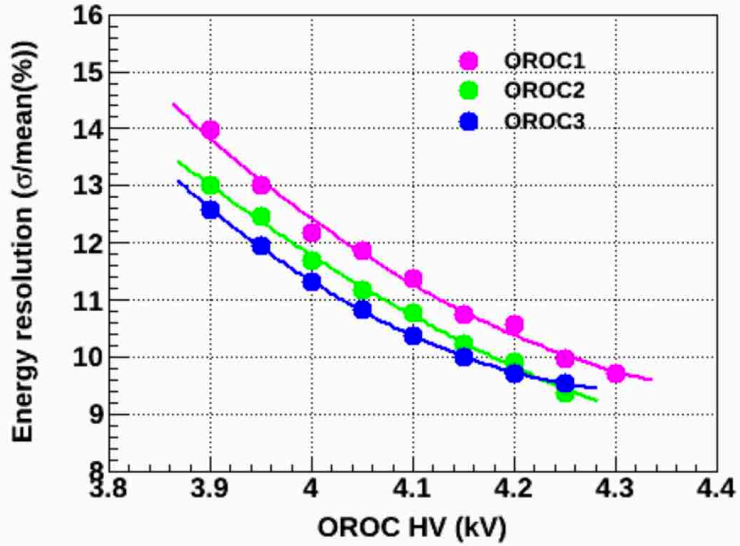


Assembling & Tests of important components of large scale experiments
ALICE-TPC Upgrade

