HPD weekly meeting

27.09.2024

Mihai Petrovici

- ***Nuclear Structure & Dynamics***

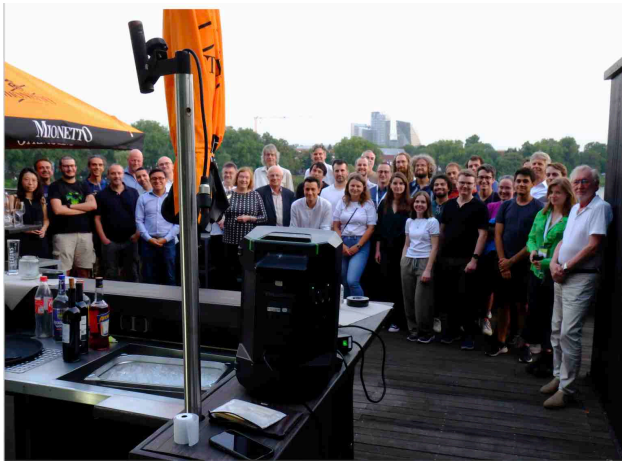
  - ***contribution to the proceedings of Valencia Conference***

    "Various facets of shape coexistence in neutron-reach nuclei within a beyond-mean-field"

  - ***preparation for SSNET 2024 Conference 4-8.11.2024***
  - ***a paper in preparation***
  - ***preparation of the new project within RO-CERN (ISOLDE)***

➢ *Strongly Interacting Matter*

➢ *QCD Challenges Workshop, 2-6 September, Munster*



➢ *PRC paper resent to the editor*

Features of strangeness production in pp and heavy ion collisions

A. Pop* and M. Petrovici
Horia Hulubei National Institute for Physics and Nuclear Engineering(IFIN-HH)
Hadron Physics Department
RO-077125 Bucharest-Magurele, Romania
(Dated: August 29, 2024)

Based on the existing experimental data for A-A collisions starting from the Alternating Gradient Synchrotron energies up to the CERN Large Hadron Collider ones, various systematics related to strange hadrons and anti-hadrons are presented. As in the case of pions, kaons and protons, the ratio between the average transverse momentum and the square root of the total particle multiplicity per unit rapidity and unit transverse overlap area ($\langle p_T \rangle/\sqrt{\langle dN/dy \rangle/S_\perp}$) decreases with collision energy and centrality supporting the predictions of color glass condensate and percolation based approaches. The dependences on $\sqrt{\langle dN/dy \rangle/S_\perp}$ of the slope and offset extracted from the $\langle p_T \rangle$ - particle mass correlation and of the average transverse expansion velocity and kinetic freeze-out temperature parameters obtained from Boltzmann-Gibbs Blast Wave fits of the p_T spectra for strange hadrons are compared to that for pions, kaons and protons.

The detailed study of the entropy density ($\langle dN/dy \rangle/S_\perp$) dependence of the ratio of strange hadron yields per unit rapidity to the total particle multiplicity per unit rapidity ($Y^S/\langle dN/dy \rangle$) at different collision energies and centralities and the correlation $Y^S/\langle dN/dy \rangle$ - $\langle dN/dy \rangle/S_\perp$ for single- and multi- strange anti-hadron yields as a function of the fireball size, are presented. $Y^S/\langle dN/dy \rangle$ - $\langle dN/dy \rangle/S_\perp$ for combined and separate species of strange hadrons, at different centralities, clearly indicates a maximum in the region where a transition from the baryon-dominated matter to the meson-dominated one takes place. Within the experimental error bars, the position of this maximum does not depend on the mass of the corresponding strange hadron. Comparison with pp experimental data reveals another similarity between pp and Pb-Pb collisions at the CERN Large Hadron Collider energies.

