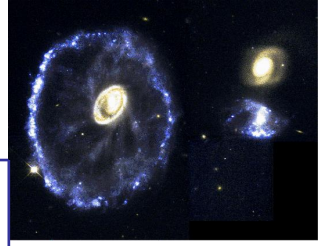
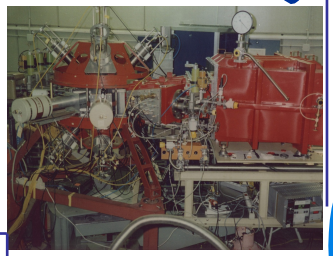
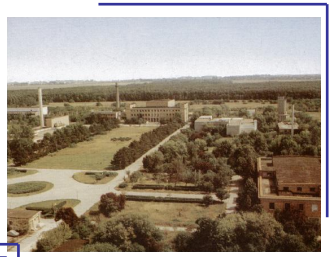
HPD-NIPNE achievements within CBM Collaboration @ FAIR

Mihai Petrovici for NIPNE CBM Branch, Scientific Symposium, May 12, 2016

Is it fair



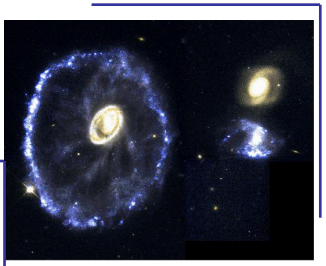


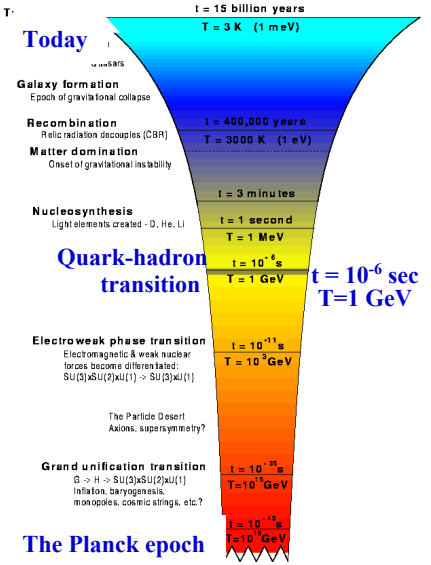


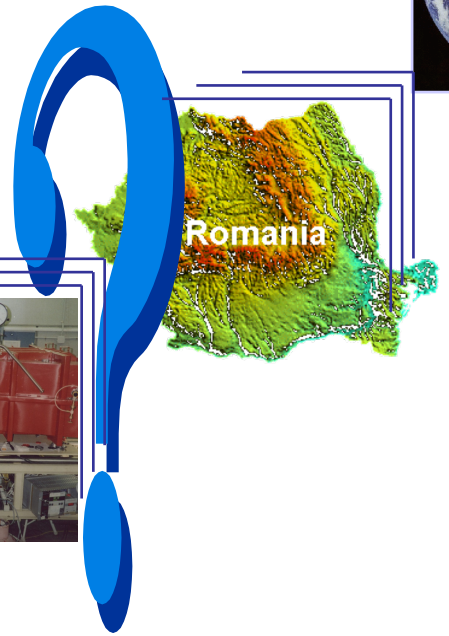
to be in

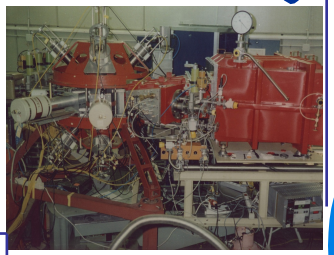
FAIR ?

"The philosophies and religions of the planet Earth will come and go, but the ultimate questions will be always alive and relevant"
James Leonard Park

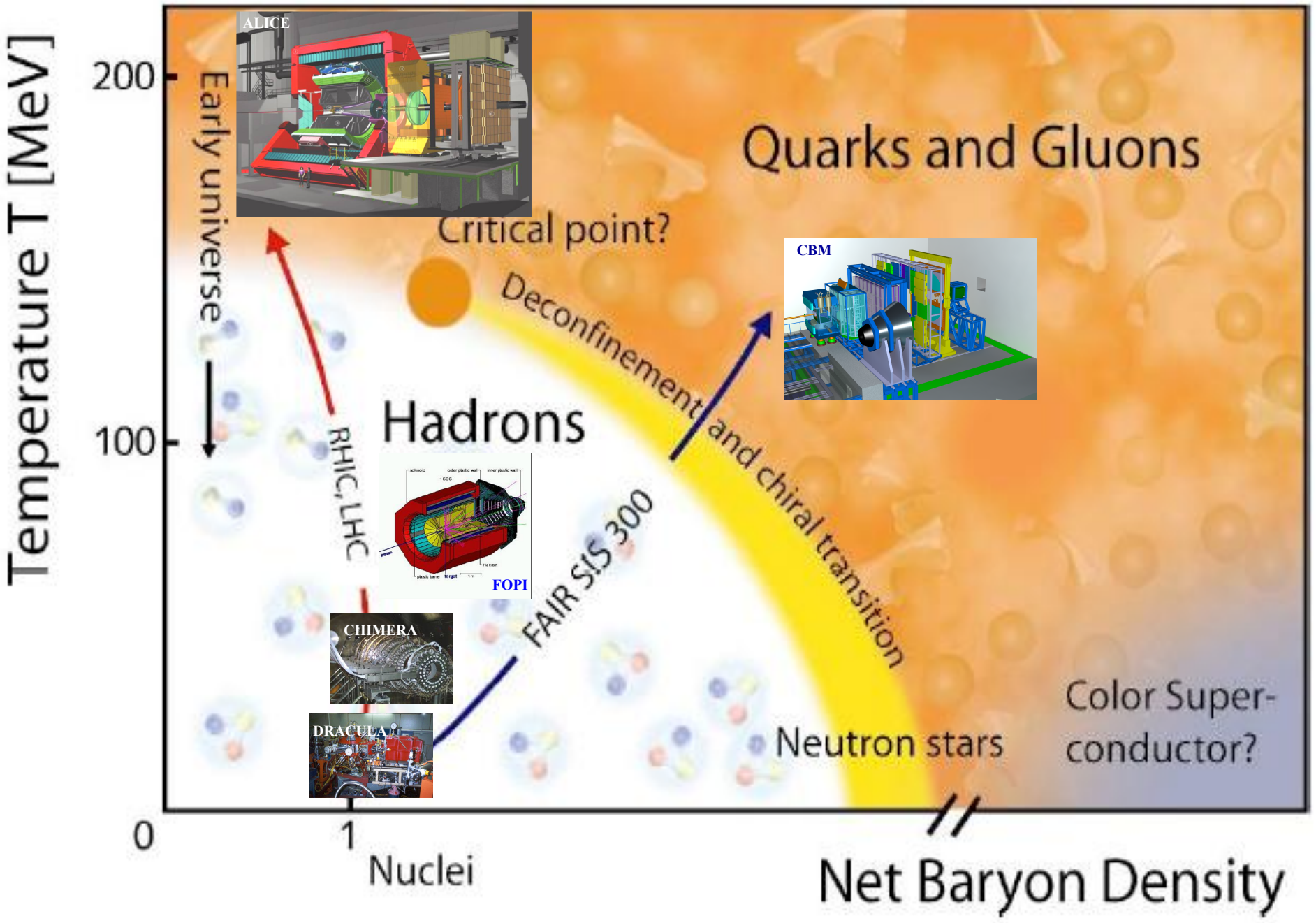






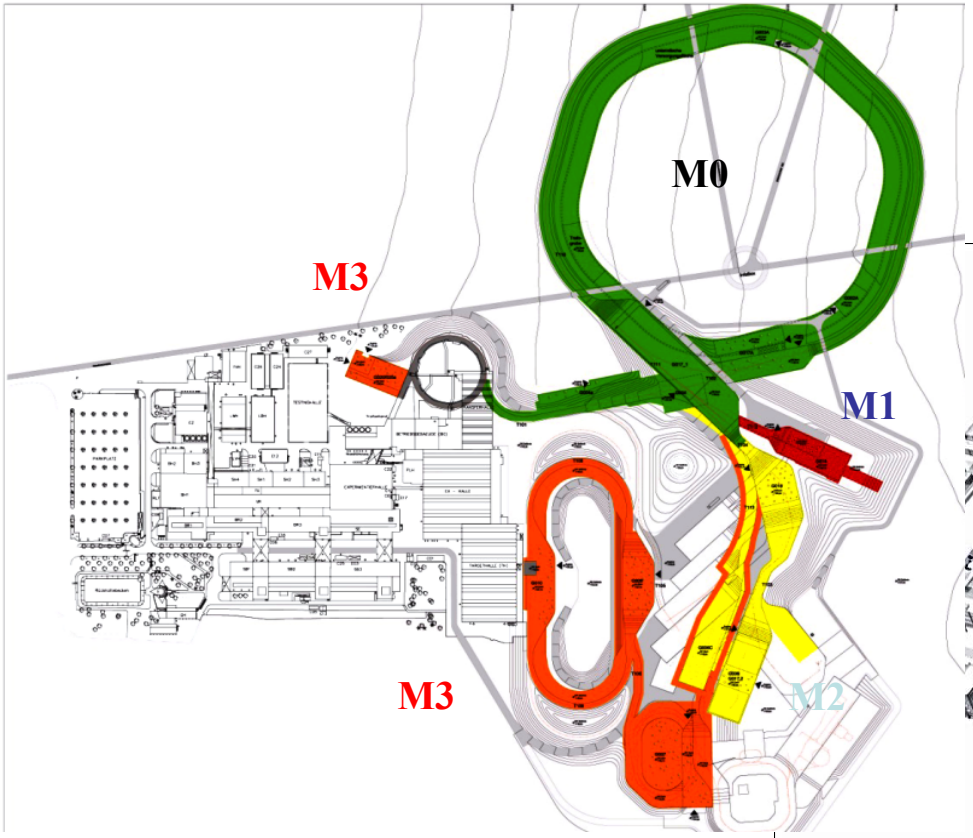


Physics Motivation

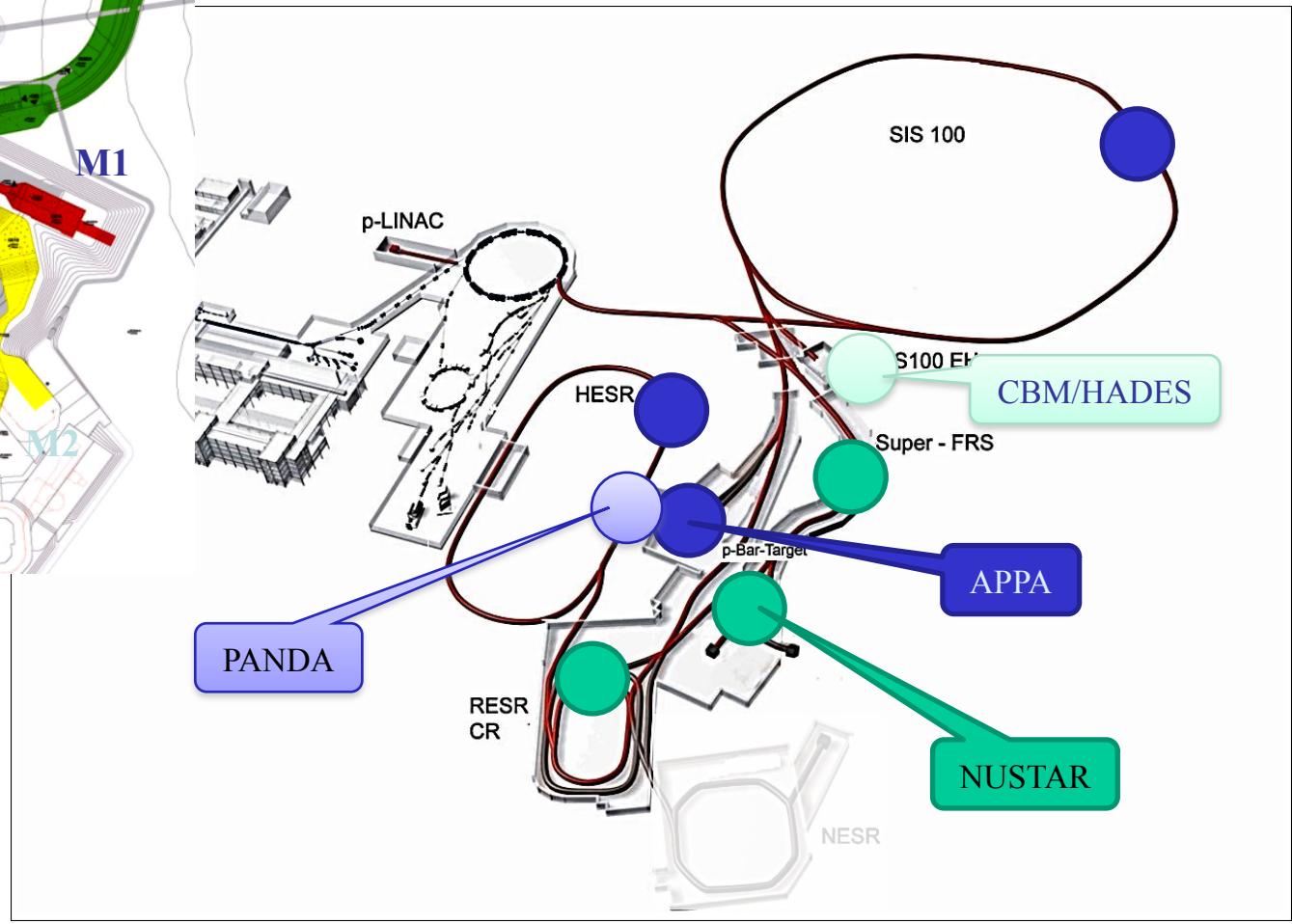


Modularised Start Version (MSV)

Downscaling with the MSV



Cost about 1.6 billion by 2018
(1 billion 2005 Euros)



Modules

M0: SIS100

M1: APPA

M1: CBM/HADES

M2: NUSTAR

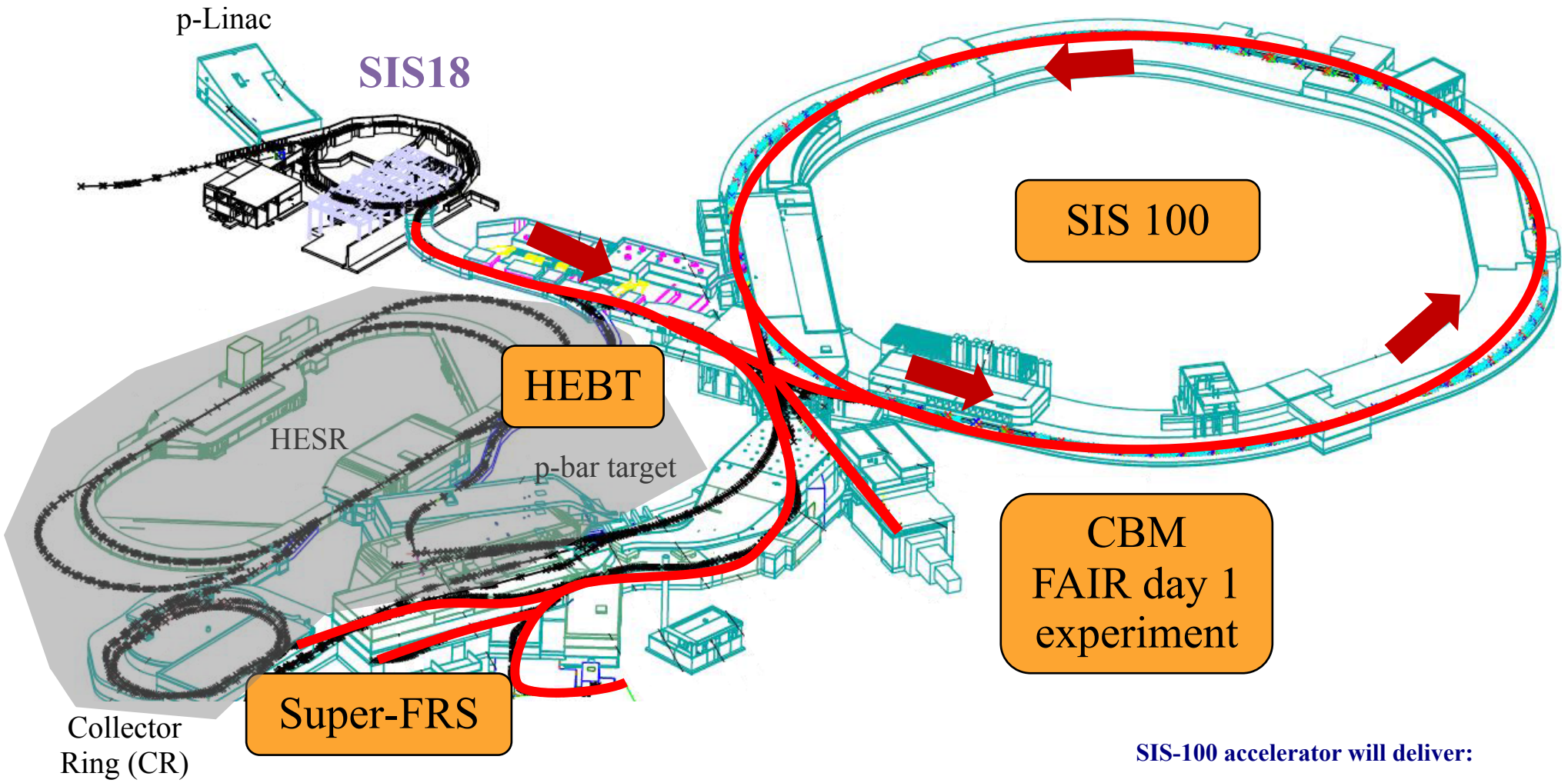
M3: PANDA, NuSTAR, APPA

Presented by Boris Sharkov
@ 26th CBM Meeting, September 2015, Prague

confirmed

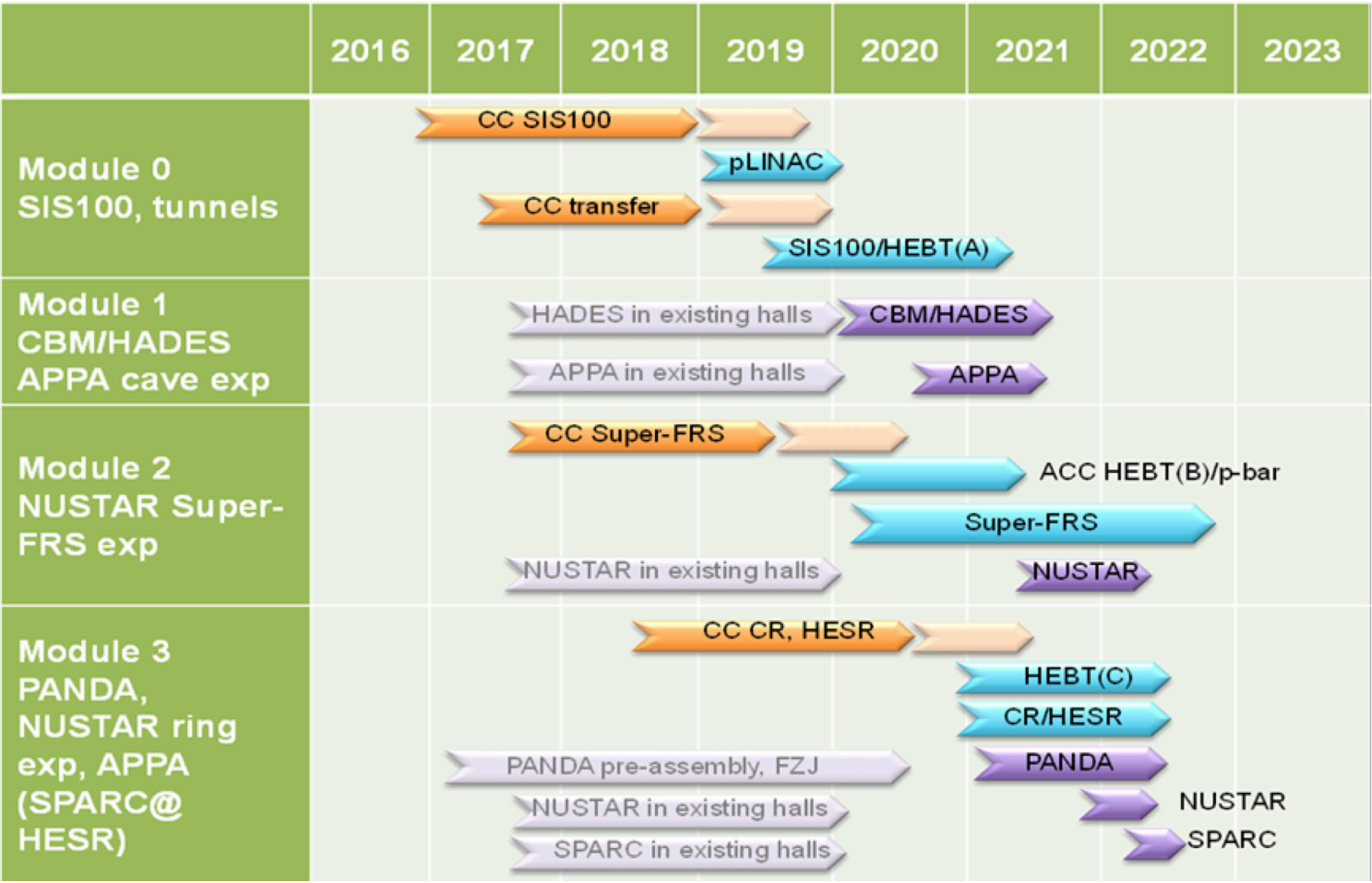
by Joerg Blaurock
@ 27th CBM Meeting, April 2016, GSI