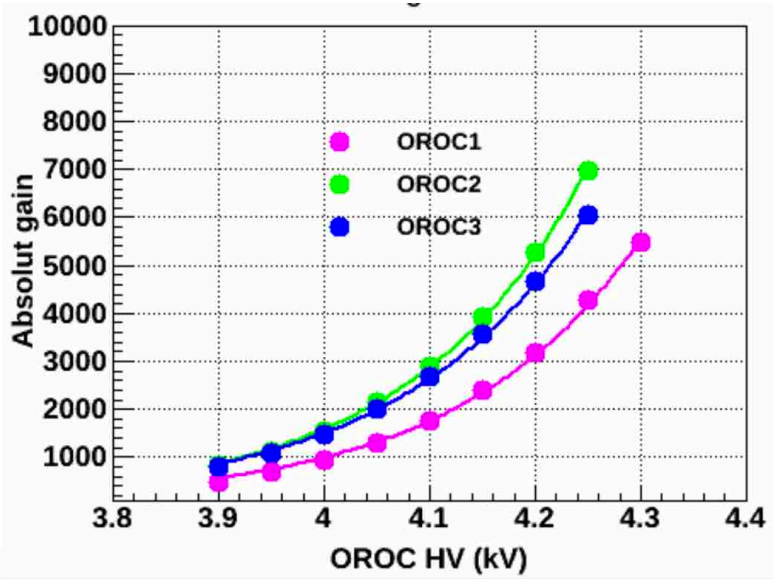
Test energy resolution
90%Ar + 10% CO_2



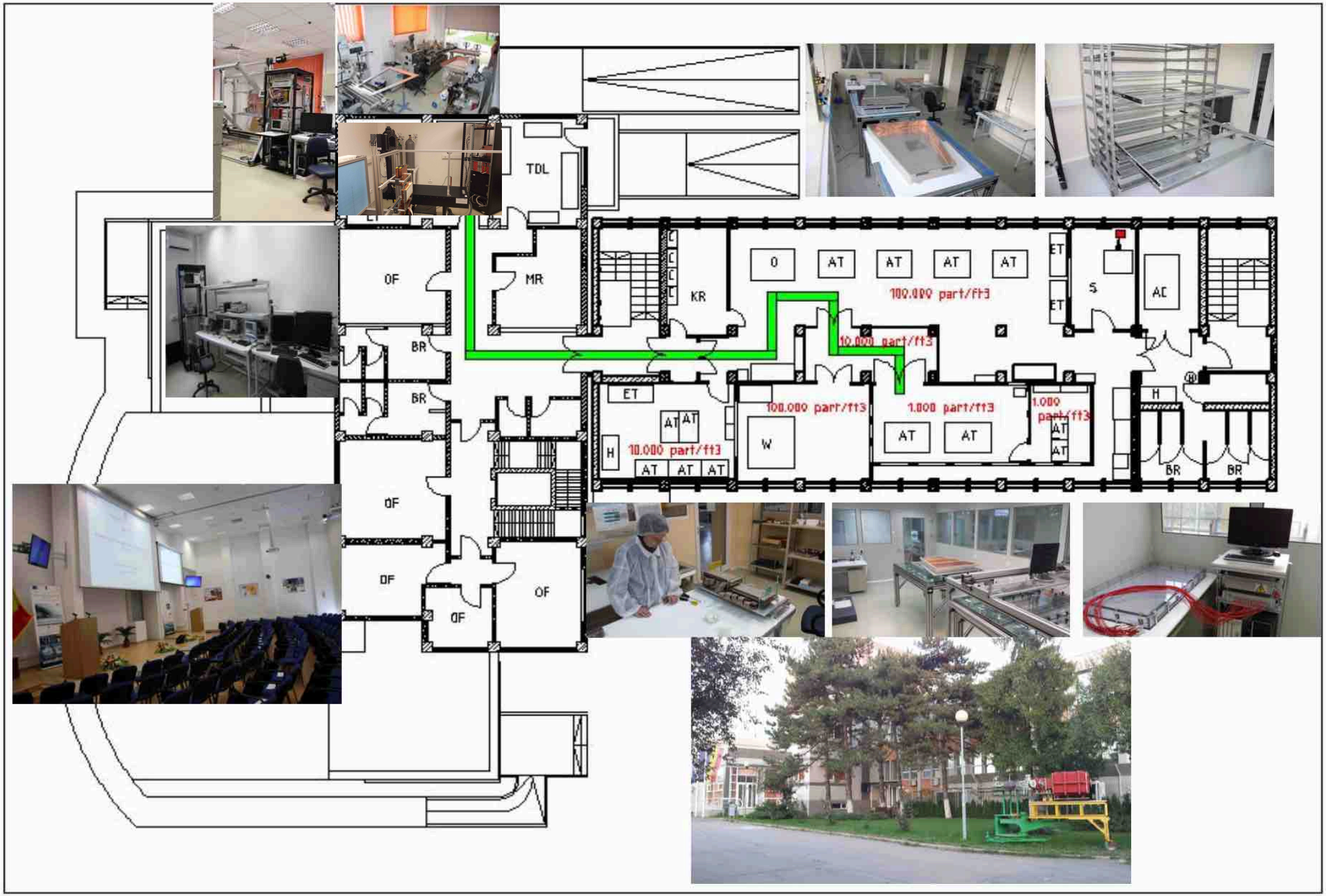
Resolution as a function of HV
Ne/CO2/N (90/10/5)



Gain as a function of HV
Ne/CO2/N (90/10/5)