I. INTRODUCTION

The possibility to produce hot and dense matter in heavy ion collisions [1] such that, based on Quantum Chromo-Dynamics (QCD) asymptotic freedom properties, a transition from the hadronic phase to a high density "quark soup" [2, 3] or "quark-gluon plasma" [4] can take place, has motivated an unprecedented international effort in building accelerator facilities and complex experimental devices. The objects produced in such collisions have a size at the fermionic level, are highly inhomogeneous and undergo violent dynamics. Therefore, specific experimental probes have to be studied and theoretical approaches, combining different hypotheses for different stages of the formation and evolution of such systems produced in heavy ion collisions, are required for an unambiguous conclusion. The first estimates of the transition from a gas of free nucleons to hadronic matter and subsequently to deconfined matter as a function of density were done within the percolation approach [5, 6]. Phenomenological models predicted some discontinuities in the behaviour of different observables as a function of collision energy or centrality, specific for a phase transition between two thermodynamic states in a closed volume [7–9]. Recently, based on the existing experimental results from the Alternating Gradient Synchrotron (AGS), Super Proton Synchrotron (SPS), BNL Relativistic Heavy Ion Collider (RHIC) and CERN Large Hadron Collider (LHC), it was evidenced such a trend in the dependence of the ratio of the energy density to the entropy density ($\langle dE_T/dy \rangle/\langle dN/dy \rangle$) as a function of entropy density ($\langle dN/dy \rangle/S_\perp$) at different collision centralities for A-A collisions [10]. At a given value of the transverse overlap area, $\langle dE_T/dy \rangle/\langle dN/dy \rangle$ increases with entropy. A tendency towards saturation at values of the entropy density beyond 6-8 fm^{-2}, corresponding to the largest collision energies at RHIC, and a steep rise at the LHC energies is evidenced for central collisions. Worth mentioning that for central collisions, a change in the collision energy dependence of the ratio $(1 - R^{pp}_{AA})/\langle dN/dy \rangle$ [11] takes place in the same energy range as the one corresponding to the transition from an increase to the saturation in $\langle dE_T/dy \rangle/\langle dN_{ch}/dy \rangle$. Such trends are in qualitative agreement with theoretical model predictions [8, 9] and [12–14], respectively. 40 years ago, well before the experimental data became available, the enhancement of the strangeness production was advocated as sensitive probe for deconfinement [15]. A series of experiments from SPS to LHC energies evidenced an enhancement of strange hadron production as a function of centrality relative to the one corresponding to the pp minimum bias collision at the same energy. The influence of the core-corona relative contribution on the centrality dependence of the strangeness production, average transverse momenta, elliptic flow or p_T spectra in heavy-ion collisions at SPS, RHIC and LHC energies was reported in many papers [16–28]. As far as concerns the centrality dependence of the strange hadron production, it was clearly shown that

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- ***ALICE - run manager Cristi***

ALICE Run Manager (16 - 29 September 2024): Cristian Andrei
Cristian is a physicist from Bucharest NIPNE. He is a specialist in pion, kaon, and proton production in high multiplicity pp events, studying the dependency of their production as a function of charged particle multiplicity and event shape. He is an active member of the PWG-LF and has made significant contributions to several analyses. Moreover, he has been a member of several paper review committees (ARC, IRC). Cristian has substantial experience in data taking and ALICE operation at P2. Since 2016, he has taken up all central shifter positions: ECS, DCS, QC, and SL. Building upon this experience, he ensured a first Run Manager mandate in 2018 and a second one in 2023, when he faced the tough challenge of starting the first Heavy Ion data taking of RUN 3.
This year, Cristian will coordinate two weeks of pp physics production, where ALICE will keep working to further improve the data-taking efficiency and the online tools in preparation for the reference run in October.
(from https://alice-collaboration.web.cern.ch/newsletter)

- ***Madalina - two charged particle correlation - multiplicity & event shape correlation***

  - shift leader ALICE

- ***Iulian - Fox-Wolfram moments***

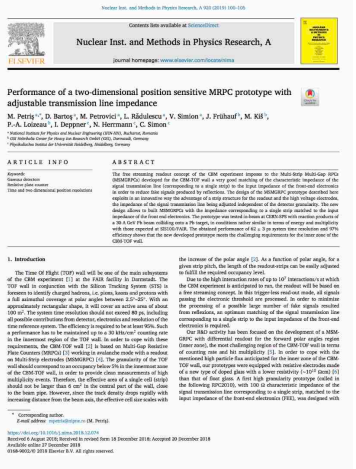
- ***Annual Summary Report for the project within RO-CERN Program***

- ***preparation of the new project within RO-CERN (ALICE)***

➢ *R&D*

➢ *RPC*

- *NIM Paper*



Nuclear Inst. and Methods in Physics Research, A

Performance of a two-dimensional position sensitive MRPC prototype with adjustable transmission line impedance

M. Petris, D. Bartoș, M. Petrovici, L. Rădulescu, V. Simion, J. Frühauf, M. Kiš,
P.-A. Loizeau, I. Deppner, N. Herrmann, C. Simon