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

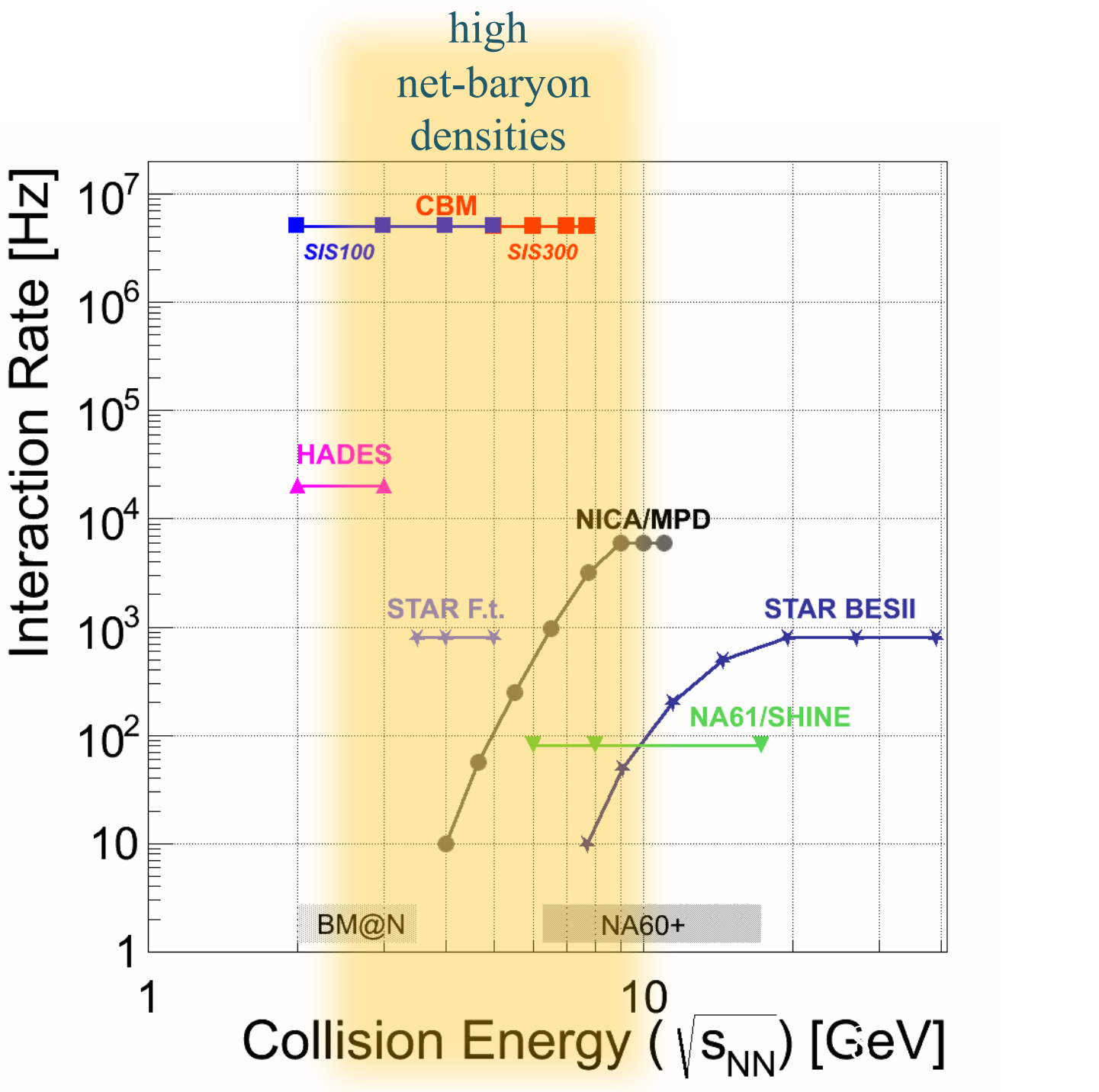


SIS-100 accelerator will deliver:

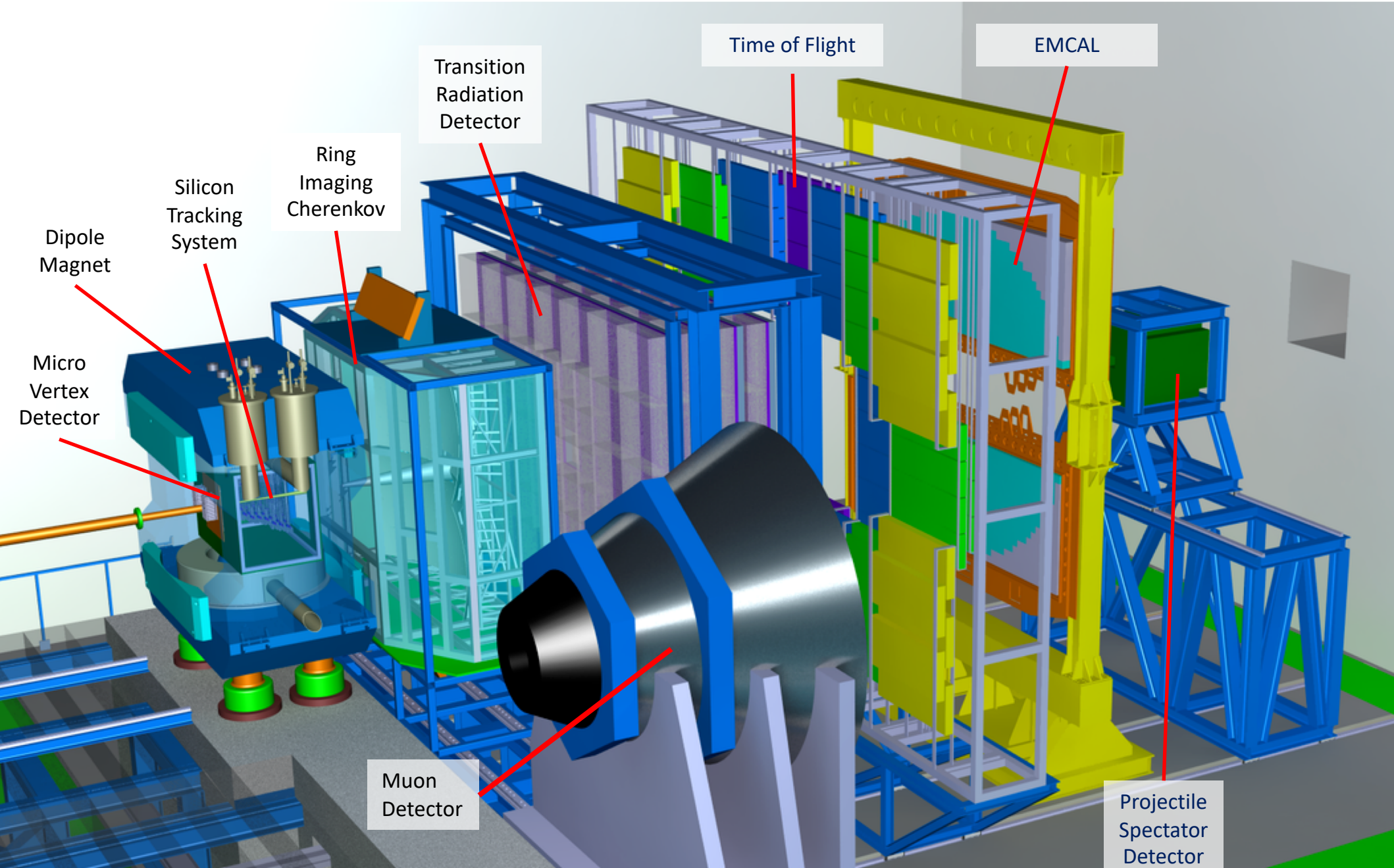
- heavy ions (Au) up to 11A GeV
$\sqrt{s_{NN}}$ = 4.7 GeV
- light ions (e.g. Ca) up to 14A GeV
$\sqrt{s_{NN}}$= 5.3 GeV
- protons up to 29 GeV
$\sqrt{s_{NN}}$= 7.5 GeV)


2016
2017
2018
2019
2020
2021
2022
2023
Module 0
SIS100, tunnels
CC SIS100
pLINAC
CC transfer
SIS100/HEBT(A)
Module 1
CBM/HADES
APPA cave exp
HADES in existing halls
CBM/HADES
APPA in existing halls
APPA
Module 2
NUSTAR Super-
FRS exp
CC Super-FRS
ACC HEBT(B)/p-bar
Super-FRS
NUSTAR in existing halls
NUSTAR
Module 3
PANDA,
NUSTAR ring
exp, APPA
(SPARC@
HESR)
CC CR, HESR
HEBT(C)
CR/HESR
PANDA pre-assembly, FZJ
PANDA
NUSTAR in existing halls
NUSTAR
SPARC in existing halls
SPARC

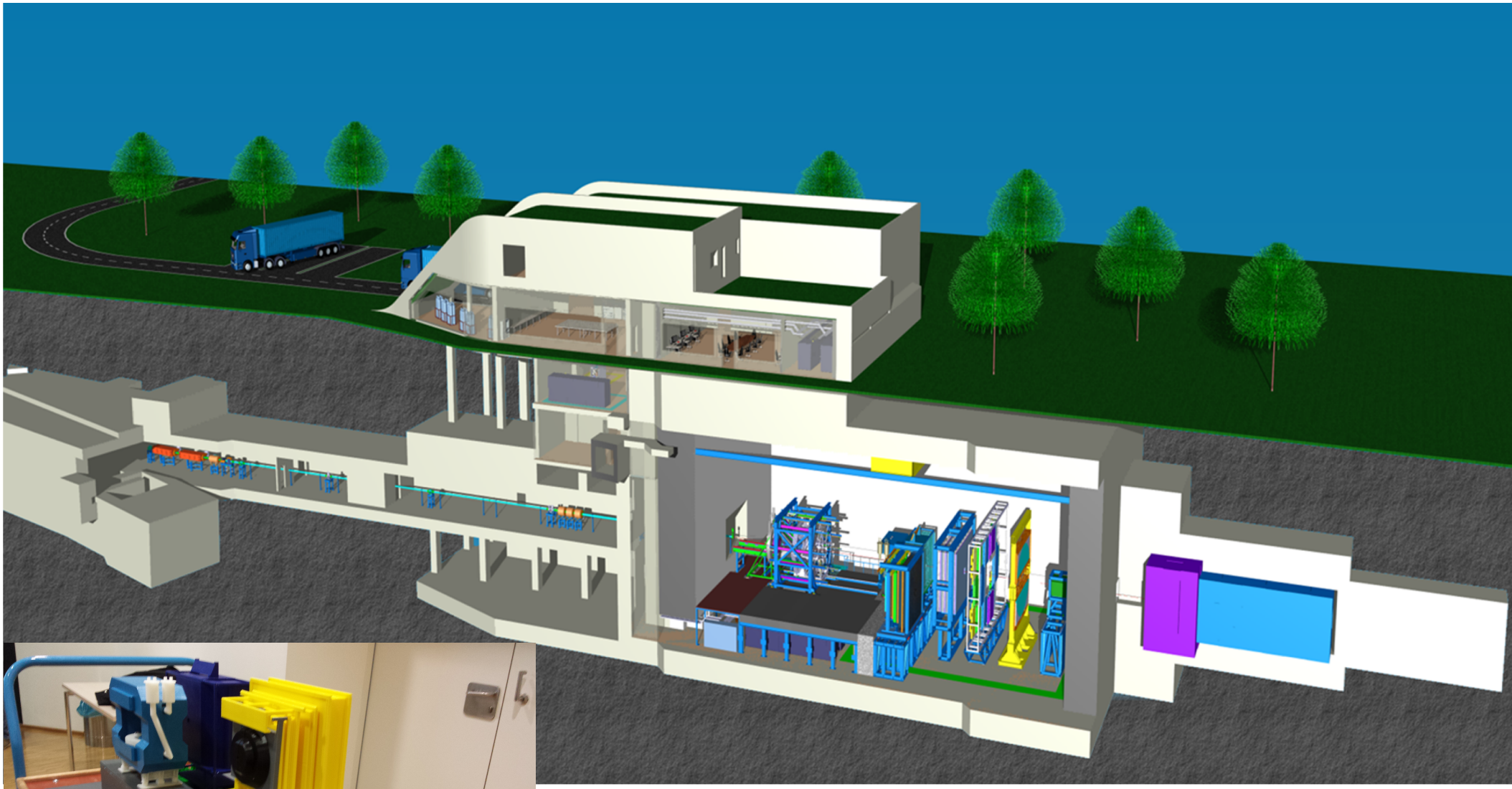
Experiments exploring dense QCD matter

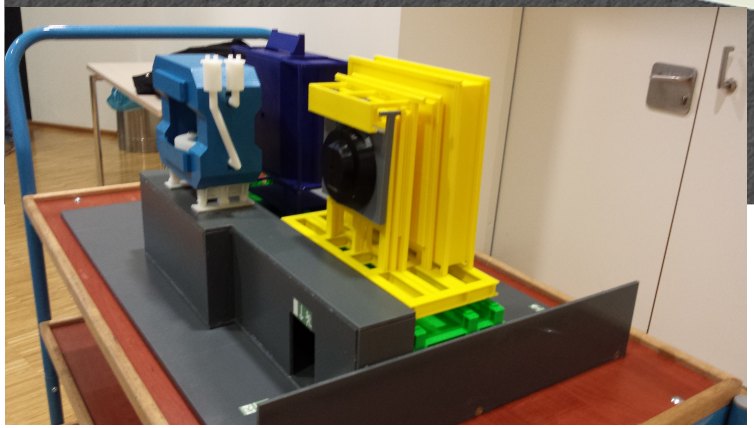


CBM at SIS 100



CBM – Experiment @ FAIR





CBM requirements & challenges

Requirements:

Tracking: STS, TRD

Vertexing: STS

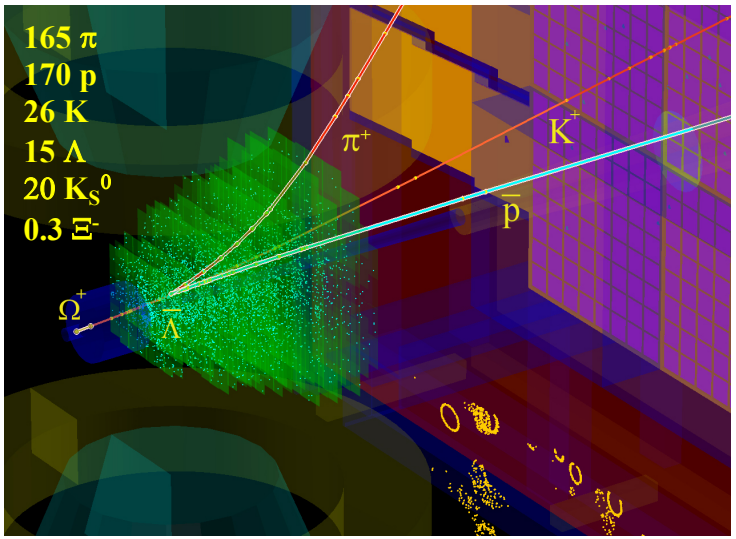
Hadron ID : TOF

Electron ID: RICH, TRD, ECAL

γ, n: ECAL

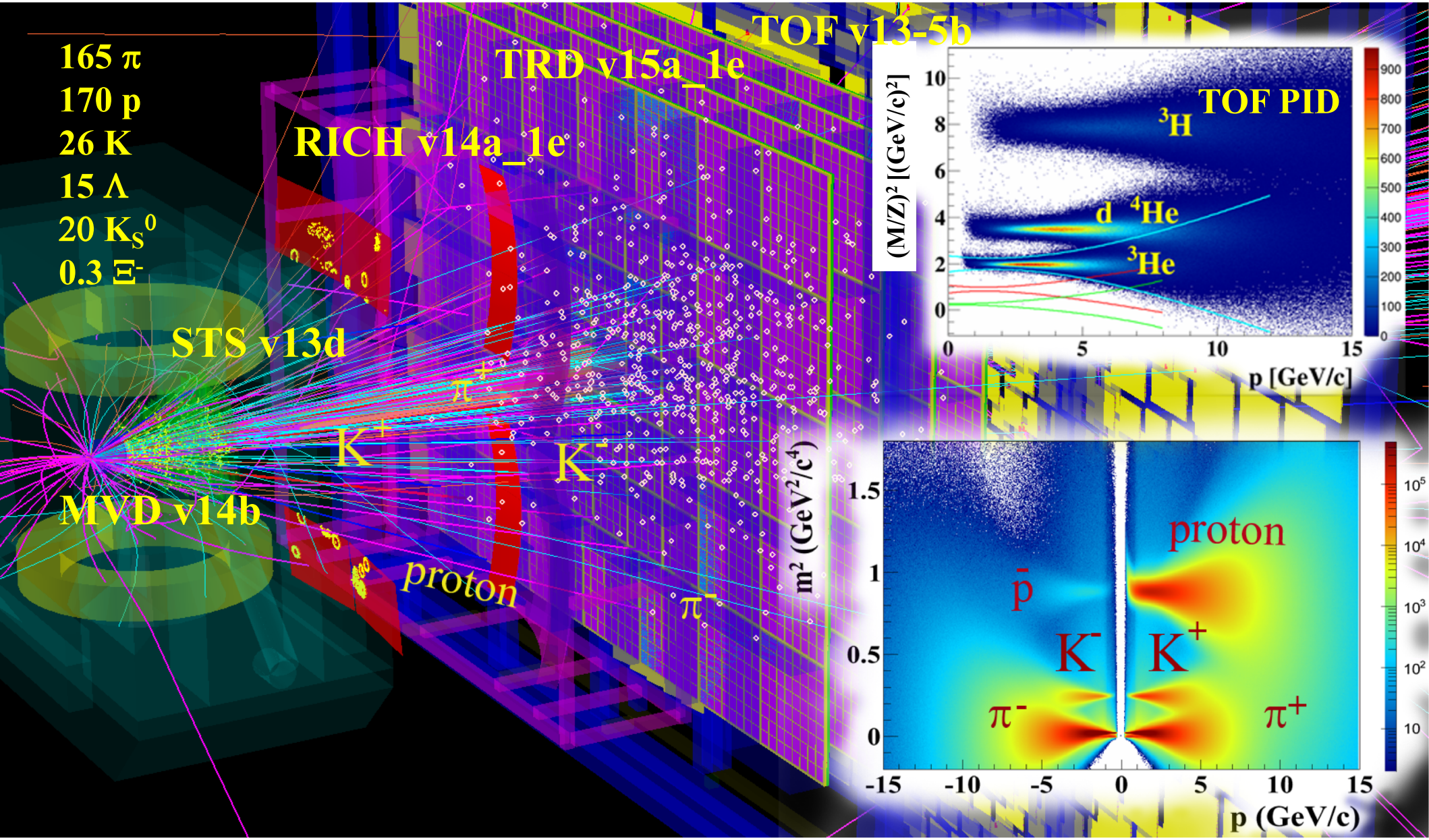
The Challenges:

- **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 $6 \cdot 10^{-2}$/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**

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



Do we have the prerequisites to aim for a visible and competitive contribution? i.e.:

- Physics Motivation

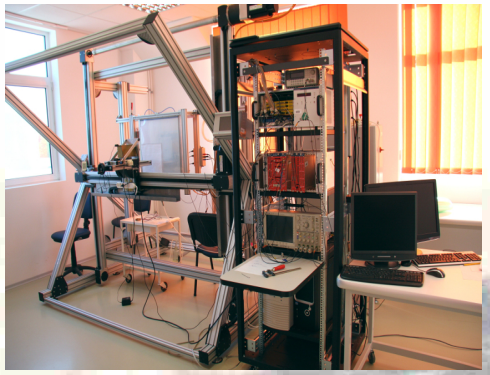
- Infrastructure

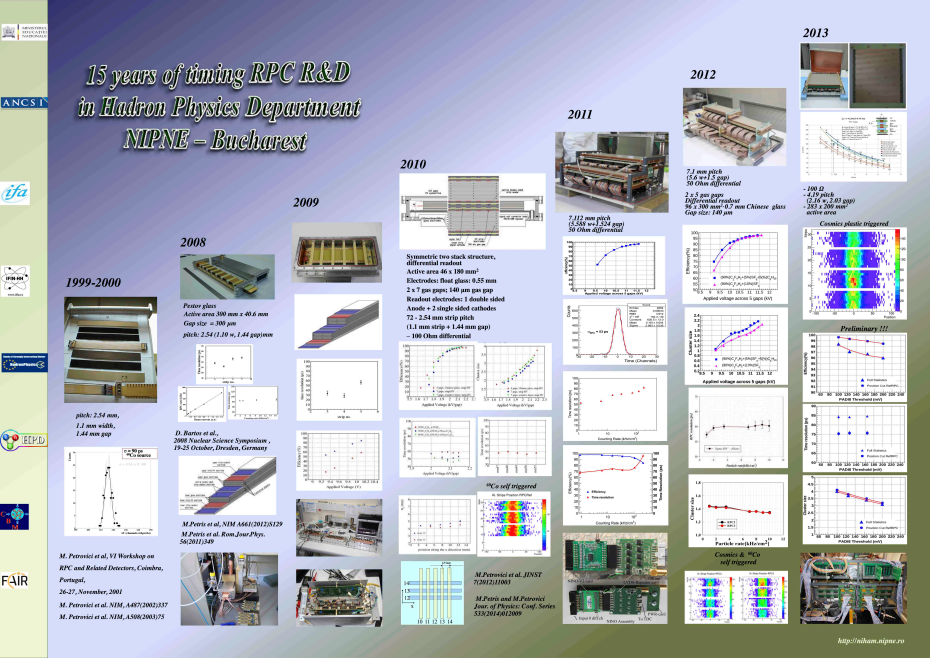
- Know how

- Manpower

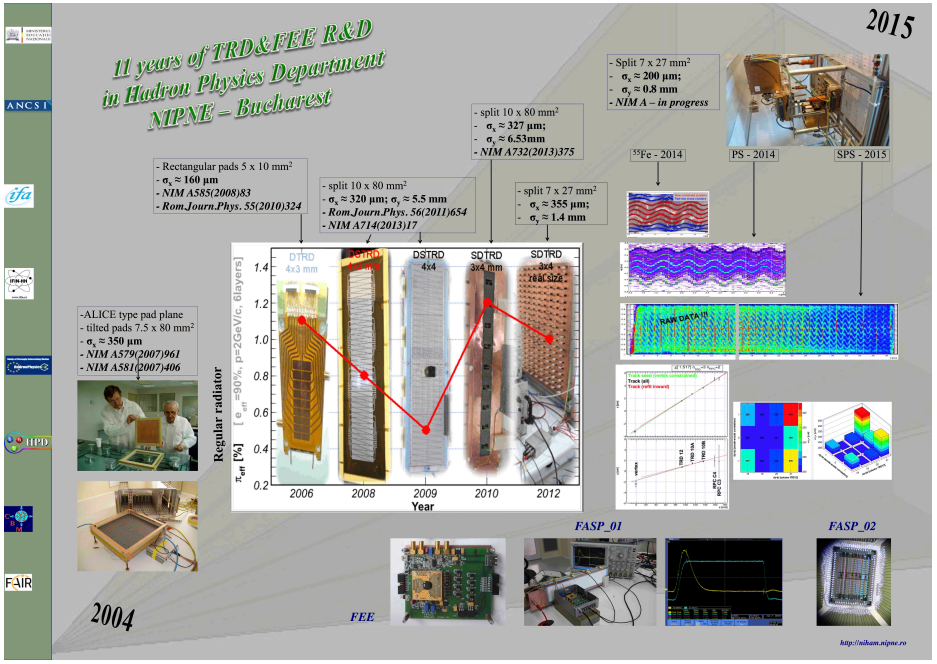
- Experience in such enterprise

Infrastructure

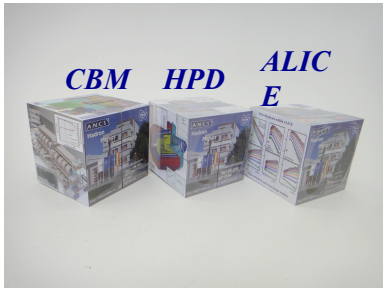




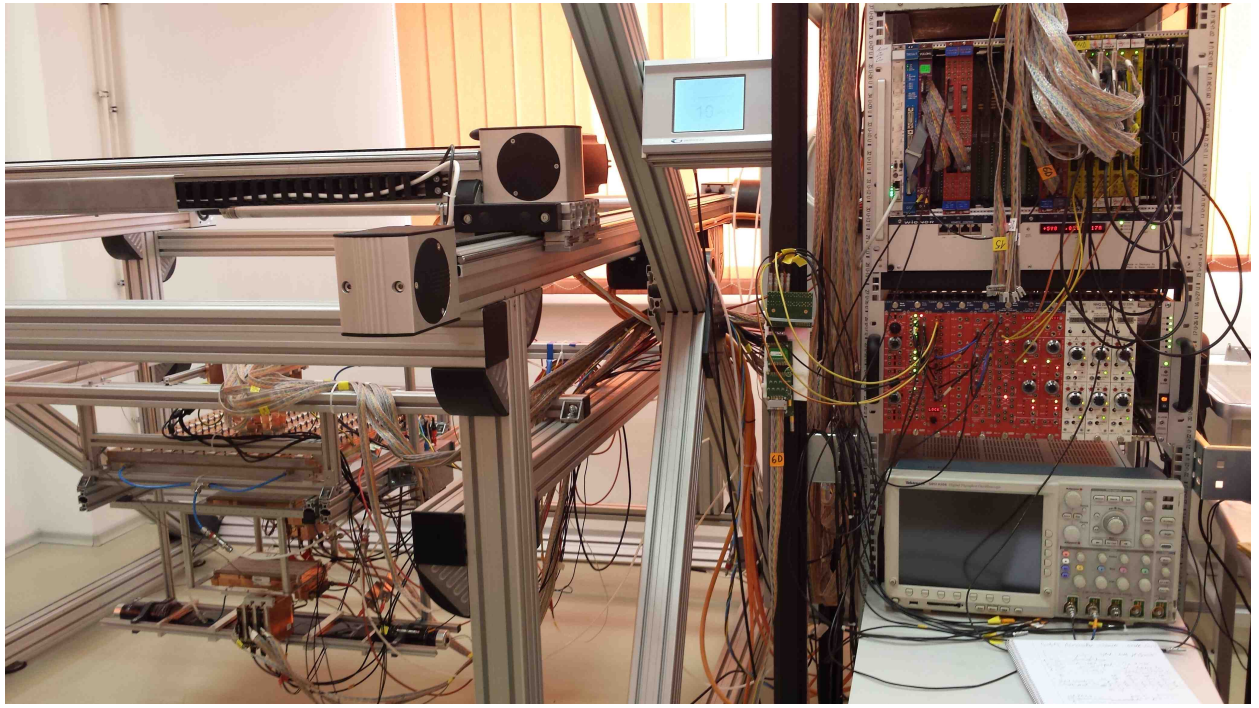
For details please have a look to our posters &

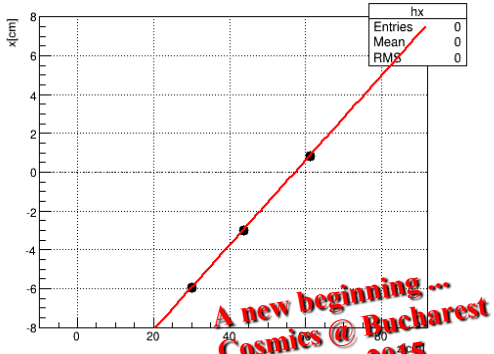


Outreach material we prepared for you

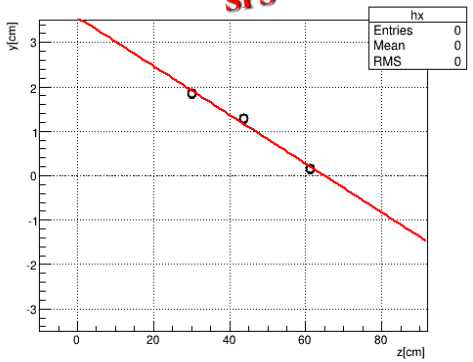


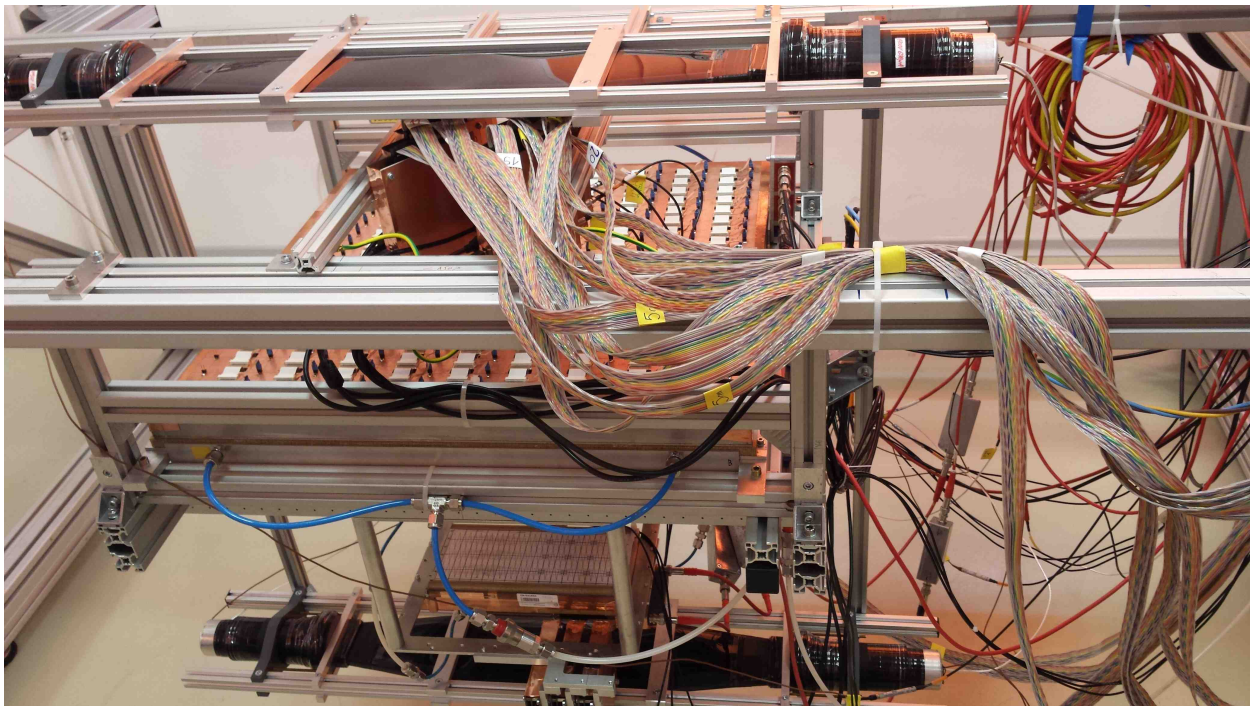
TRD in-house test set-up ~ with the one for in-beam tests





A new beginning ...
Cosmics @ Bucharest
SPS – Nov. 2015

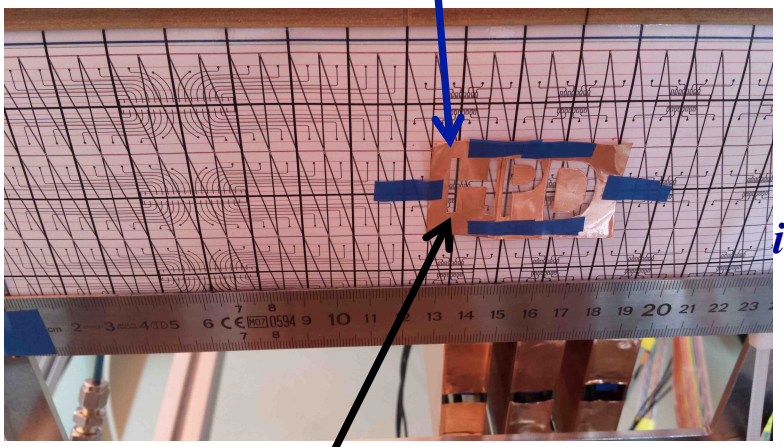




TRD in-house test set-up ~ the one for in-beam tests

The Photo of the Week

Cupper foil - absorber

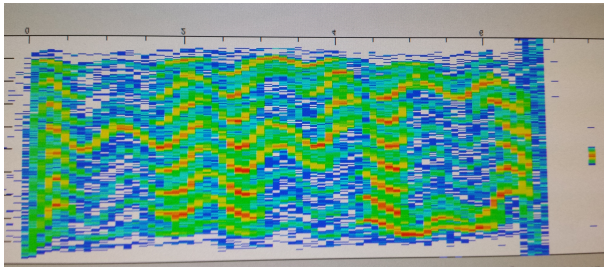


Letters cut on a Cupper foil

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

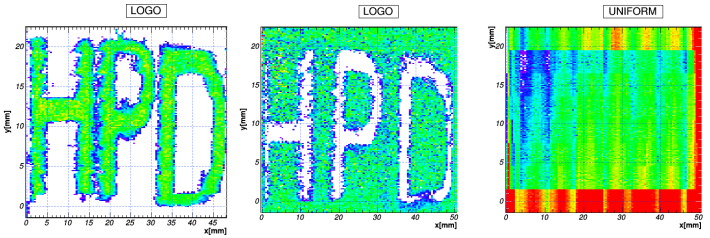
On-line result without any corrections or image processing software

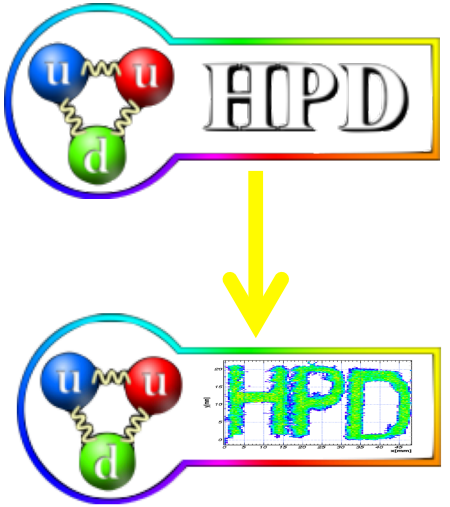
x-y position plot based on the calibration and reconstruction worked-out by Alexandru Bercuci



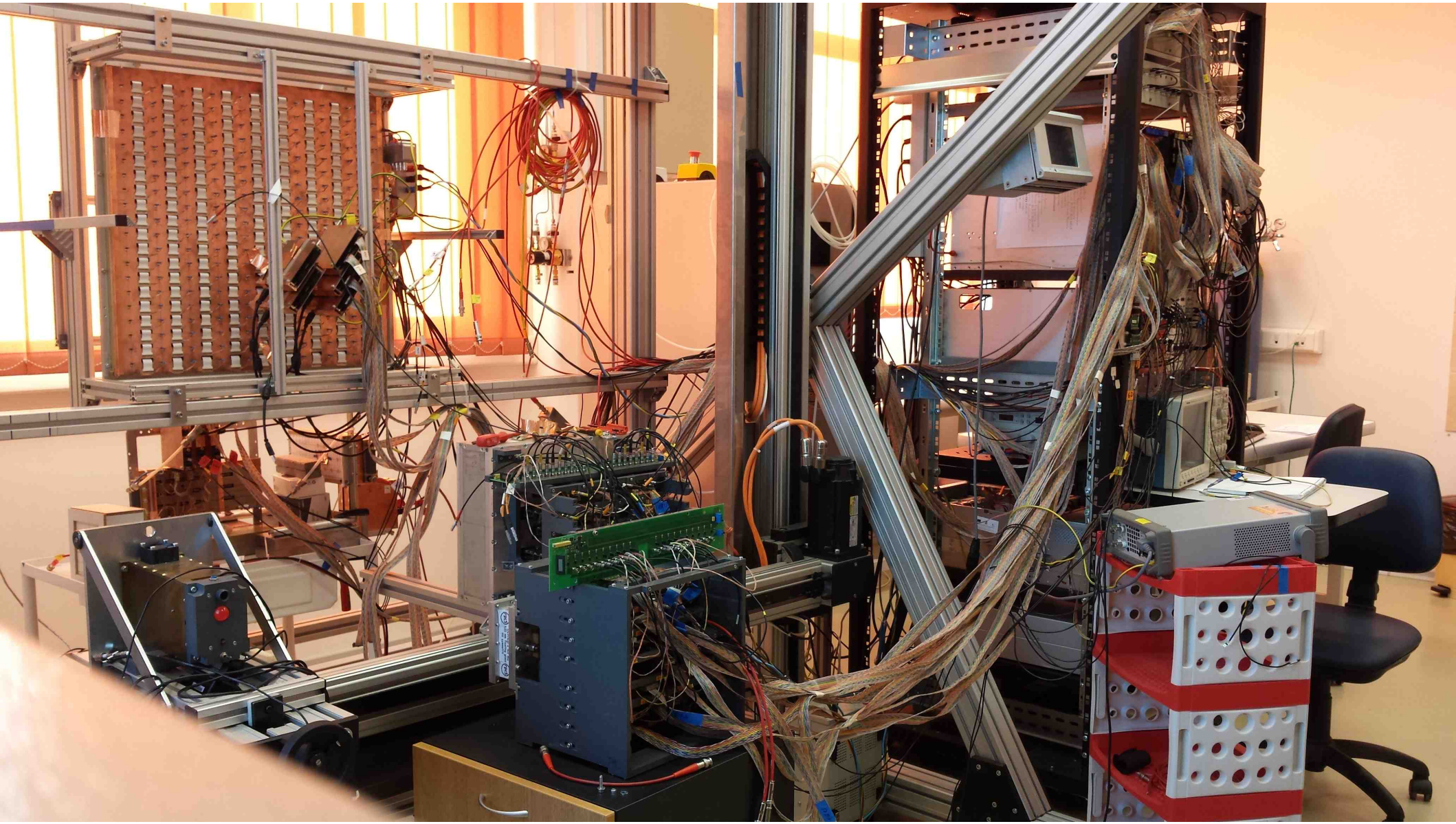
A photo of the DAQ display taken by a handy