Research Infrastructure

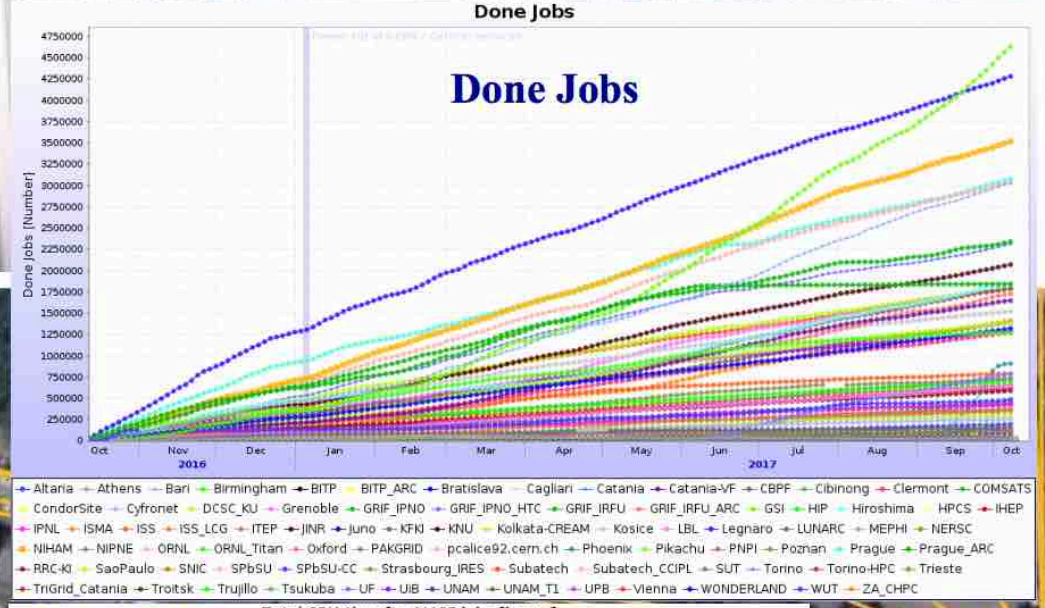


Research Infrastructure

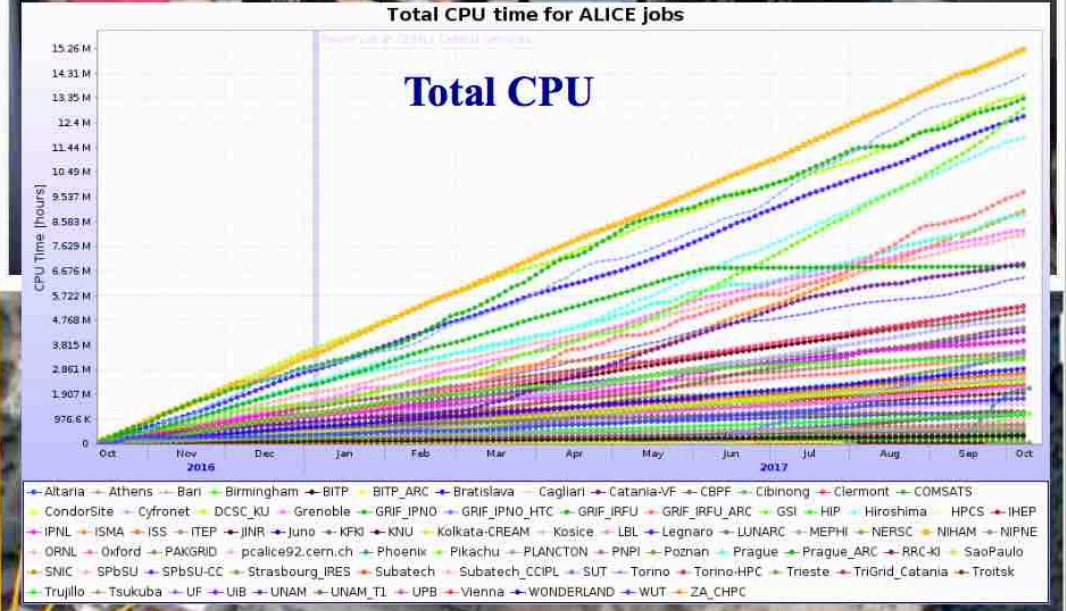
NIHAM
Tier2 component of ALICE GRID

NAF (Niham Analysis Facility)