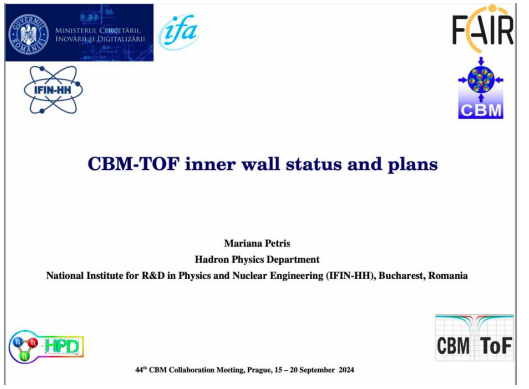
ARTICLE INFO

ABSTRACT

1. Introduction

- *XVII Conference on Resistive Plate Chambers and Related Detectors 9-13 September 2024*
  "Radiation hard Multi-Strip Multi-Gap Resistive Plate Chamber architecture for low polar angles of the CBM-TOF wall "

- *44th CBM Collaboration Meeting, 15-20 September 2024, Prague*



CBM-TOF inner wall status and plans

Mariana Petris
Hadron Physics Department
National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania

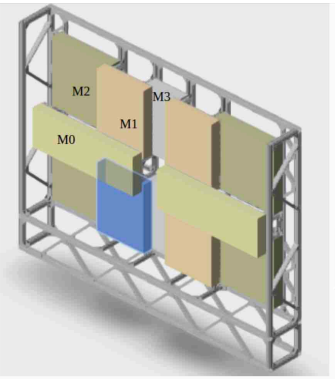
44th CBM Collaboration Meeting, Prague, 15 – 20 September 2024

➢ *R&D*

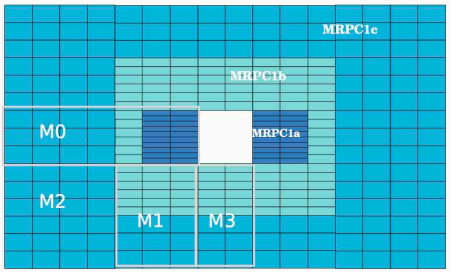
- ➢ *Assembling components for MSMGRPC - M0 module - in progress*
- ➢ *Samples of discrete disk-type spacers arrived and their positioning on the glass electrode successfully tested*
  Order for all MSMGRPCs for M0 module - in progress
  Gas distribution boxes for the rest of MSMGRPCs for M0 module in production
- ➢ *Signals twisted cables for M0 - finalized*
- ➢ *Back flange of the housing box for MSMGRPCs QA tests ready - BCBs, HV and gas connectors in progress*
- ➢ *The Al back flange for the 2nd M0 module arrived*
- ➢ *Honey comb "plates" for MSMGRPC and housing box - ordered*
- ➢ *MSMGRPCs PCBs, signal transmission PCBs - to be ordered*
- ➢ *Chinese glass electrodes - in negotiations with FAIR team account rules*
- ➢ *Particle counters maintenance - looking for offers*
- ➢ *Lab tools and consumables - in progress, partly done*
- ➢ *Assembling manual and IKC draft - in progress*
- ➢ *Preparation of 3 MSMGRPC (60, 100, 200 mm strip lengh) for in-beam tests in Feb. 2025 mCBM campagn*

- ➢ *<u>Is it feasible to have the CBM ToF inner zone in due time?</u>*

- Design for all type of modules - soon ready
- Mechanical support - soon ready
- All details of assembling and tests - in place
- 316 MSMGRPC in 4 years, 10 moths/year
=> 8 MSMGRPC/months => <u>2 MSMGRPC/week</u>
- in-kind contract needed - conditioned by CBM=>FS



CBM-TOF inner zone
- ~15 m^2 active area, modular architecture:
  - 12 modules
  - 4 types (M0, M1, M2, M3)

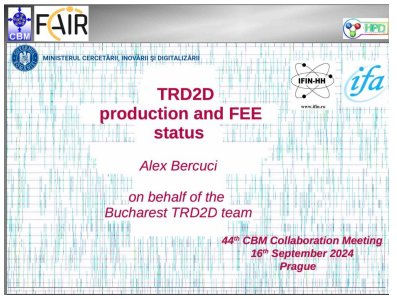


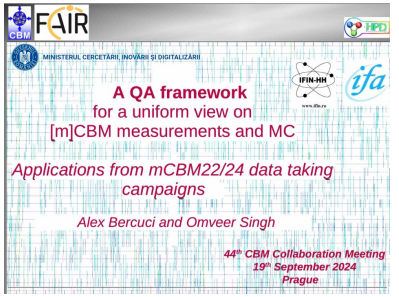
	MRPC1c (196 mm)	MRPC1b (96 mm)	MRPC1a (56 mm)	Total
No. MRPCs	168	108	40	316
No. channels	10752	6912	2560	20224

- Based on the costs of the M0 module, realistic costs of all module types were estimated.
- Assembling chamber, cables manufacture and routing manuals are in progress.
- Assembling module manual will be also drafted.