After calibration





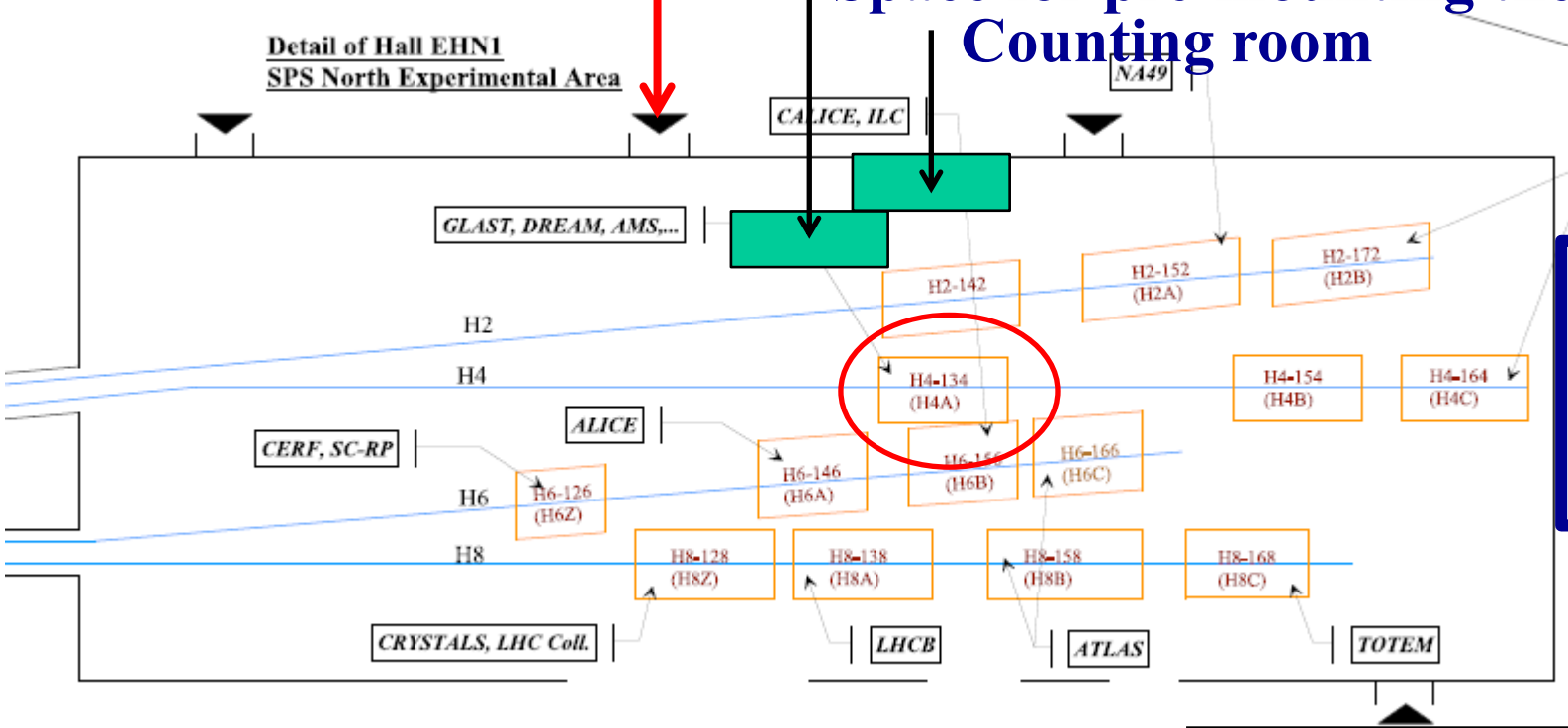
Typical preparations for in-beam tests



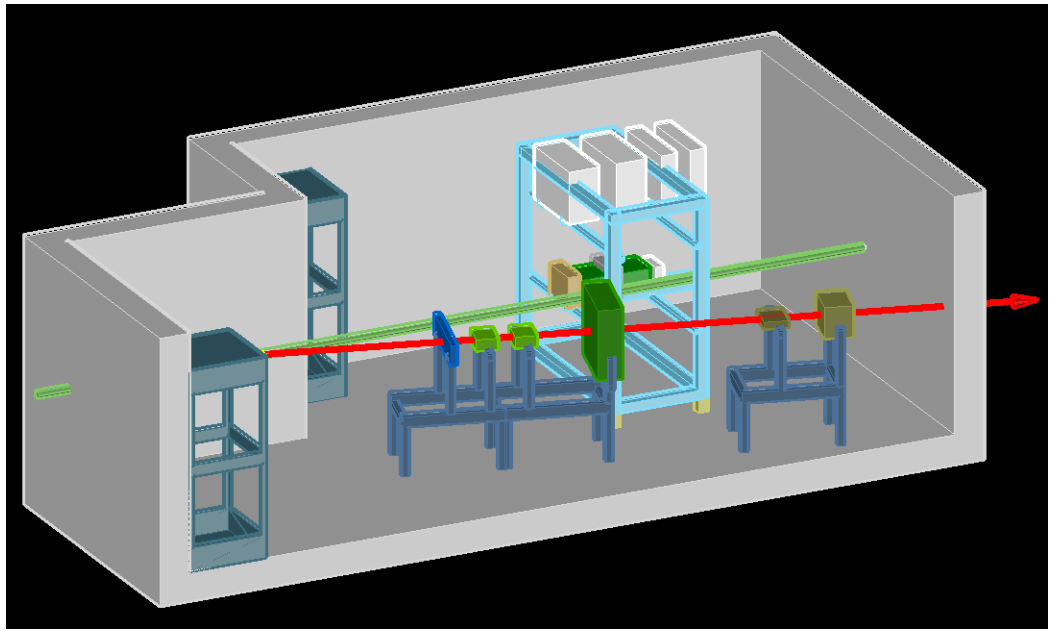
In-beam tests @ SPS-CERN, Nov.2015

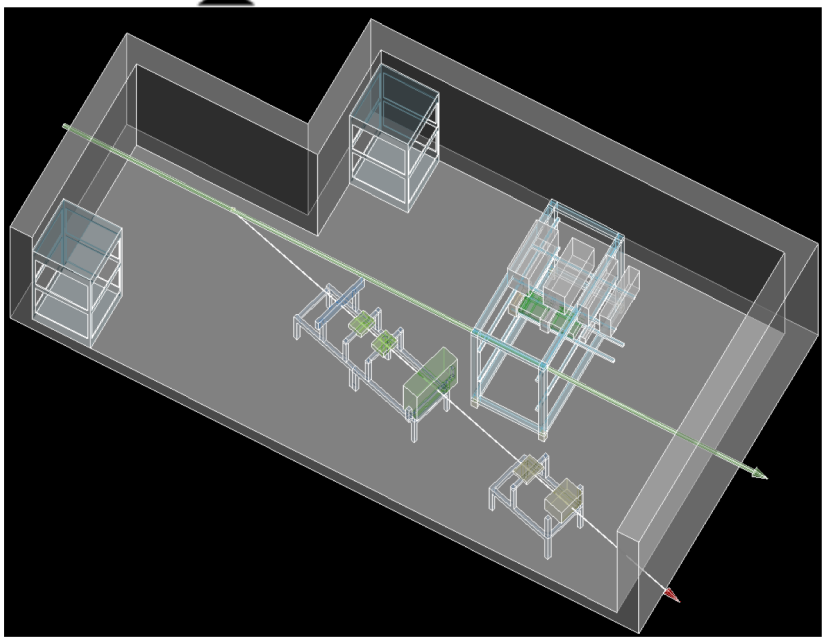
Gate for equipment delivery

Space for pre-mounting the Counting room



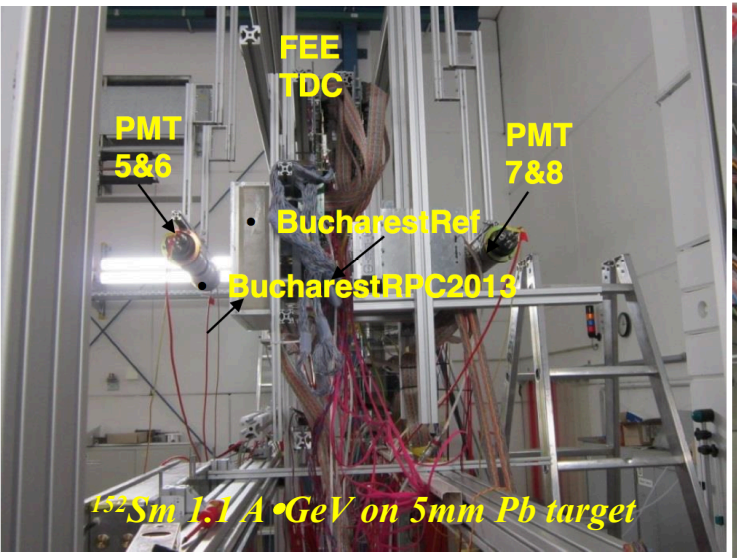
Beam: *Pb*
Beam energy: *30 A GeV*
Beam intensity: *about 10^8 / spill*
Spill length: *15 s*
Beam height: *1.2 m*
Target: *Pb up to 2 mm thickness*
Flux: *Not estimated yet*

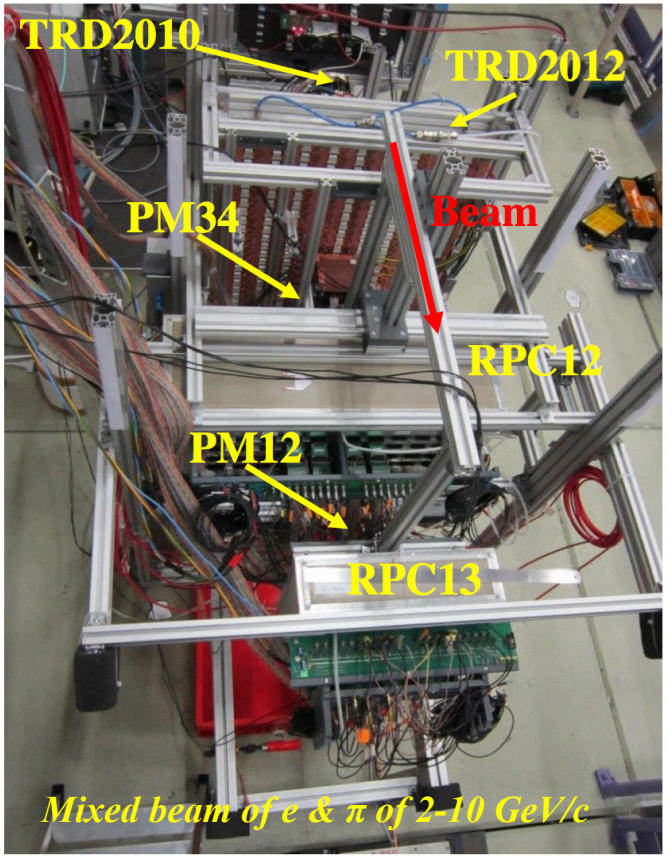


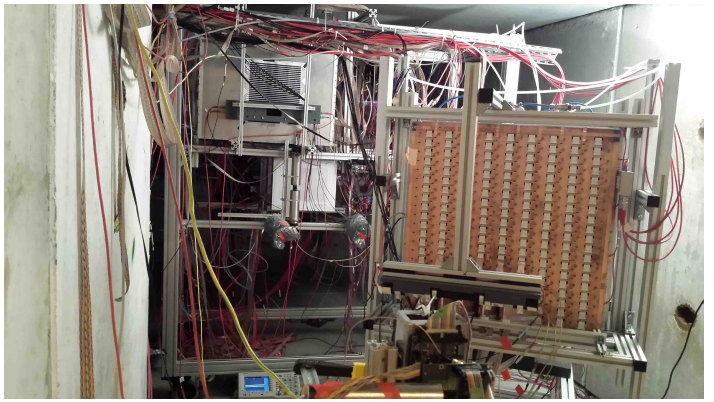


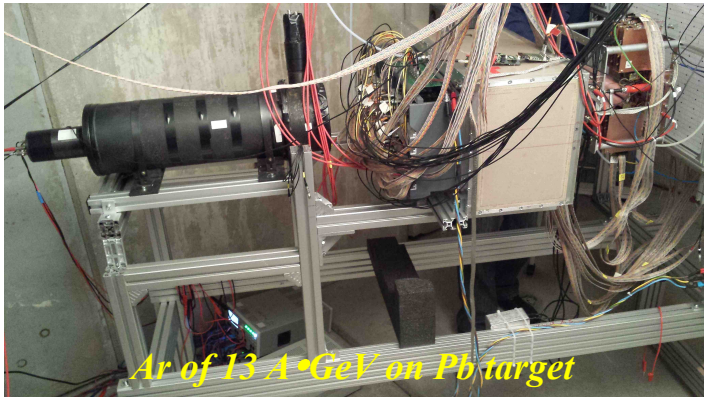
2014-2015 in-beam RPC test results - summary

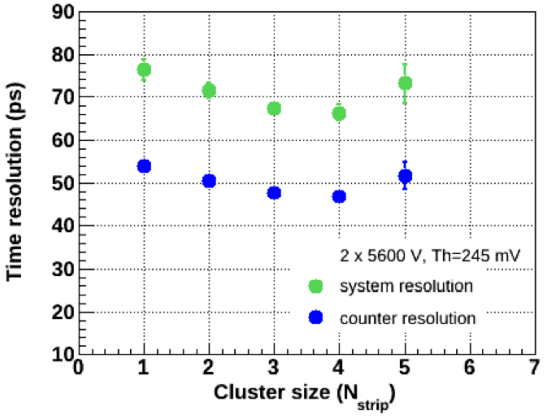
Oct. 2014 @ SIS18-GSI *Nov. 2014 @ PS-CERN* *Feb. 2015 @ SPS-CERN*

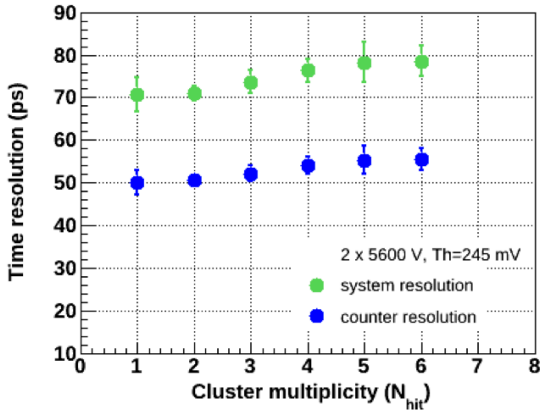


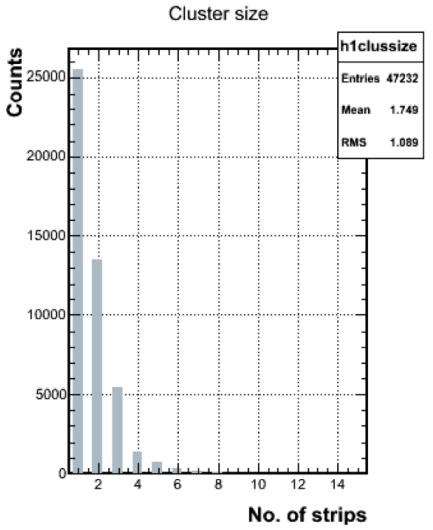


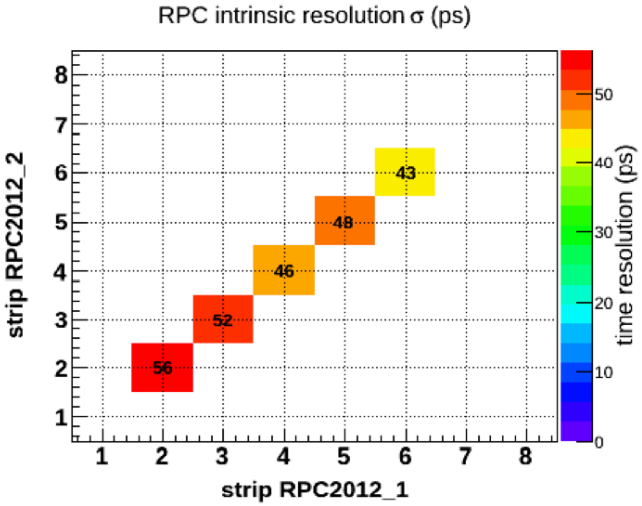




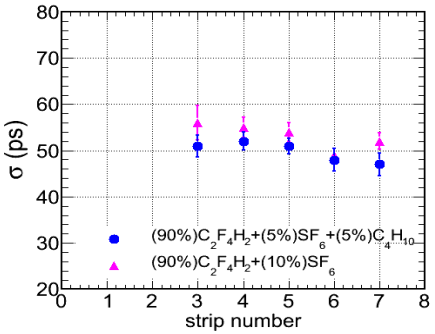


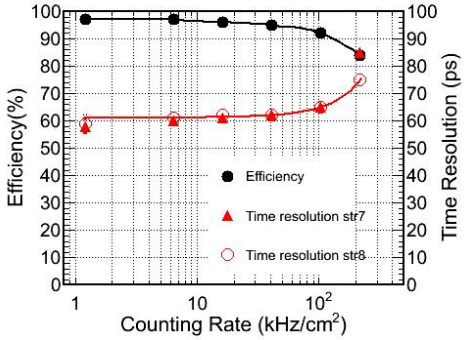


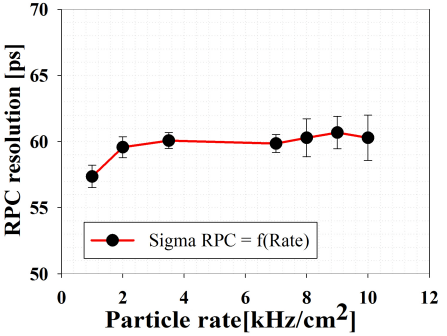


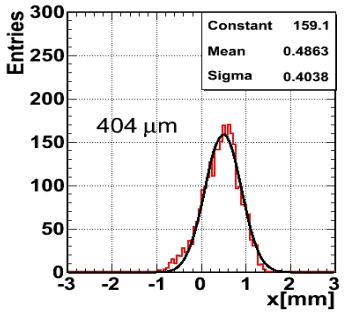


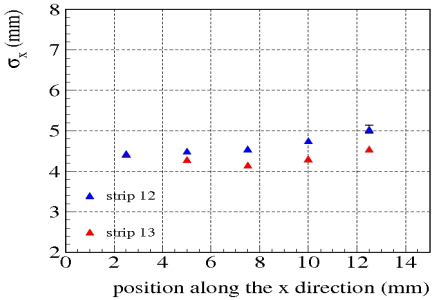
High counting rate RPC
R&D results & the architecture of the inner zone of CBM-TOF