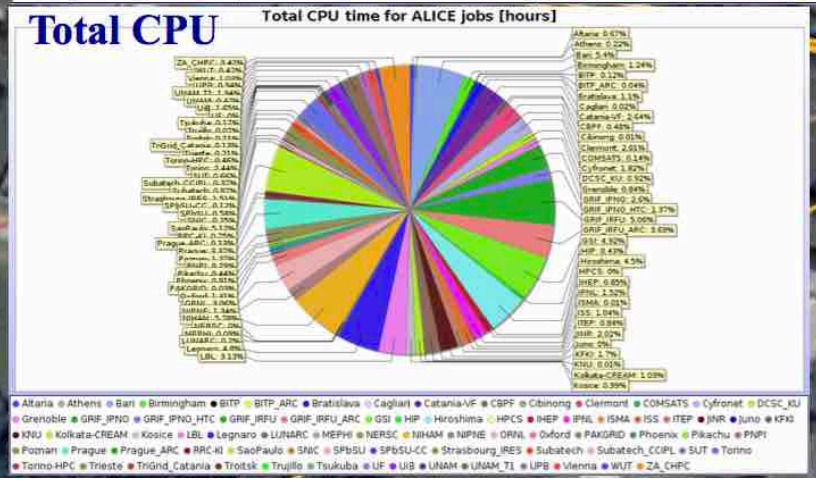
- Software development for an efficient and flexible local data analysis
- Analysis - efficiencies, contaminations
  - multiplicity & event shape
  - two-particles correlations
- Theoretical Models calculations

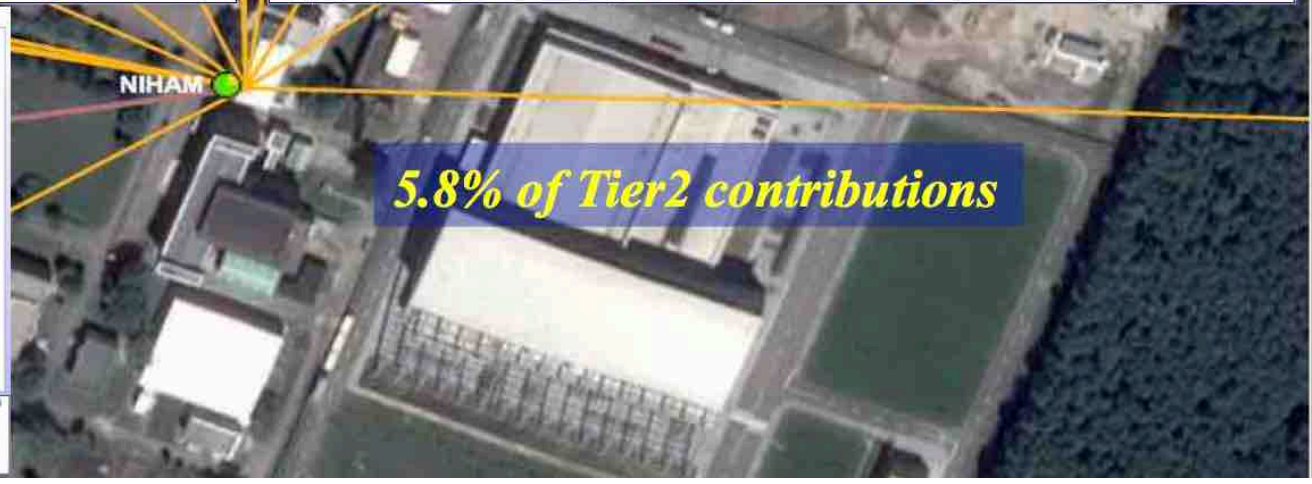


Done Jobs



Total CPU





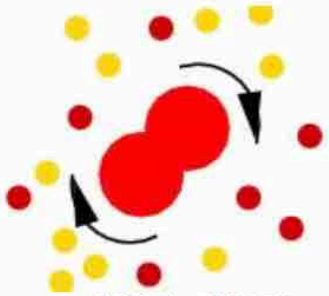
5.8% of Tier2 contributions

HPD Physics within CBM

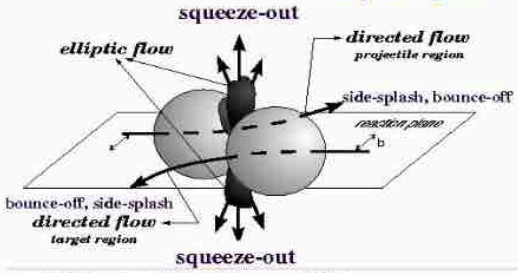
Elliptic flow

SIS-100 accelerator will deliver:

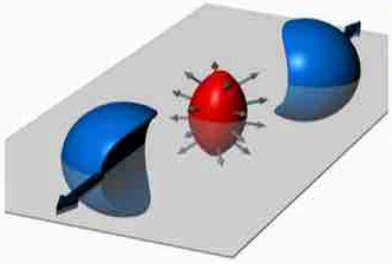
- heavy ions (Au) up to 11A GeV
  $\sqrt{s_{NN}}$ = 4.7 GeV
- light ions (e.g. Ca) up to 14A GeV
  $\sqrt{s_{NN}}$ = 5.3 GeV
- protons up to 29 GeV
  $\sqrt{s_{NN}}$ = 7.5 GeV)



< 100 A•MeV

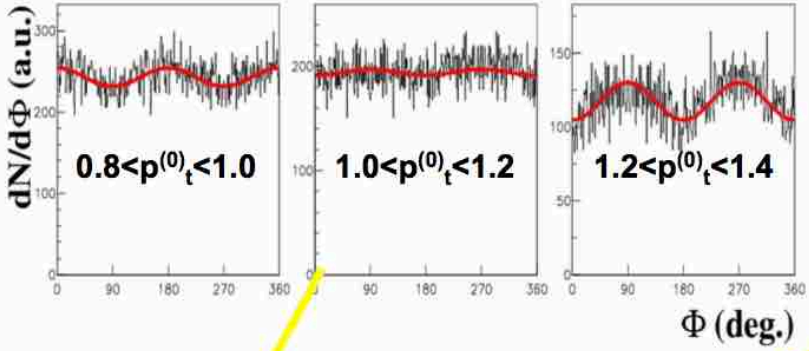


100 A•MeV - ~600 A•MeV



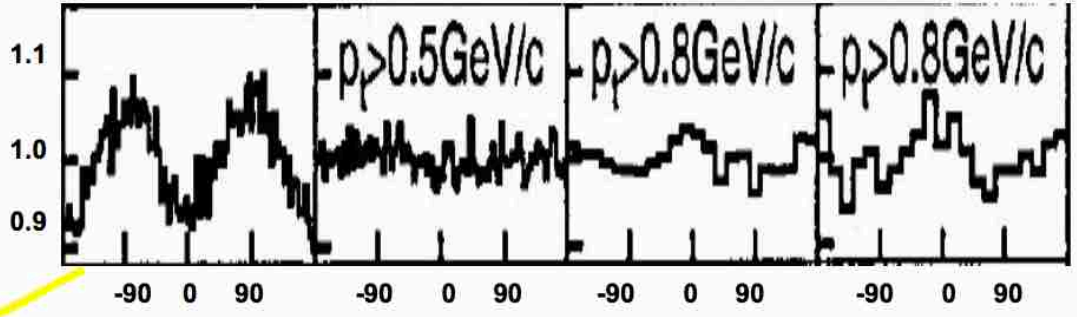
~4 A•GeV