- ***R&D***

  - ***TRD***
    - 44th CBM Collaboration Meeting, 15-20 September 2024, Prague





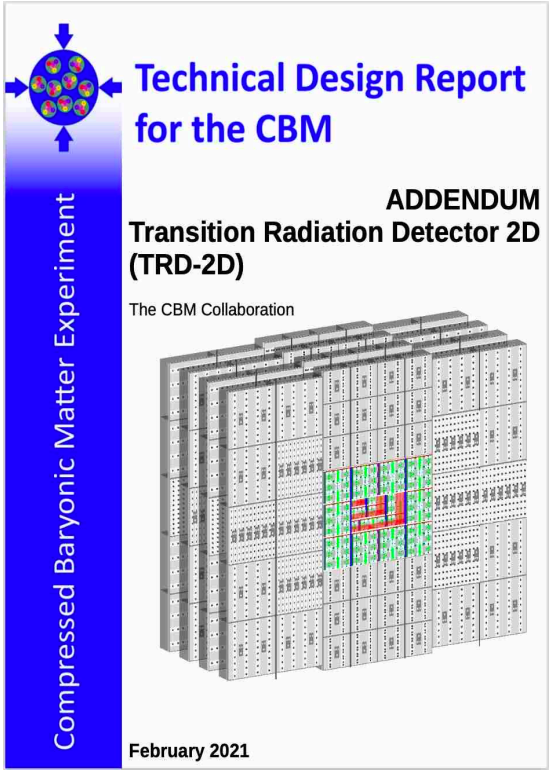
- ***"PRP" TRD-2D - in progress***
- ***FAST + packaging - no problem***
- ***Channel 0 problem appears after assembling the FEB***
- ***Claudiu has an alternative - under discussion***
- ***In this case, could we ordered an engineering run for FASP ?!***
- ***Vasile "official" presentation of FASP - TB discussed why, what and when (radiation hardness ?)***
- ***4 pad planes PCB for flat cables soldered on & 4 EM shielding PCBs - to be replaced by:***
- ***4 pad planes PCB for connectors soldered on & 4 EM shielding PCBs - to be ordered***
- ***Honey comb plates for 10 chambers - order in progress***
- ***Carbon fiber foil - Clinceni, aluminized kapton foil 20 μm - looking for provider***
- ***All latches for assembling the chamber - order in progress (to be decided the design changes & for how many chambers (10?)***
- ***HV ISEG units***
- ***Assembling manual and IKC draft - in progress***

➢ *R&D*

➢ *TRD*

➢ ***Is it feasible to have the CBM TRD-2D inner zone in due time?***

- Chamber design - soon frozen
- Mechanical support - soon ready
- All details of assembling and tests - in place
- 40 chambers in 4 years, 10 moths/year
=> 1 chamber/months => more than comfortable
- in-kind contract needed - conditioned by CBM=>FS



➢ *What to be done @ SIS100 - slides delivered for Figures-and-Facts discussion scheduled for the last day of CBM Collaboration Meeting*

➢ *Tetyana presentation*

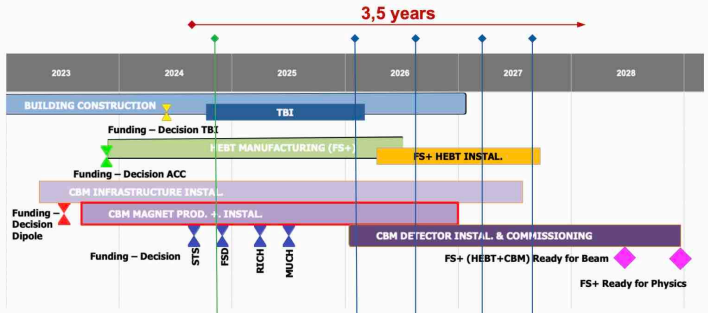
First physics outcome

- CBM shall aim to deliver the first results – paper – soon after the first runs
- Heuer review 2015: "Name 3 first PRLs"
  - The QCD matter equation of state at neutron star core densities studied in heavy-ion collisions
  - Restoration of chiral symmetry (chiral $\rho - a1$ mixing) observed in heavy-ion collisions
  - Evidence for a first order phase transition in QCD matter
  - Extension of the nuclear chart into the strange sector
- **Flow of weak decays** (Λ, Ξ?) might be an option
  (Ar+KCl (commissioning) and Au+Au (first year) max energy for Au ions)
  - peaks of weak decays should be seen (experience from mCBM)
  - no finetunes of MC needed
  - FSD for EP
  - centrality with FSD or N_{ch} in STS