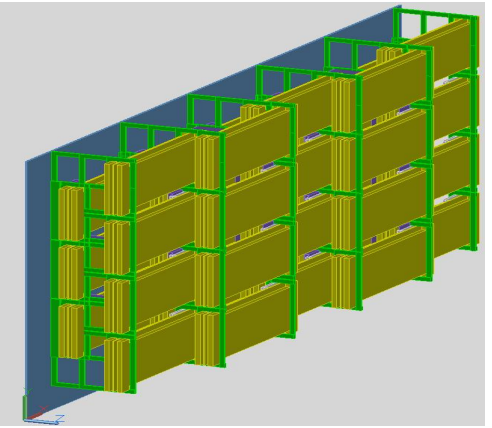






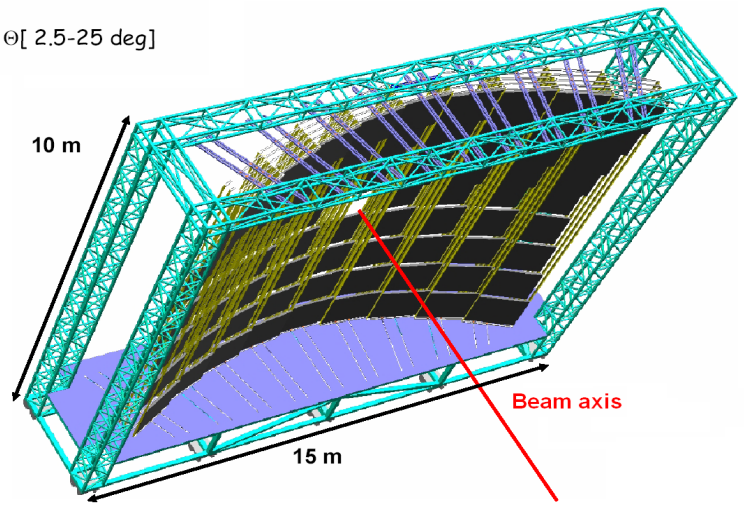




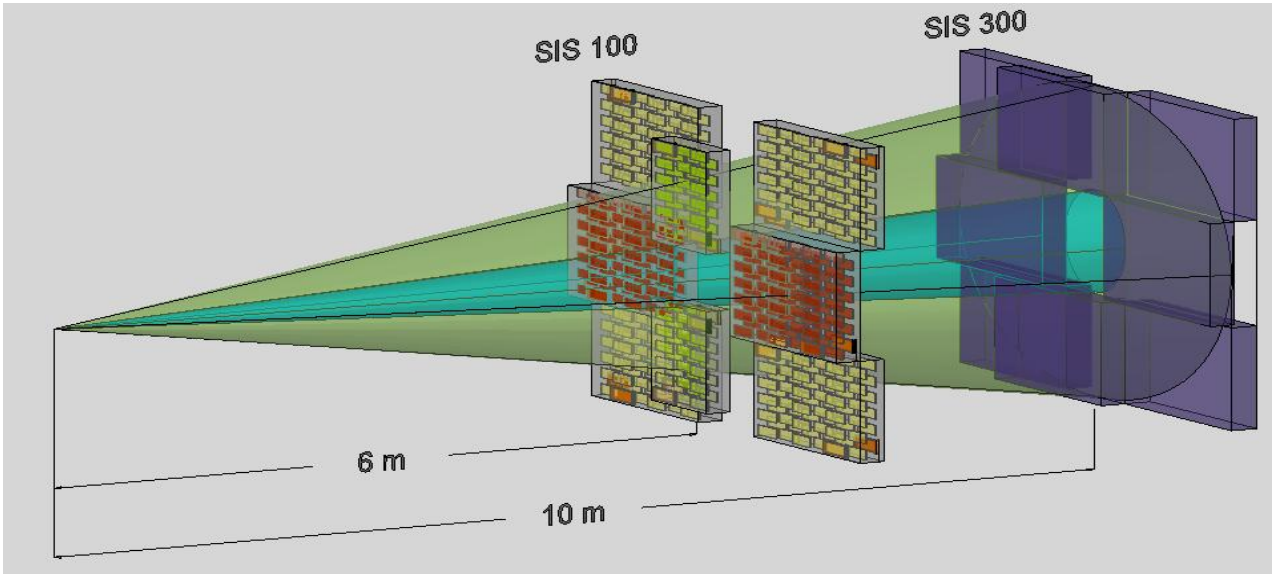


D_{wall} = 10 m

Θ[2.5-25 deg]



9 columns with 9 supermodules each
$A_{super\text{-}module}$ = 1.5 m x 1 m

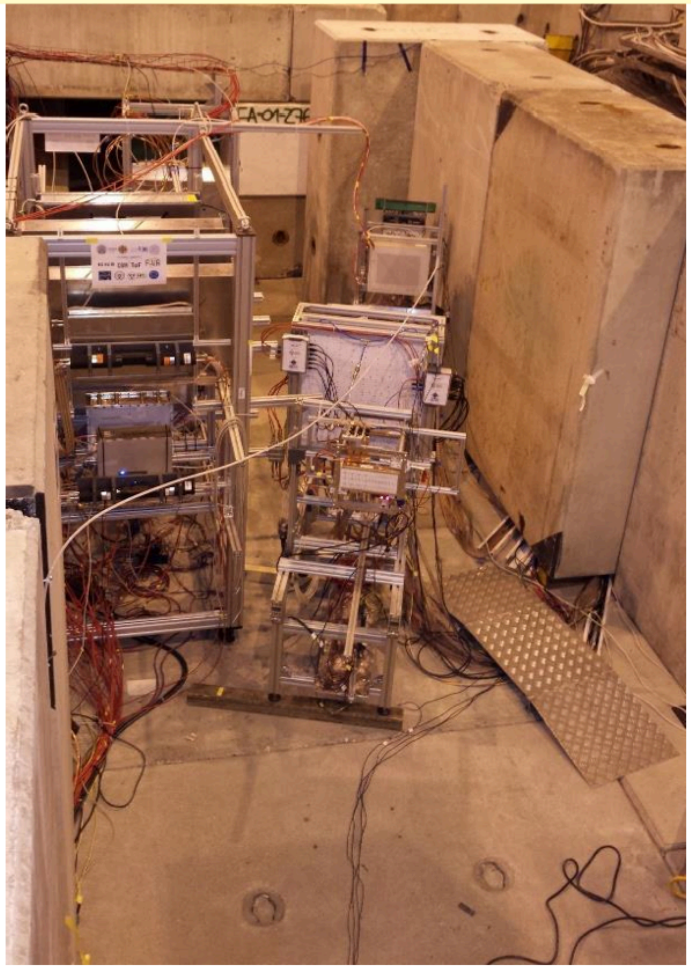


November 2015 CERN - SPS in-beam tests

Pb beam of 30A GeV on a Pb target

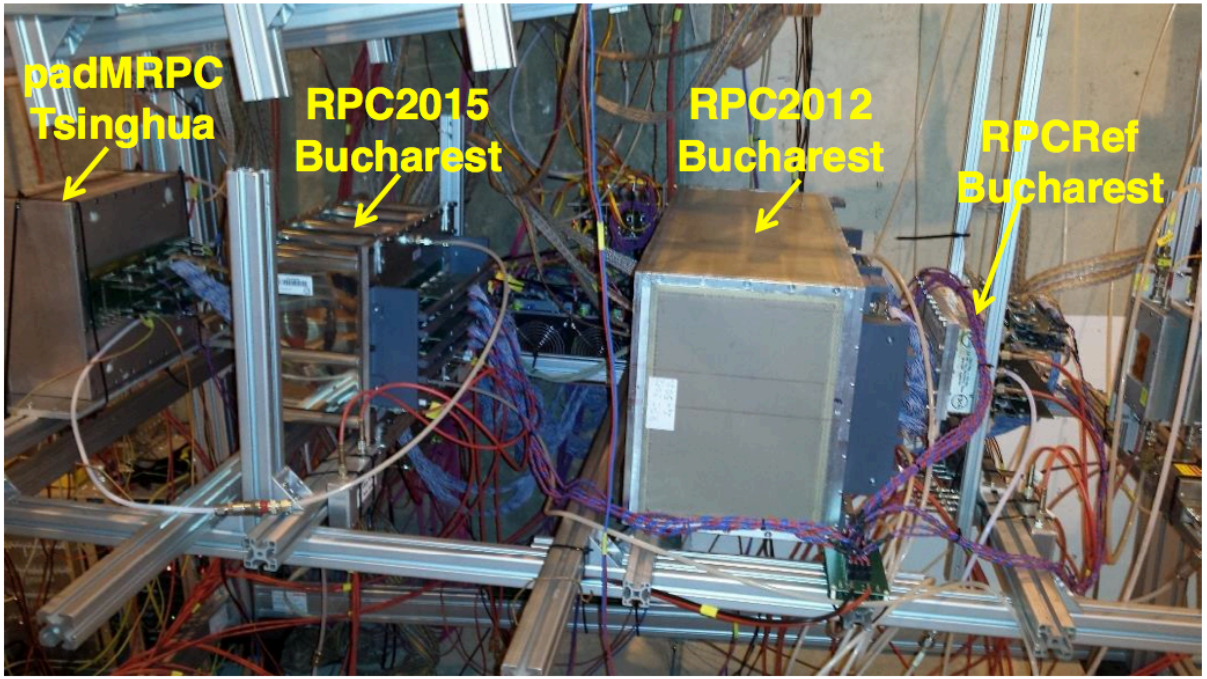
Goal: Tests in real operation conditions:

high counting rate + multi-hit test



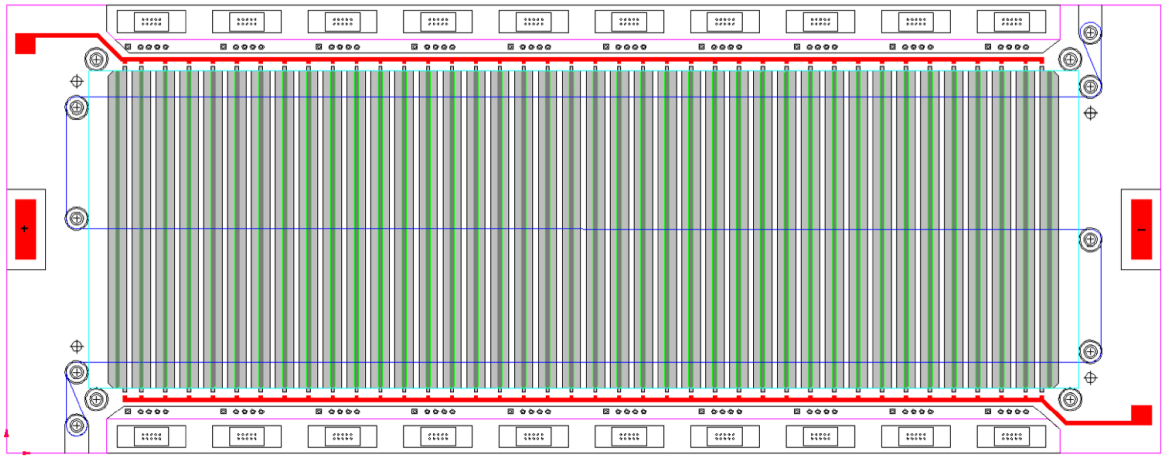
High counting rate experimental set-up

- *RPC Tsinghua University – 3 pad MRPCs*
- *RPC2015 Bucharest – 2 new strip MRPCs*
  - *I. 7.2 mm strip pitch (see next slide)*
  - *II 10.1 mm strip pitch (see next slide)*
- *RPC2012 Bucharest – 4 strip MRPCs*
- *RPCRef – 1 strip MRPC*



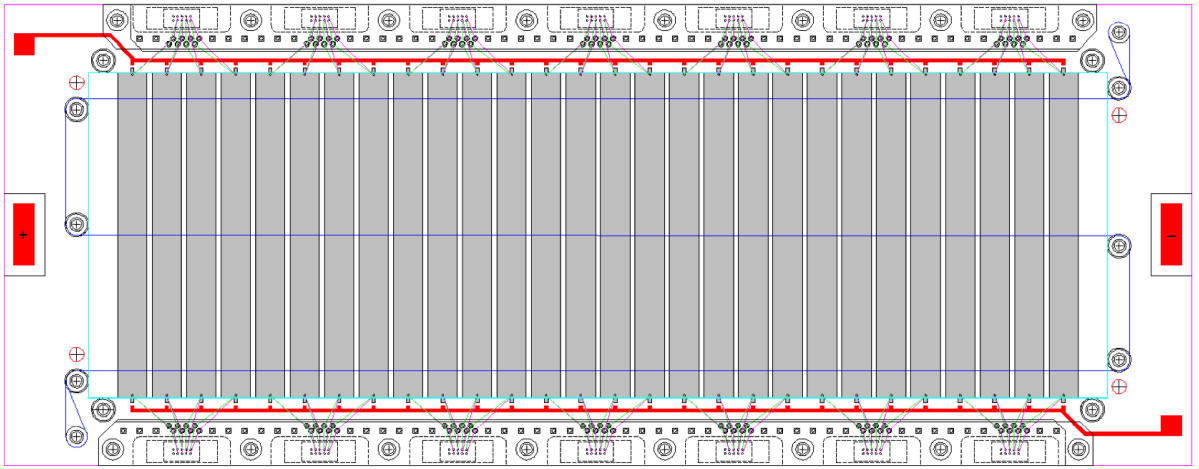
2015 MSMGRPC prototypes for Nov. SPS in-beam test

DS 100Ω impedence



Readout electrode: 7.2 mm pitch= 1.3 mm width + 5.9 mm gap
High Voltage electrode: 7.2 mm pitch= 5.6 mm width + 1.6 mm gap

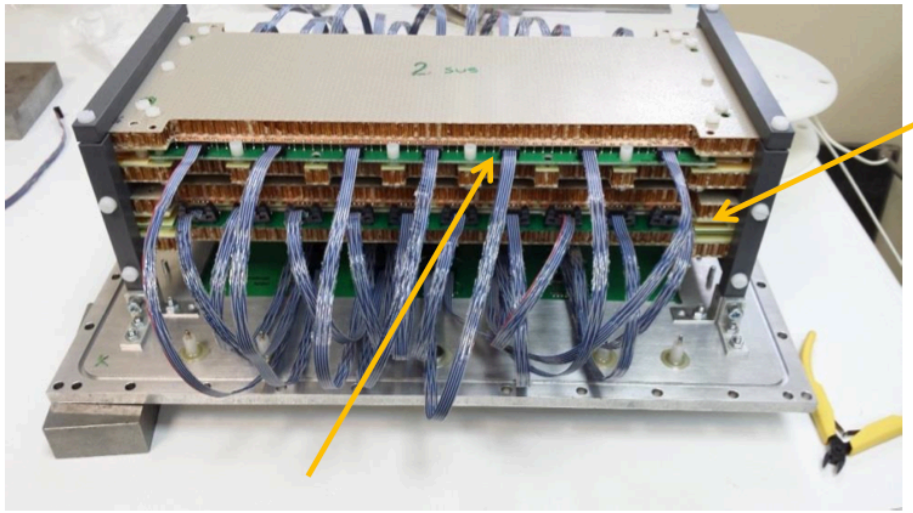
SS 100Ω impedance



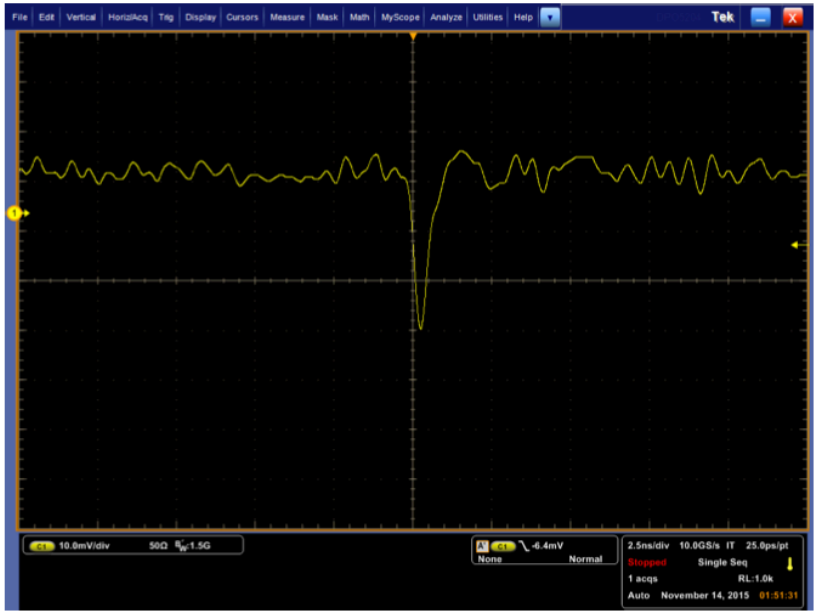
Readout electrode: 10.1 mm pitch= 8.6 mm width + 1.5 mm gap

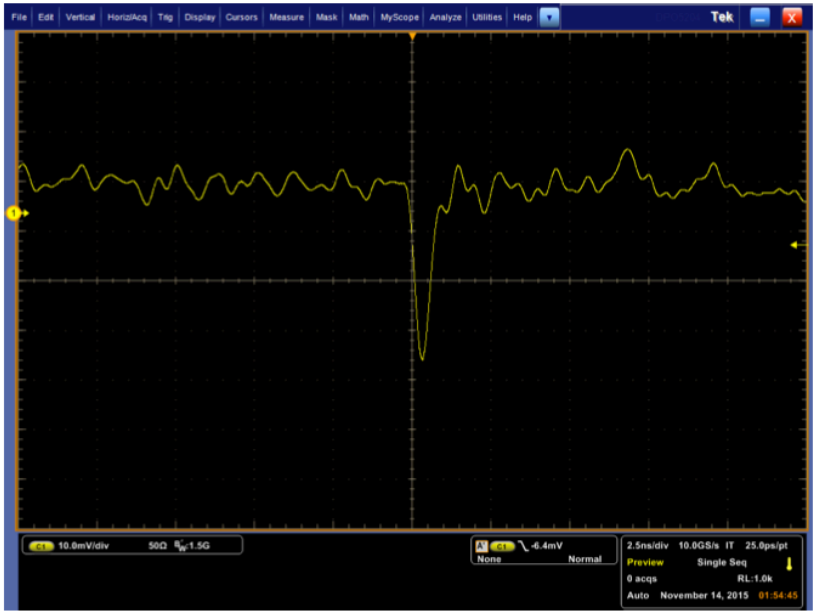
^{60}Co and cosmic rays laboratory tests of the new prototypes

DS-RPC2015



SS-RPC2015





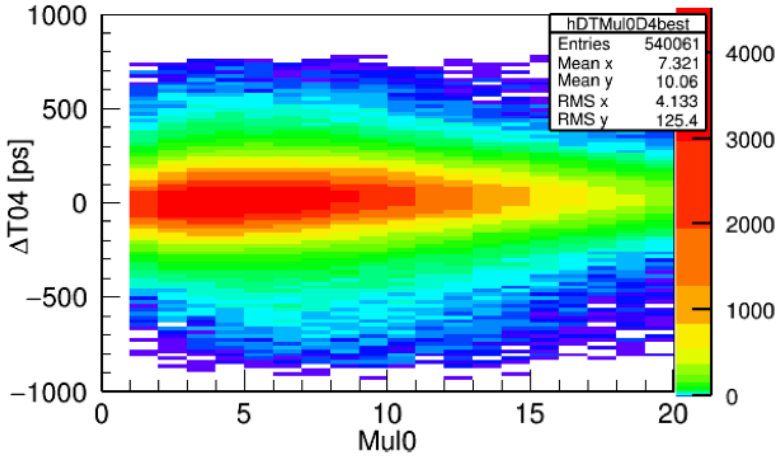
Tested at CERN SPS with a Pb beam (30A GeV) in November 2015: data analysis in progress

Preliminary results of November 2015 in-beam test

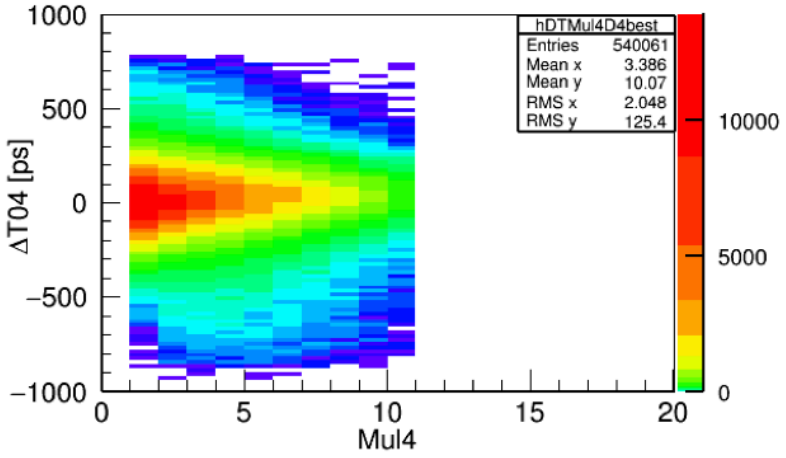
Run CernTofSps_01Dec0225, DUT = SS-RPC2015, Ref =RPCRef, Sel2= DS-RPC2015