Au+Au 120 MeV/u, CM3



A.Andronic, G.Stoicea, M.Petrovici &FOPI Coll. NPA679(2001)765

2 A•GeV 4 A•GeV 6 A•GeV 8 A•GeV

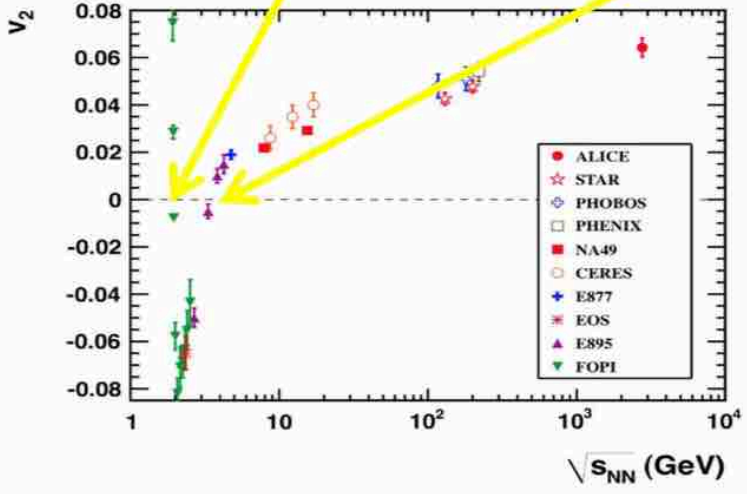


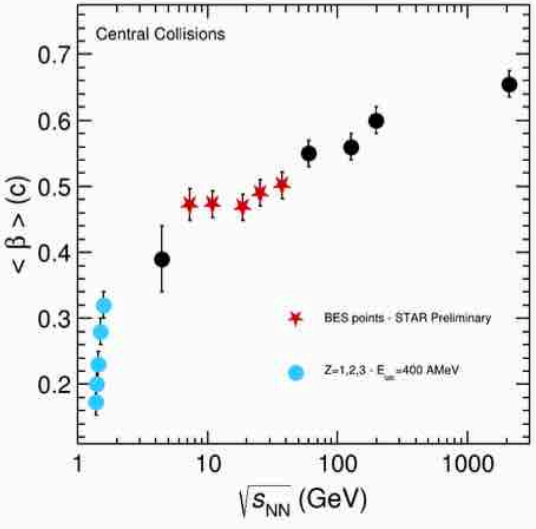
C.Pinkenburg & EOS Coll. Phys.Rev.Lett. 83(1999)1295

"Radial flow" flow

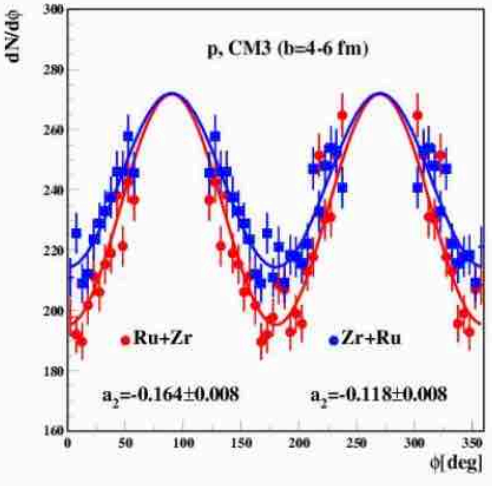
M. Petrovici Carpathian Summer School 2007

K. Aamodt et al, ALICE Collaboration PRL105(2010)252302

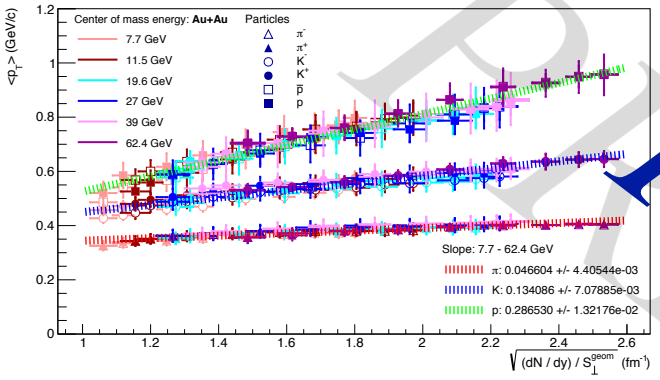


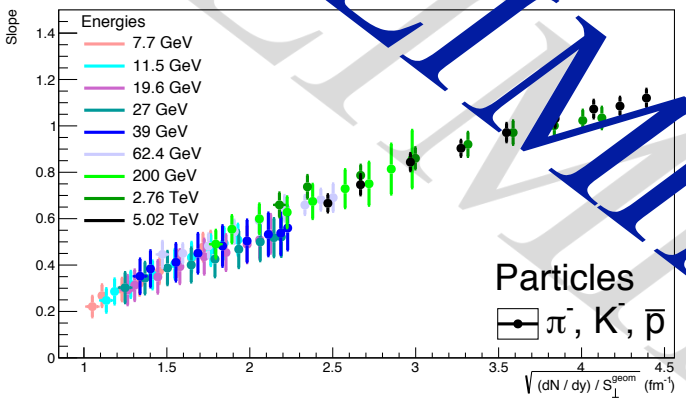


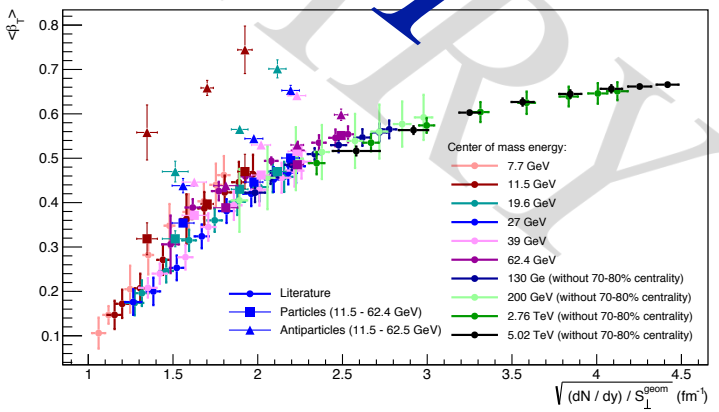
Isospin effects



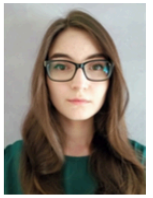
HPD Physics within CBM

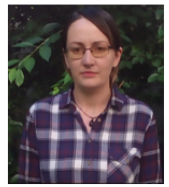


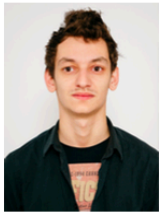




Teaching & Summer Student Program







Teaching & Summer Student Program

Would you like to contribute to understand the secrets of the Universe?

High Energy Physics
Nuclear Astrophysics
Particle Detection Systems
Front-End Electronics & IT

Join us for the:

Summer Student Program 2018

Organized by: **Hadron Physics Department**
Horia Hulubei National Institute of Physics and Nuclear Engineering

Contact: 0040-21-4046135, mpetro@niham.nipne.ro
For further information visit the Training /Summer Student Program at http://niham.nipne.ro

Outreach

- *Interview on TVR International*

- *Numerous visits of Romanian and foreign delegations, gymnasium pupils, students of the Romanian Physics Faculties network*

- *Posters at Researchers Night, September 2017*

Team:

- *Prof. Dr. Mihai Petrovici (physicist) – team leader*
- *Scientific Researcher III Dr. Cristian Andrei (physicist)*
- *Senior researcher III Daniel Bartos (physicist)*
- *Senior researcher II Dr. Alexandru Bercuci (physicist)*
- *Senior researcher II Gheorghe Caragheorgheopol (electronics engineer)*
- *Senior researcher II Dr. Vasile Catanescu (electronics engineer)*
- *Senior researcher II Dr. Florin Constantin (physicist)*
- *Senior researcher II Viorel Duta (mechanical engineer)*
- *Scientific Researcher III Dr. Andrei Herghelegiu (physicist)*
- *Senior Engineer I Dr. Gheorghe Mateescu*
- *Senior researcher II Dr. Mariana Petris (physicist)*
- *Prof. Dr. Alexandrina Petrovici (physicist)*
- *Senior researcher I Dr. Amalia Pop (physicist)*
- *Senior engineer II Dr. Laura Radulescu (mechanical engineer)*
- *Senior researcher II Dr. Victor Simion (physicist)*
- *Computing coordinator Claudiu Schiaua (physicist)*
- *PhD student Madalina Tarzila (physicist)*
- *Technician Valerica Aprodu*
- *Technician Lucia Prodan*
- *Technician Andrei Radu*
- *Technician Constanta Dinca*
- *Turner Dima Gheorghe*
- *Financial coordinator Georgiana Toma (economist)*

Highlights of accomplishments in the last year

- Data analysis of CERN-SPS in-beam tests campaign.