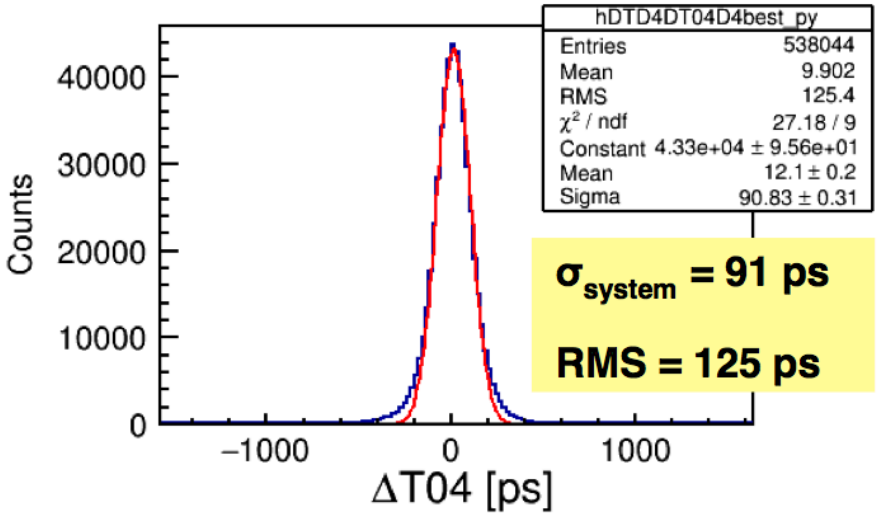
HV SS-RPC2015 = +/-9.5 kV, Th = 245 mV, HV RPCRef = +/-5.5 kV, Th = 205 mV,

SS-RPC2015



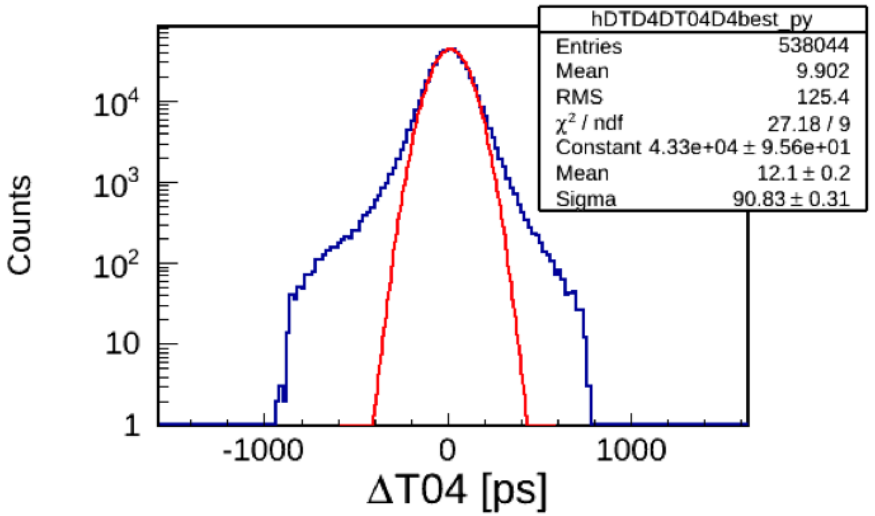
RPCRef





σ_{system} = 91 ps

RMS = 125 ps

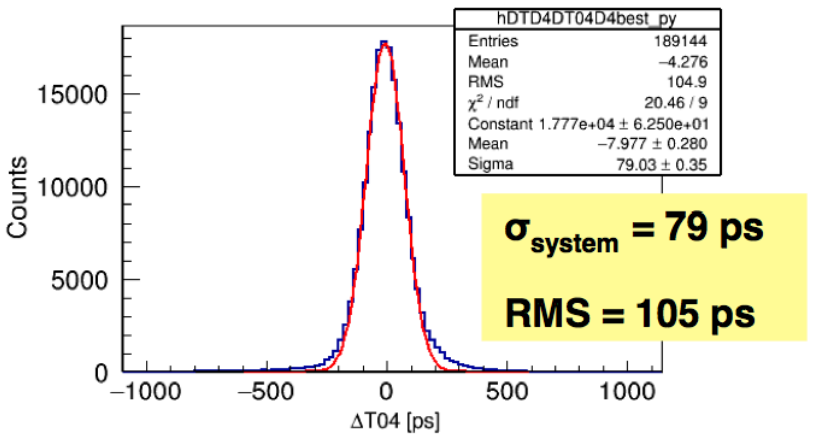


Efficiency = 0.954, Cluster size SS-RPC2015 = 2.4, Cluster size RPCRef= 2.5

Preliminary results of November 2015 in-beam test

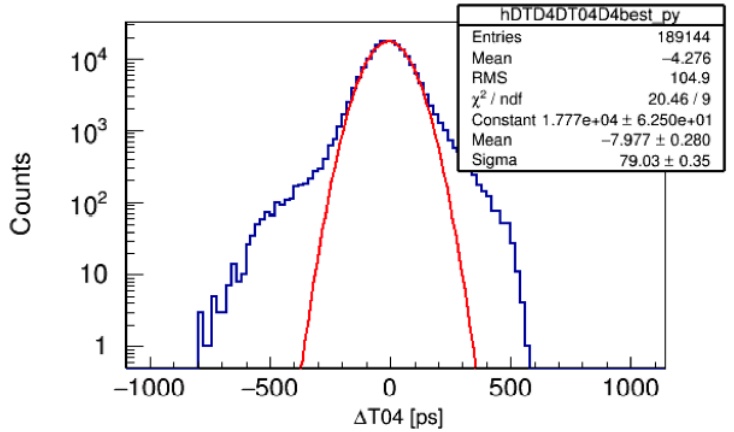
Run CernTofSps_01Dec0225, DUT = DS-RPC2015, Ref =RPCRef, Sel2= SS-RPC2015

HV DS-RPC2015 = +/-9.5 kV, Th = 245 mV, HV RPCRef = +/-5.5 kV, Th = 205 mV,

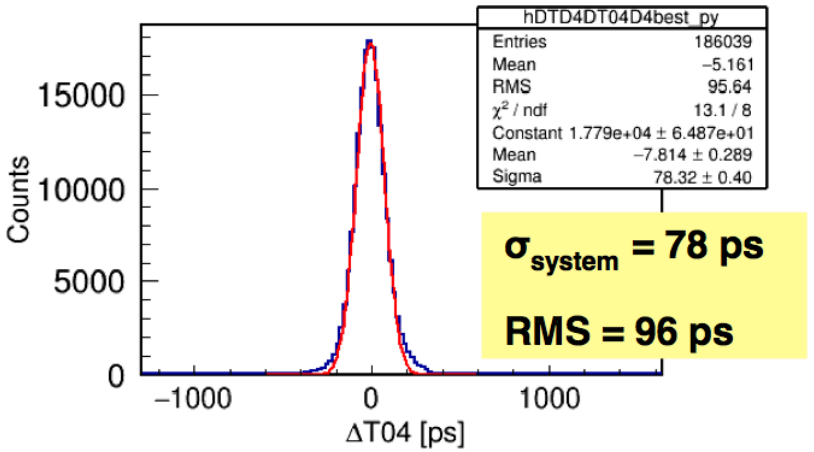


σ_{system} = 79 ps

RMS = 105 ps

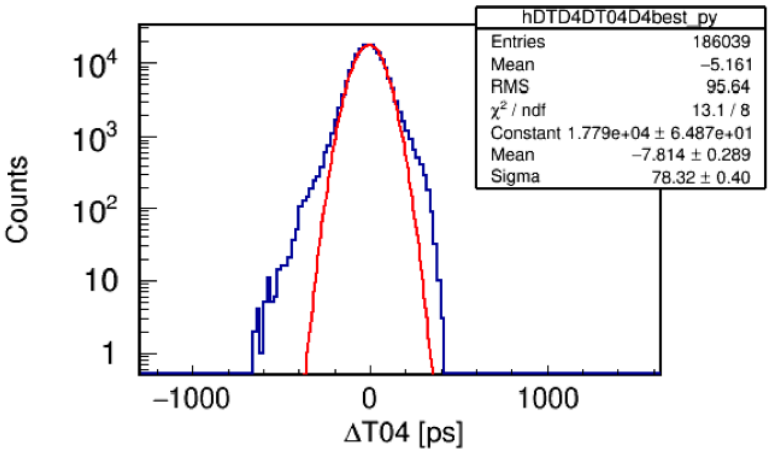


Efficiency = 0.916, Cluster size DS-RPC2015 = 2.3, Cluster size RPCRef = 2.6



σ_{system} = 78 ps

RMS = 96 ps



Efficiency = 0.901, Cluster size DS-RPC2015 = 2.3, Cluster size RPCRef = 2.6

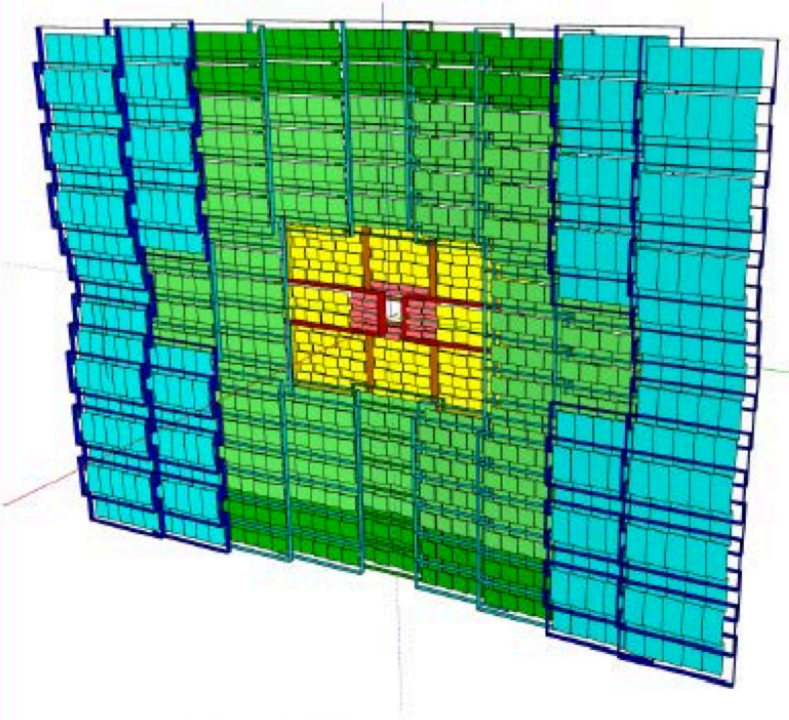
CBM-TOF

Compressed Baryonic Matter Experiment

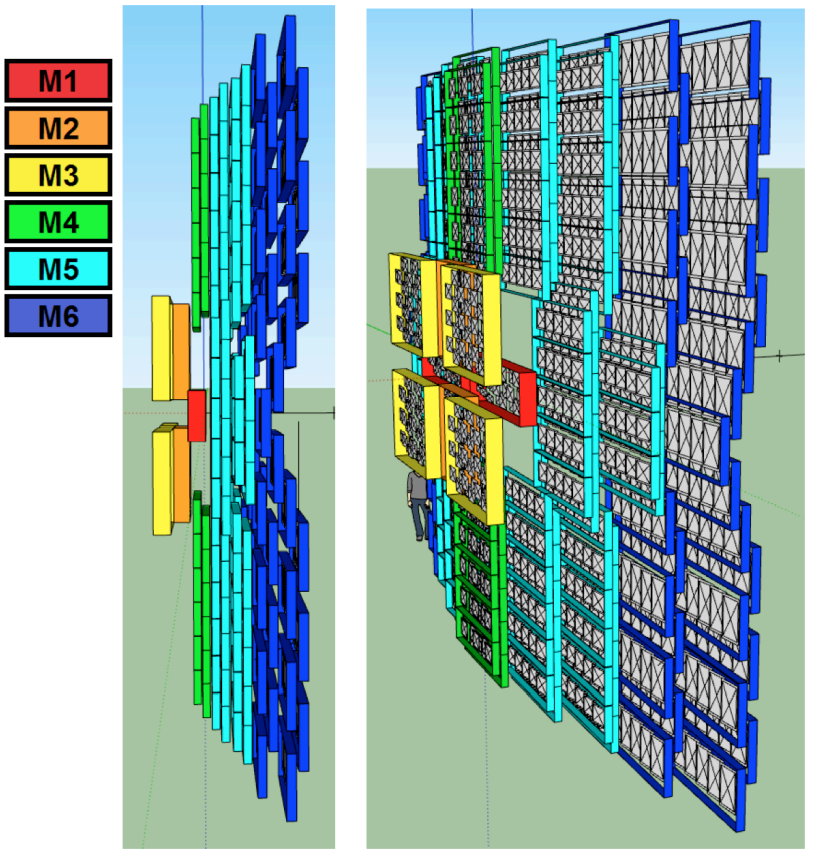
Technical Design Report for the CBM

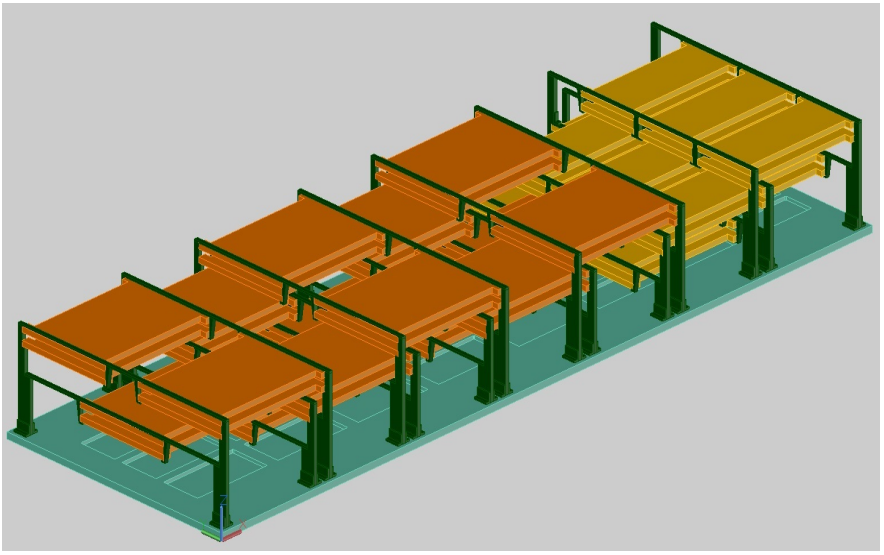
Time – of – Flight System (TOF)