- Laser monitoring system.

- Construction and tests of the CBM compliant DAQ of TRD.

- Construction and tests of a new motherboard for electronic tests of FASP-0.2 ASIC.

- In beam tests of MSMGRPC prototypes with the granularity required by the inner zone of the CBM-TOF wall, using Pb beam of 30A· GeV at SPS-CERN.

- 6 contributions to CBM Progress Report/GSI Scientific Report

- 5 presentations to CBM Collaboration Meetings

- 2 presentations to the CBM TRD TDR Review

- 2 paper drafts, one accepted for publication, one is still under internal reviewing

- A summer Student Program with 8 participants was successfully accomplished.

Scientific objectives for the next year

- Finalizing the data analysis obtained at SPS in-beam test in 2016

- In-house tests using high flux X-ray tubes, radioactive sources and cosmic rays of the TRD and RPC prototypes

- Data calibration and analysis

- Close to final design of the CBM ToF inner zone

- Core-Corona interplay for BES

- Outreach activities

- Summer Student Program

Financial status

Spend until December 30,2017

	Type of expenditures	2017 Planned			Spend until December 30, 2017	
		TOTAL 2017 Planned	2017 Planned for budget (CB)	2017 Planned for commitment appropriations (CA)	2017 Spend CB	2017 Spend CA
1	**PERSONNEL EXPENDITURES, from which:**	**243,740.00**	**243,740.00**	**0.00**	**243,740.00**	**0.00**
	1.1. wages and similar income, according to the law	198,403.00	198,403.00	0.00	198,403.00	0.00
	1.2. contributions related to salaries and assimilated incomes	45,337.00	45,337.00	0.00	45,337.00	0.00
2	**LOGISTICS EXPENDITURES, from which:**	**468,214.00**	**170,000.00**	**298,214.00**	**180,879.33**	**308,378.02**
	2.1. capital expenditures	267,359.00	100,000.00	167,359.00	90,519.31	219,286.08
	2.2. stocks expenditures	142,359.00	25,000.00	117,359.00	40,394.58	55,515.94
	2.3. expenditure on services performed by third parties	58,496.00	45,000.00	13,496.00	49,965.44	33,576.00
3	**TRAVEL EXPENDITURES**	**70,000.00**	**70,000.00**	**0.00**	**42,706.71**	**0.00**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**266,660.00**	**220,860.00**	**45,800.00**	**237,273.96**	**35,635.98**
	TOTAL EXPENDITURES (1+2+3+4)	**###**	**704,600.00**	**344,014.00**	**704,600.00**	**344,014.00**

Data confirms our responsibility. **100.00%** **100.00%**

* Specify the rate (%) and key of distribution (excluding capital expenditures): 40% from pct.(1+2.2+2.3.+3) IFIN -HH overheads and HPD overheads 35.51% from pct.1

Financial status

Form C1-EN – Cost Estimates

COST ESTIMATES
according with the regulations from H.G. 134/2011

lei

	Type of expenditures	Contracted Initial 2018	Spend in 2017 Commitment Appropriations (CA)	Aditional Act No. 2/2017 2018
1	**PERSONNEL EXPENDITURES**	**276.013,00**	**0,00**	**248.633,00**
2	**LOGISTICS EXPENDITURES, from which:**	**113.496,00**	**308.378,02**	**0,00**
	2.1. capital expenditures	75.000,00	219.286,08	0,00
	2.2. stocks expenditures	25.000,00	55.515,94	0,00
	2.3. expenditure on services performed by third parties	13.496,00	33.576,00	0,00
3	**TRAVEL EXPENDITURES**	**70.000,00**	**0,00**	**0,00**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**232.591,00**	**35.635,98**	**99.453,00**
	TOTAL EXPENDITURES *(1+2+3+4)*	**692.100,00**	**344.014,00**	**348.086,00**

Thanks for your attention

&

We kindly invite you to visit our HPD