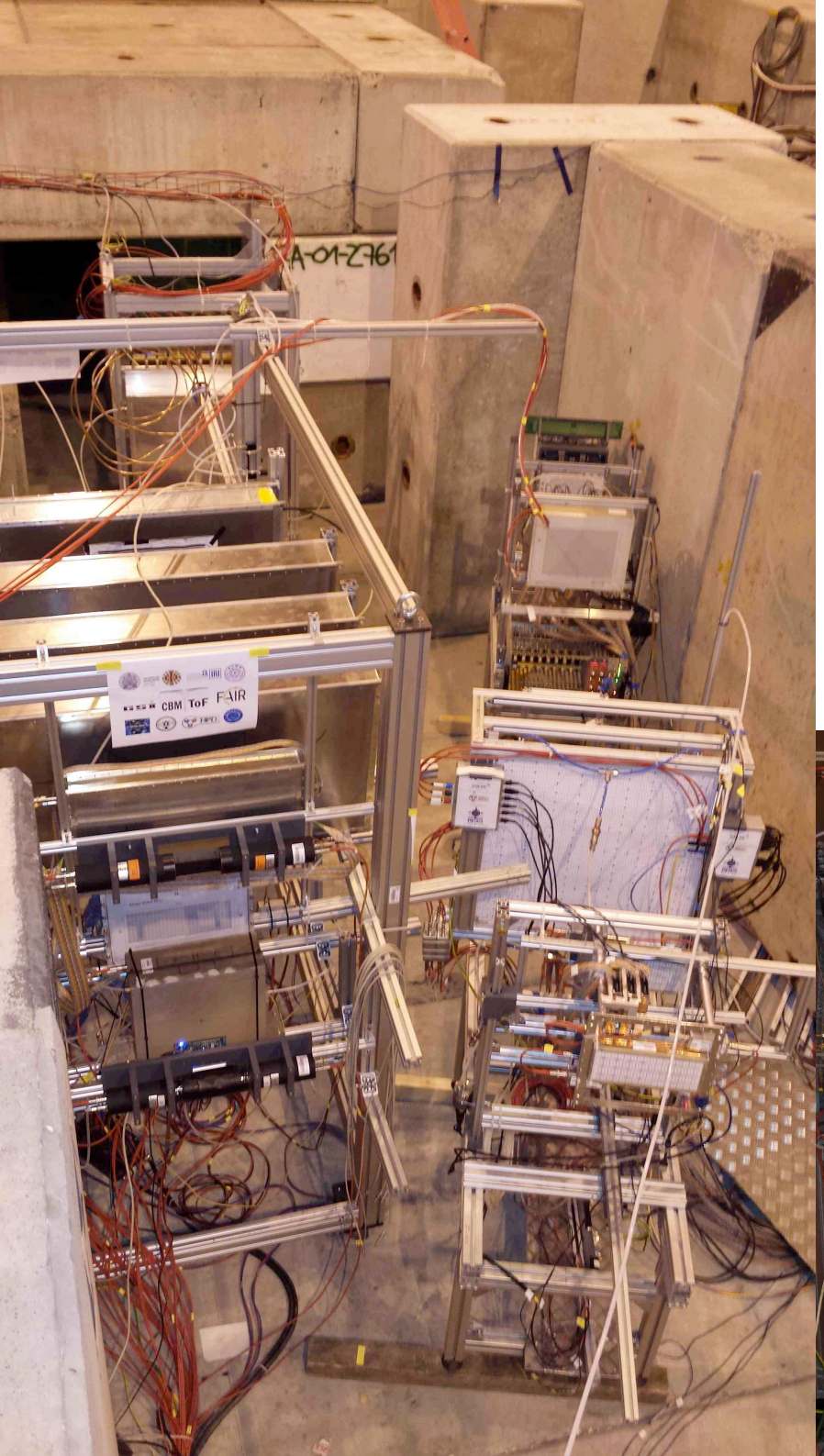
The CBM Collaboration



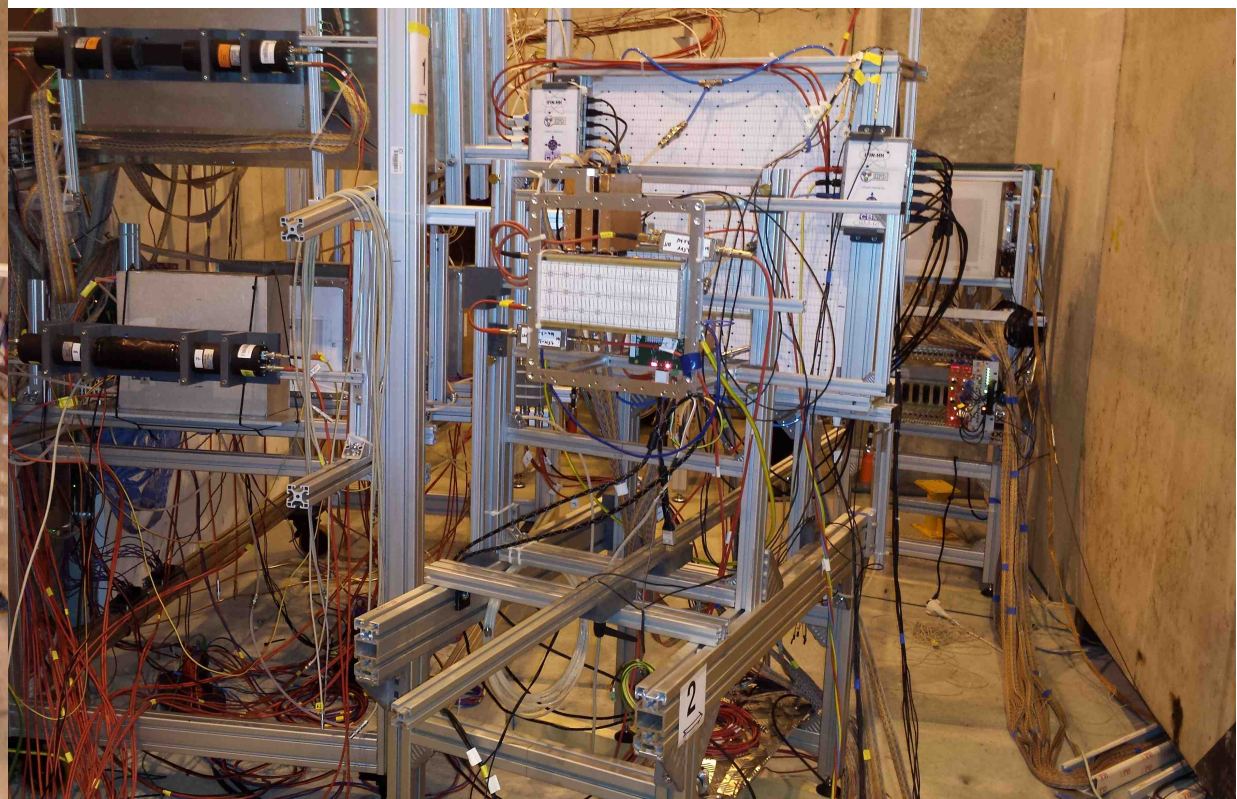
September 2014







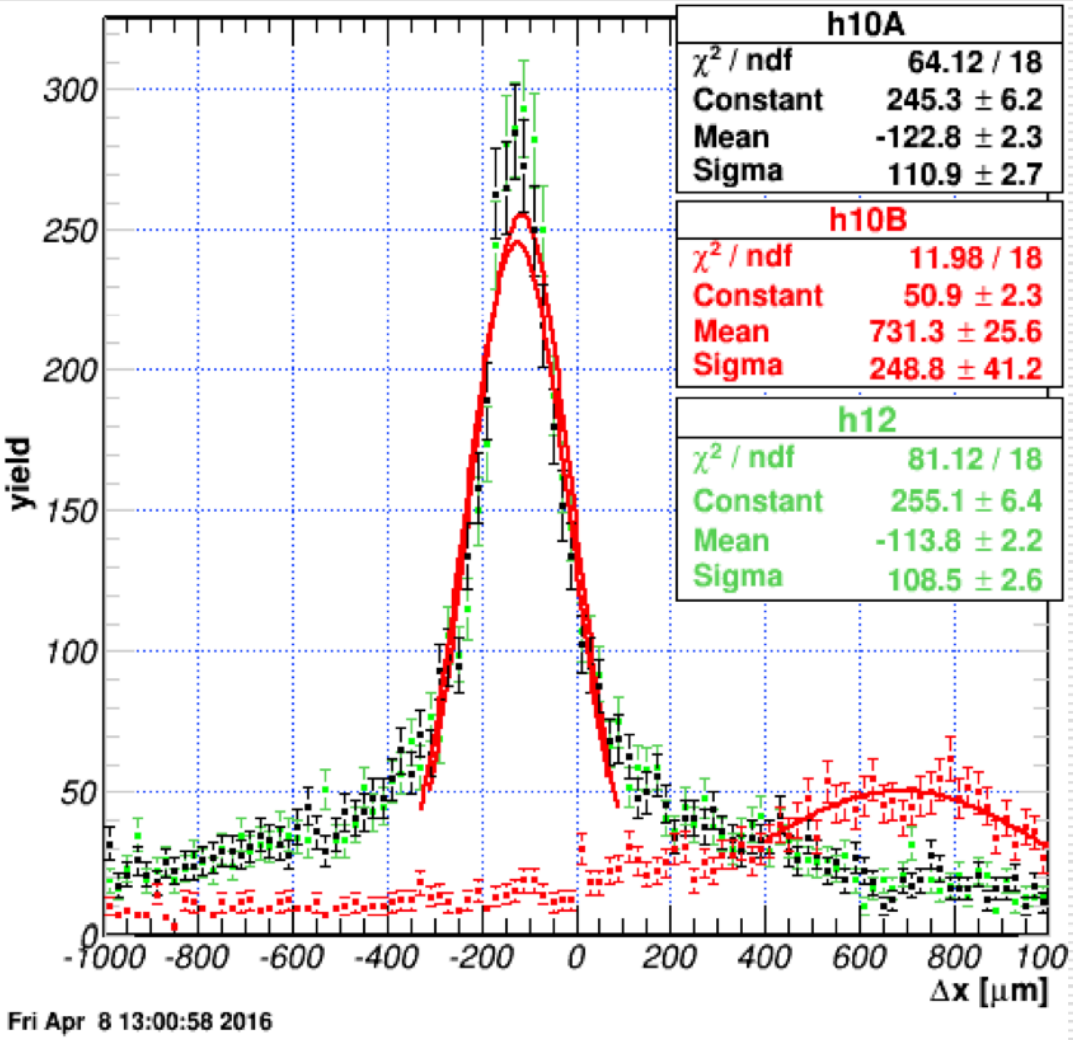
In-beam tests @ SPS, Nov.-Dec. 2015

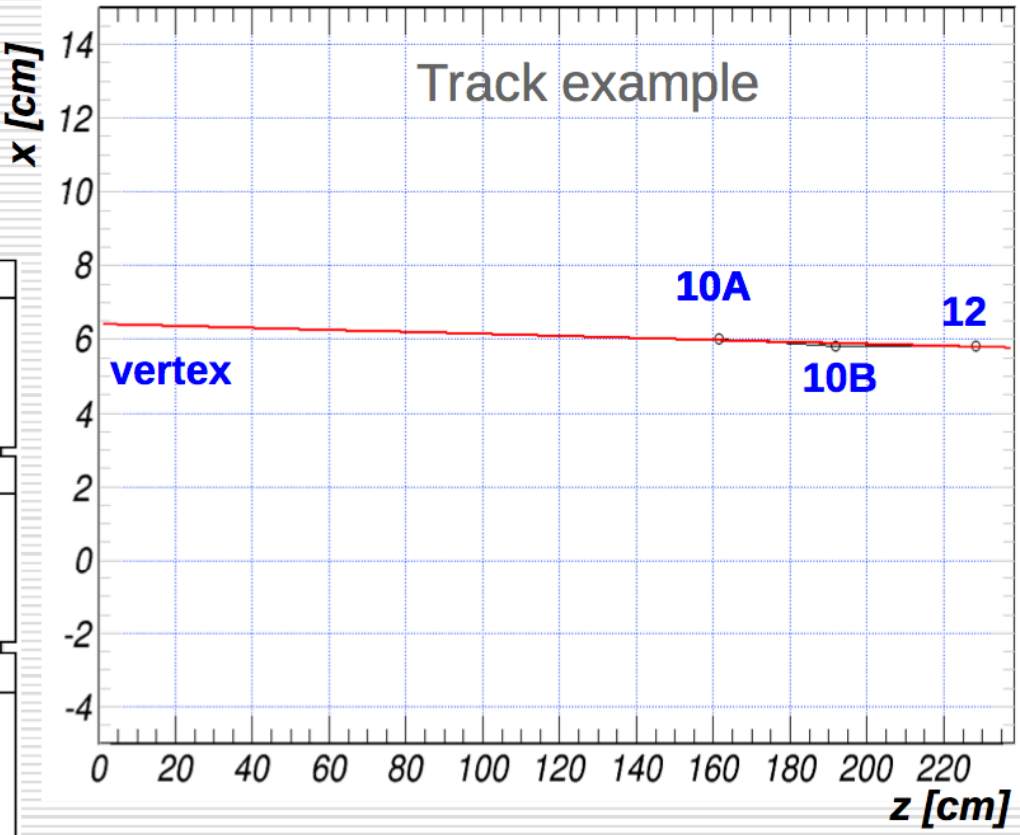


Tracking

Fit to cluster residuals

(not the proper way to estimate detector resolution but still ...)



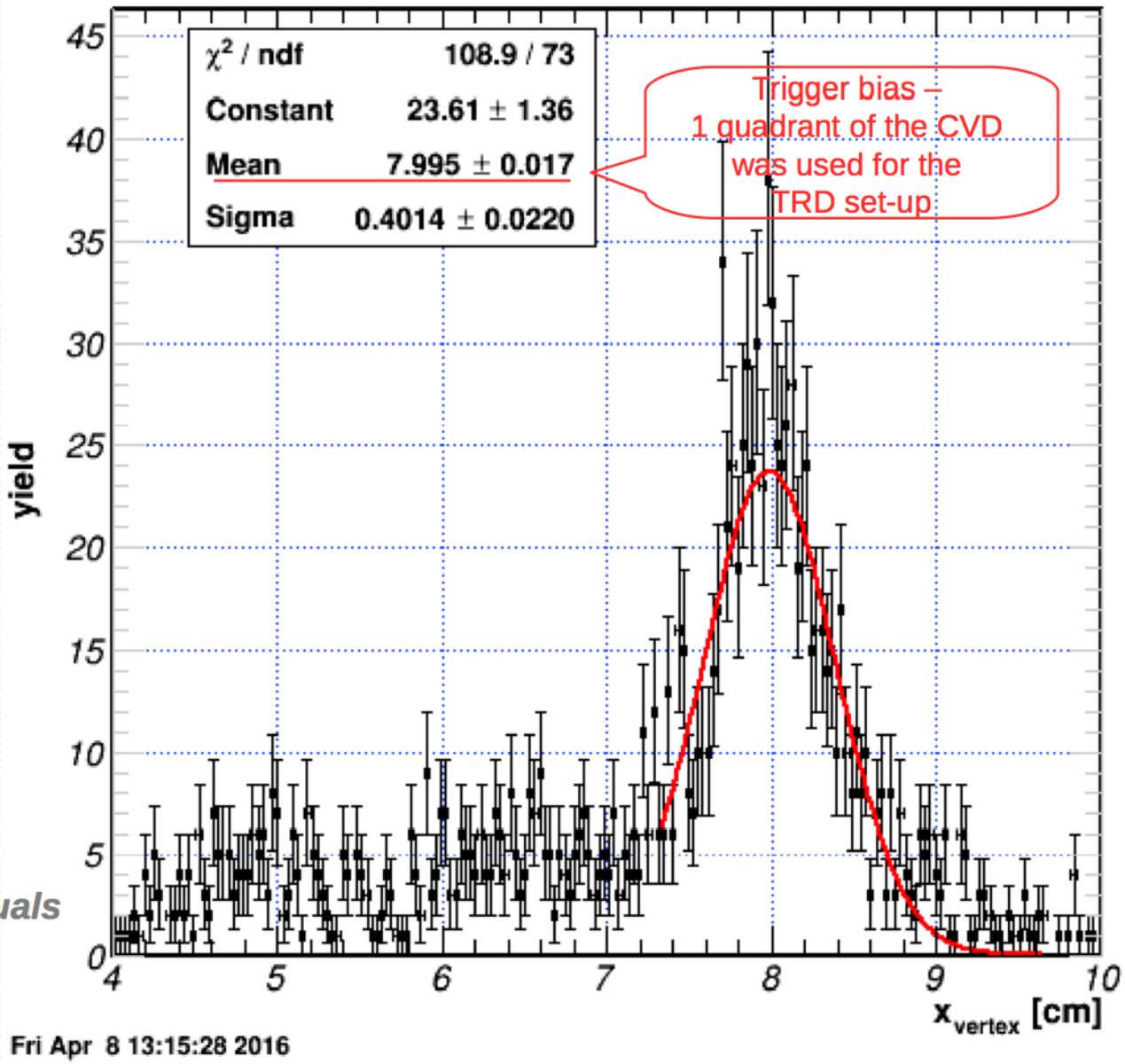


9.7e6 triggered events

7.3e3 single track events

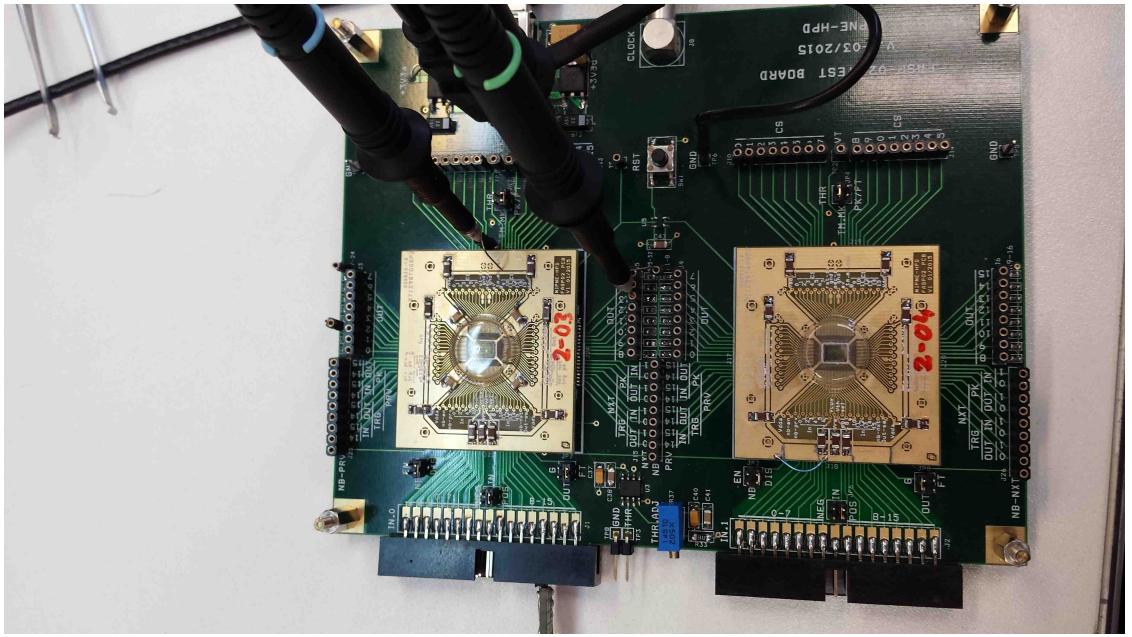
Vertex

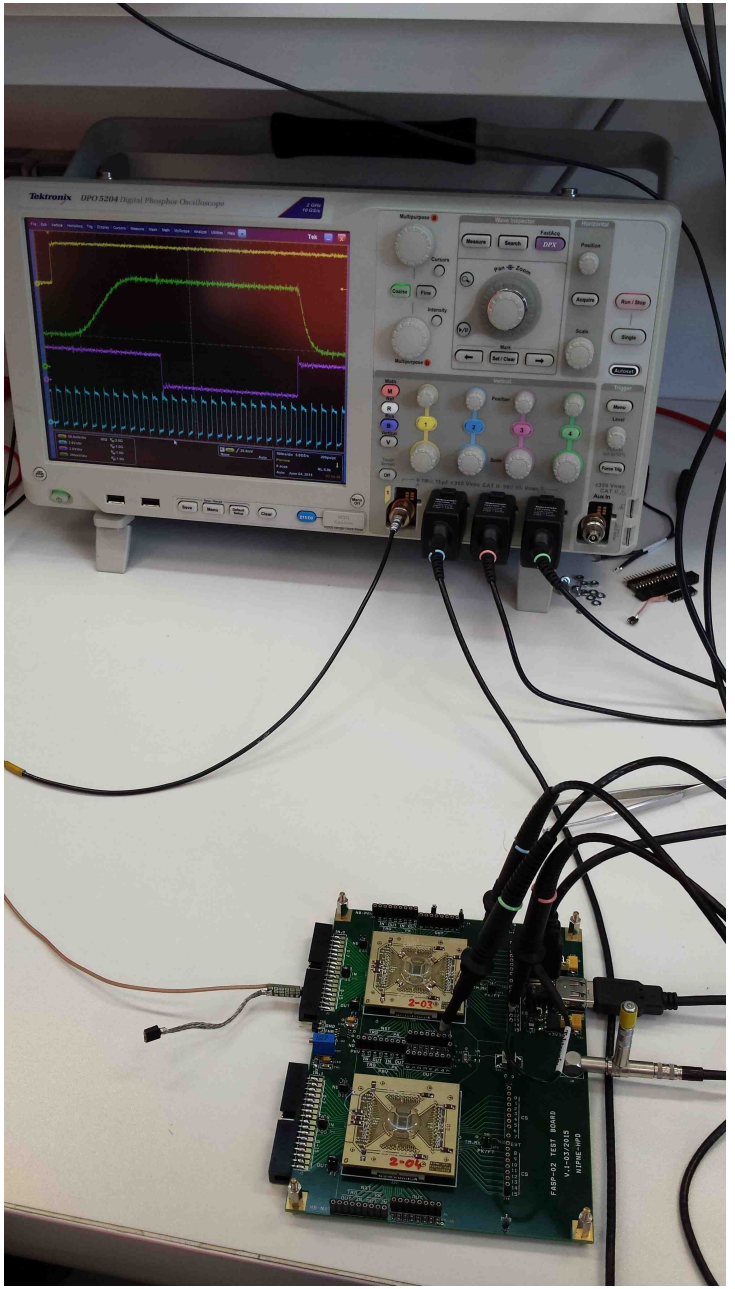
1.6e3 vertex events
1.e3 for vertex definition



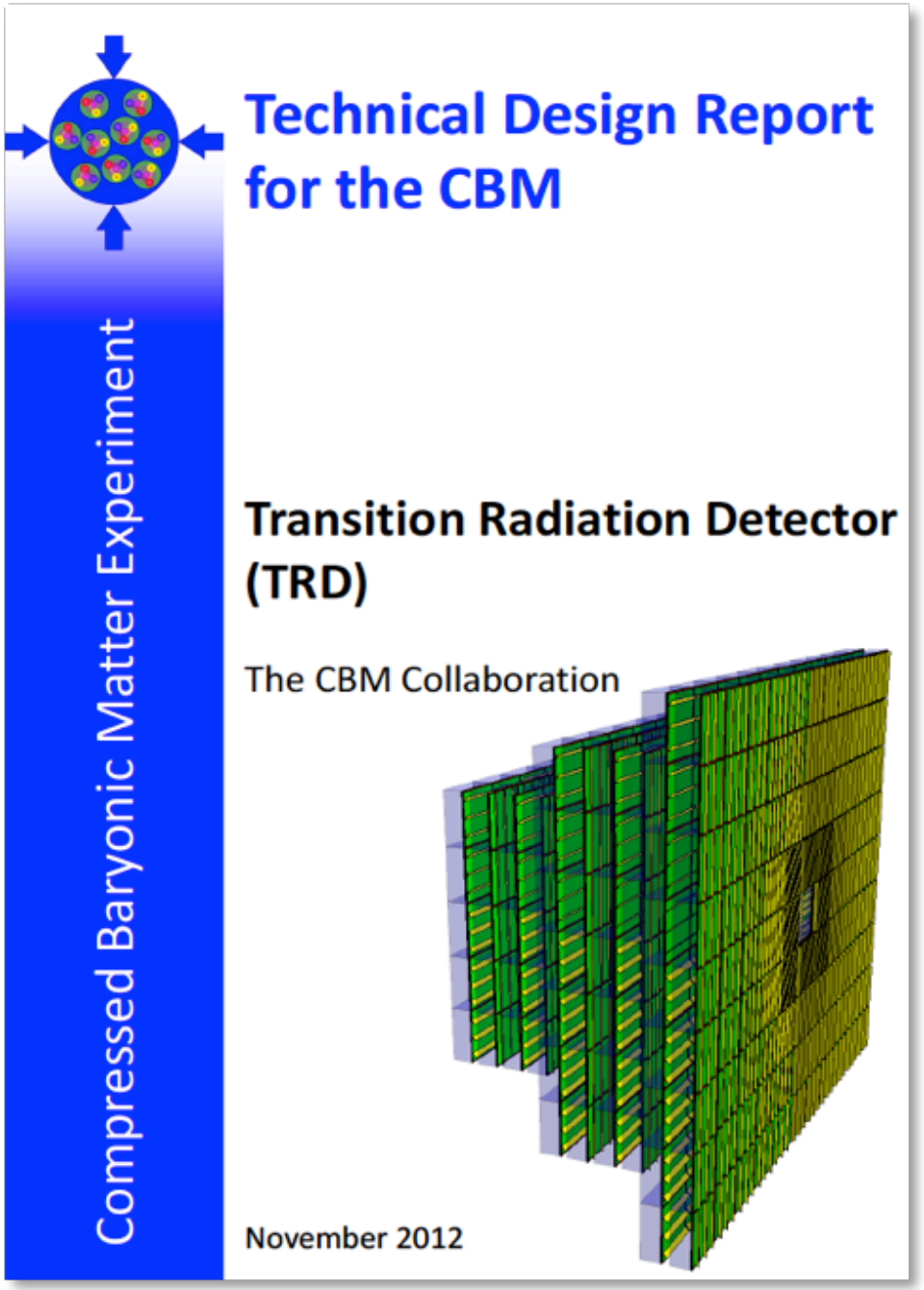
Definition :: vertex track
Track in single track event with all residuals in the +- resolution range

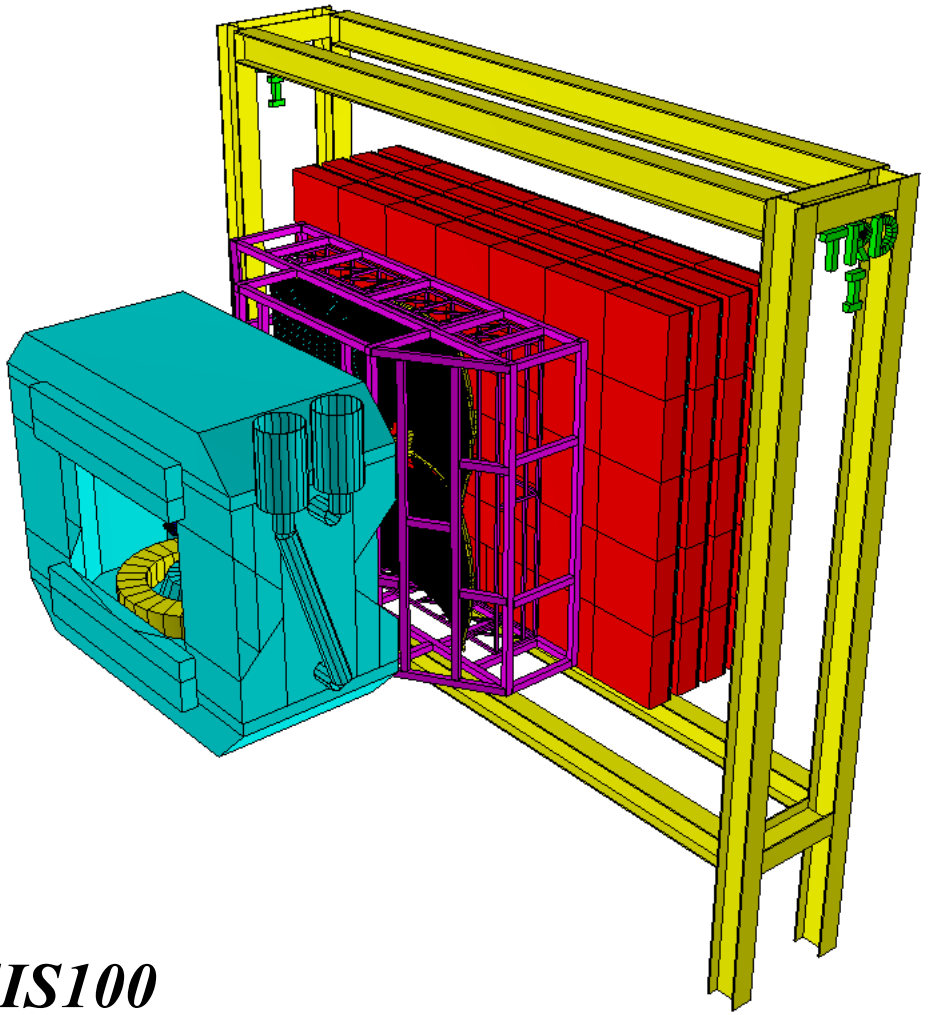
FASP-02 electronic tests





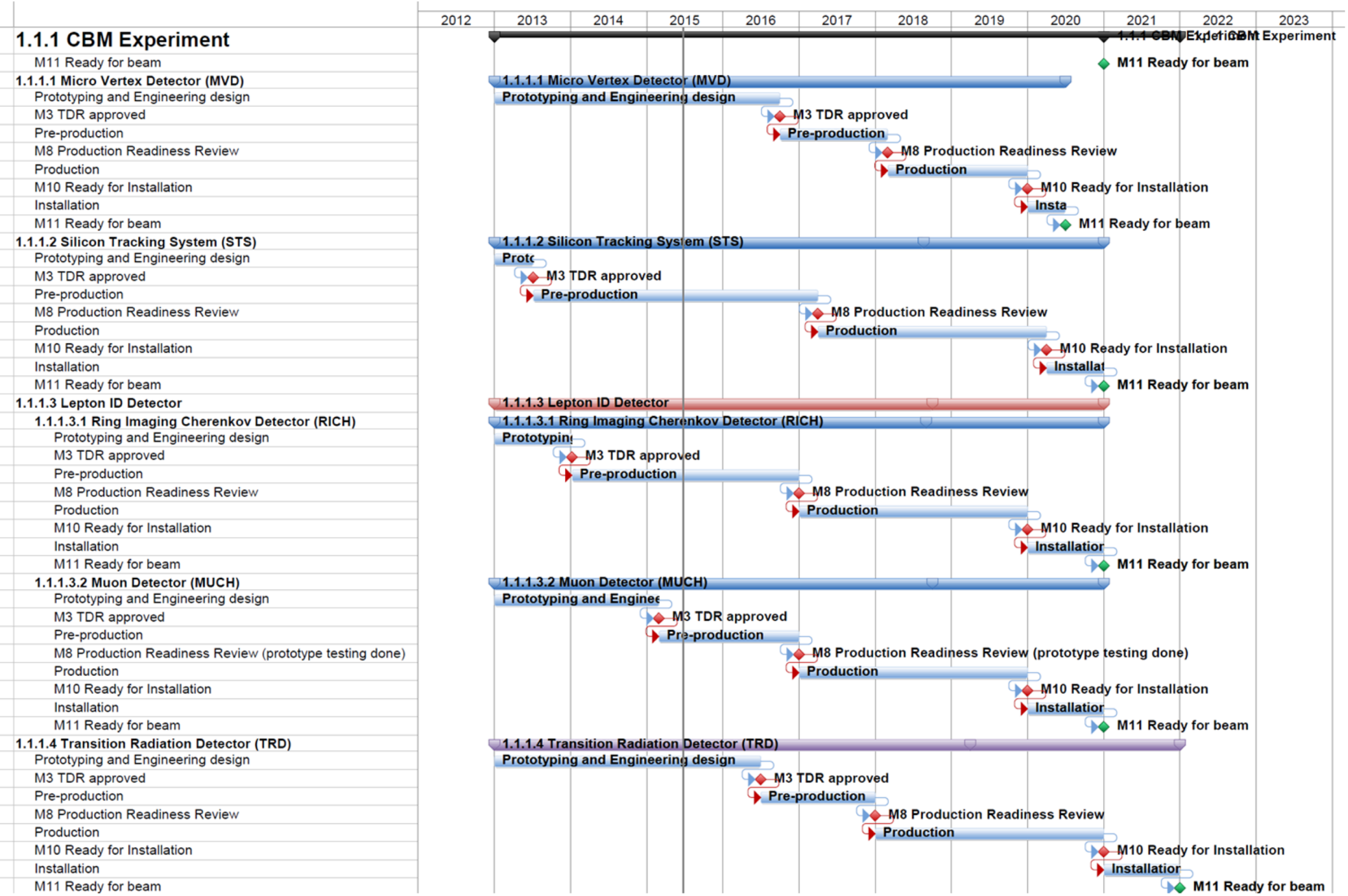
CBM-TRD



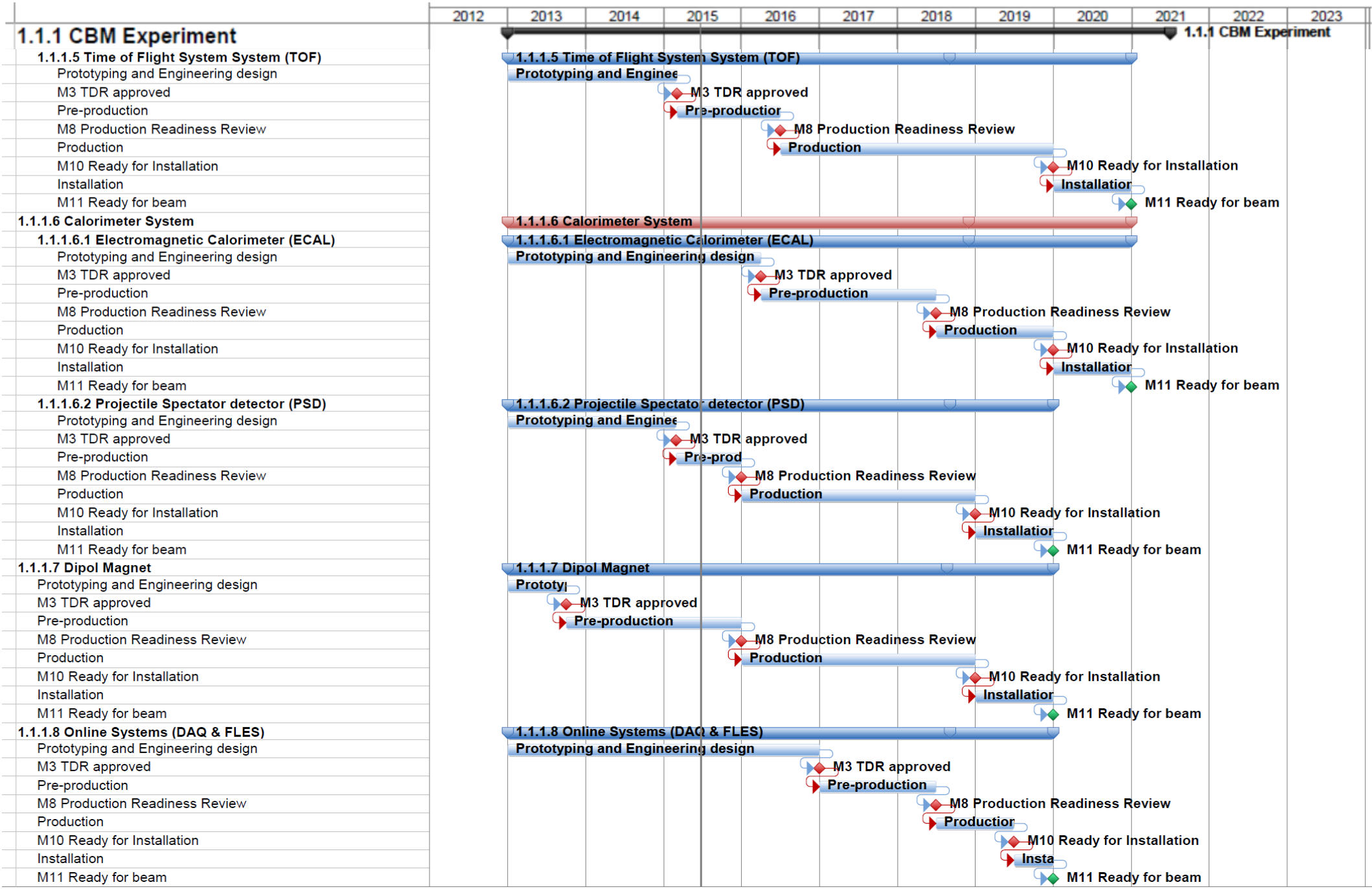


SIS100

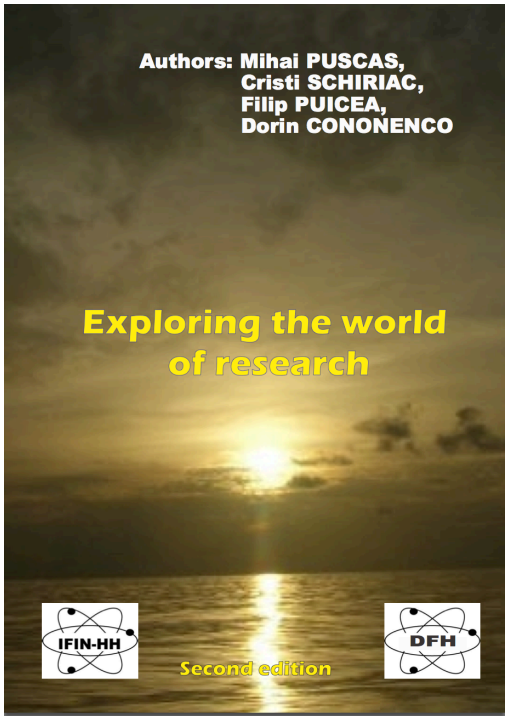
CBM time line

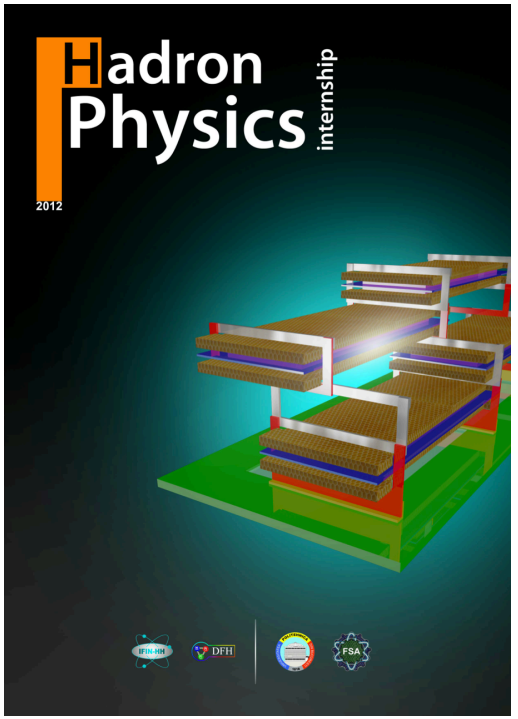


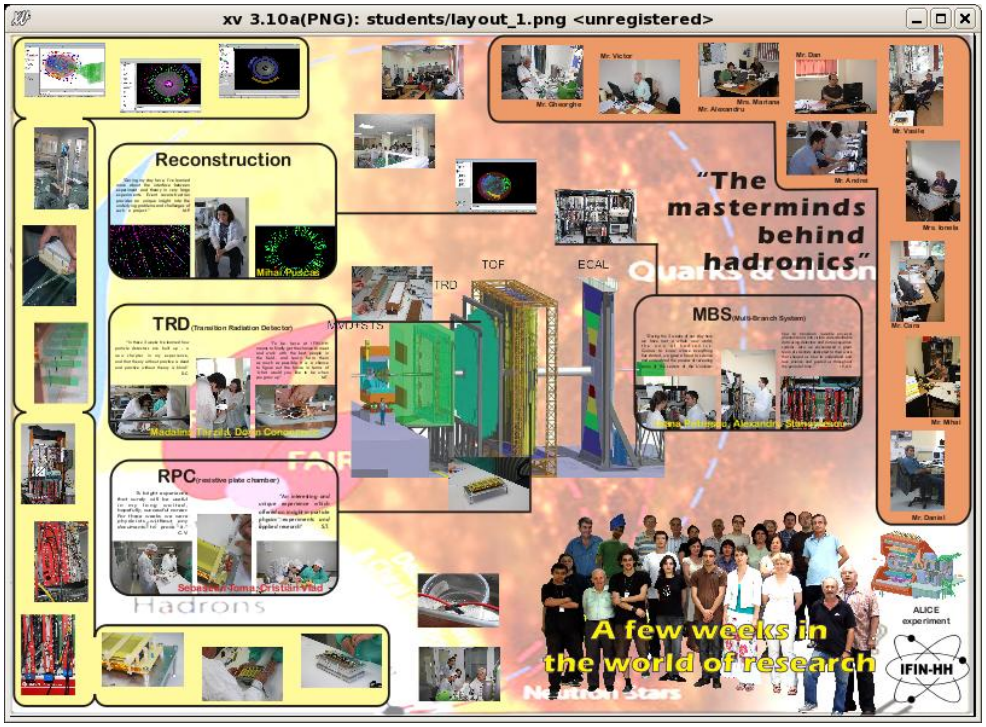
CBM time line



Training & teaching



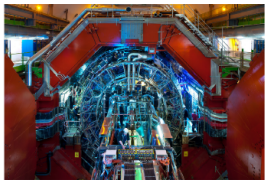




Outreach

Booklet

MINISTERUL EDUCAȚIEI NAȚIONALE

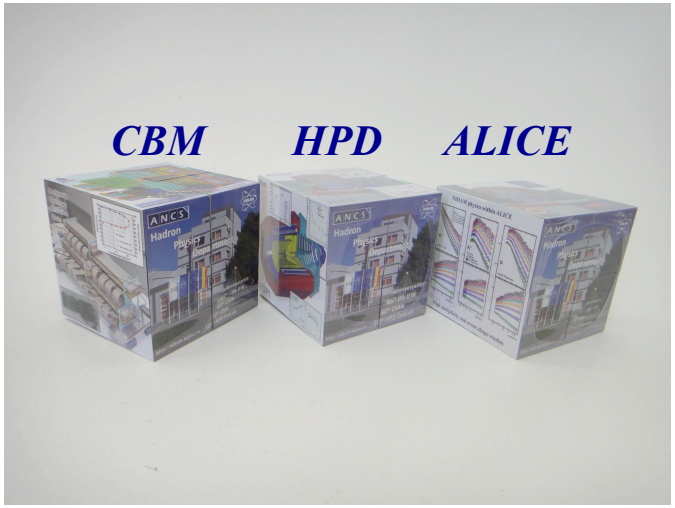


2014

- The 65th anniversary of IFA-IFIN-HH
- The 60th anniversary of CERN
- The 15th anniversary of ALICE membership
- The 10th anniversary of CBM membership
- The 10th anniversary of DetLab of HPD

ALICE CBM HPD

Magic cubes



Movie

- *Numerous visits of students, local and foreign delegations*
  On the occasion of CERN 60th anniversary, IFIN 65th anniversary:
- *Presentation at special events organized on the occasion of CERN 60th anniversary*
  July 19, 2014 – Sinaia - with the participation of Rolf Heuer - CERN DG
- *Presentation - September 26 – Bucharest - with the participation of Livio Mapelli, head of Physics Division at CERN*
- *Posters*
- *Update of HPD web page - http://niham.nipne.ro*

Visibility & competitiveness @ international level

- > 52 presentations @ 22 CBM Collaboration Meetings

- 2 presentations @ International Workshop on Resistive Plate Chambers – 2010, 2012

- 2 presentations at Vienna Conference on Instrumentation – 2011, 2013

- 1 presentation @ IEEE Conference – Dresda 2008

- > 22 contributions to the Annual CBM Scientific Report

- 1 plenary talk & 1 in parallel sessions @ EuNPC 2012

- 2014 JINST 9 C10014
- Nuclear Theory, Vol. 33 (2014), p.152, ISSN 1313-2822 (Proceedings of the 33-rd International Workshop on Nuclear Theory (IWNT-33), Rila Mountains 2014)

- Journal of Physics: Conference Series, Volume 533, 012009, 2014

- Varna Summer School - lecture - 2015

- 7 NIM & 2 Rom. Journal of Physics papers

- 7 diploma thesis

- 2 master degrees

- I3HP - FP6, HadronPhysics2 and HadronPhysics3 – FP7

- 2 brevets

- 2 silver medals @ Geneva salon of inventions

- 4 editions of Summer Student Program in HPD

- 2 International events: - Workshop - Cheile Gradistei – 2005

- CBM Meeting - Mamaia – 2010

- CBM Collaboration Chairman – 2 mandates (elaboration of the CBM Constitution)

- Member of the Management Board & Technical Board

- Co - convener of CBM-TRD subgroup

They are the main actors !

http://niham.nipne.ro