Today: discuss, collect input → topical meeting on "First CBM run"

GSI FAIR September 20, 2024 Tetyana Galatyuk | 44th CBM CM | Strategic discussion | Prague

Key milestones for timely CBM realization

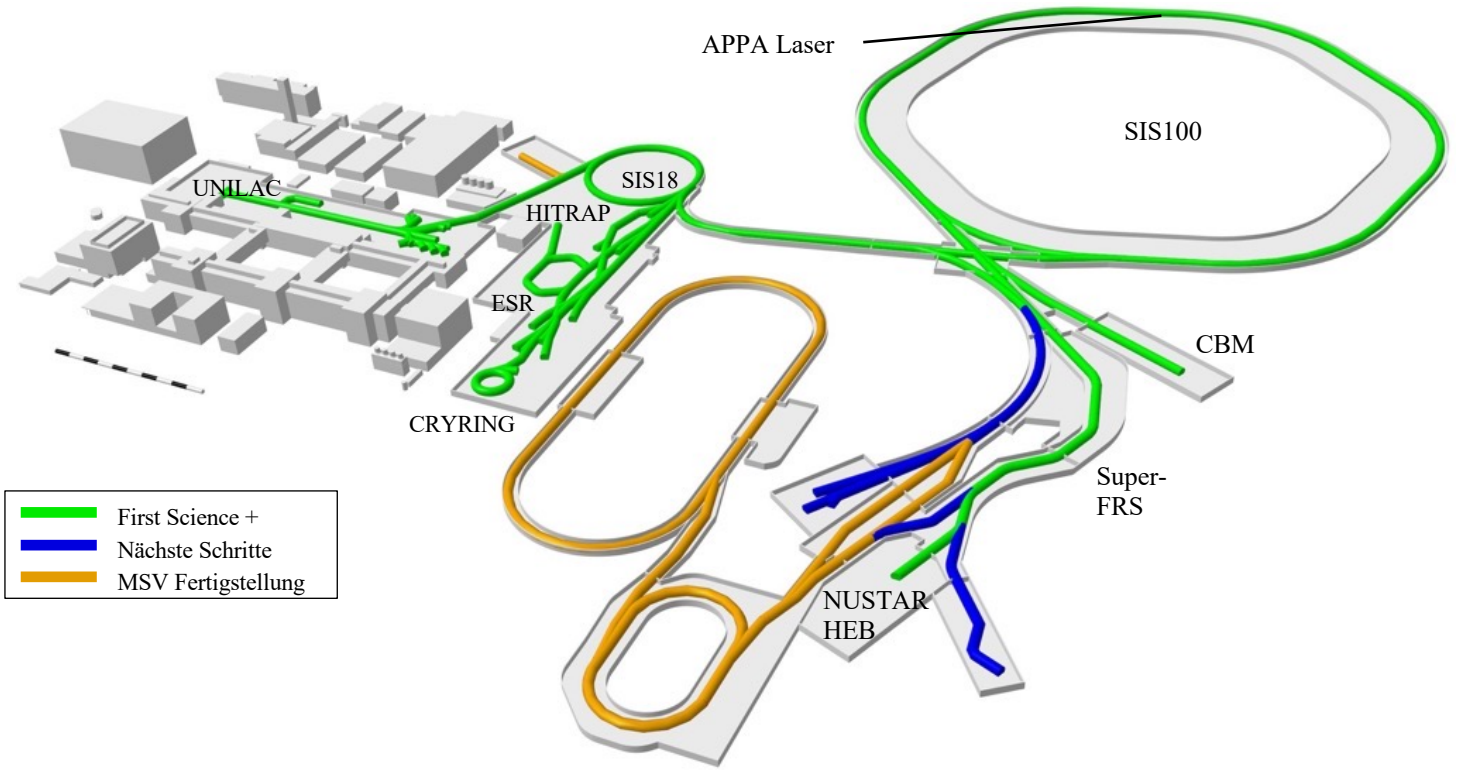


1. Consolidate physics performance for CBM Day-1 configuration
2. Demonstrate loss of the performance for the Day-1 currently funded version (CFV24)

- ***Applied research & Technological Transfer***
  - ***formalities to apply for patent***

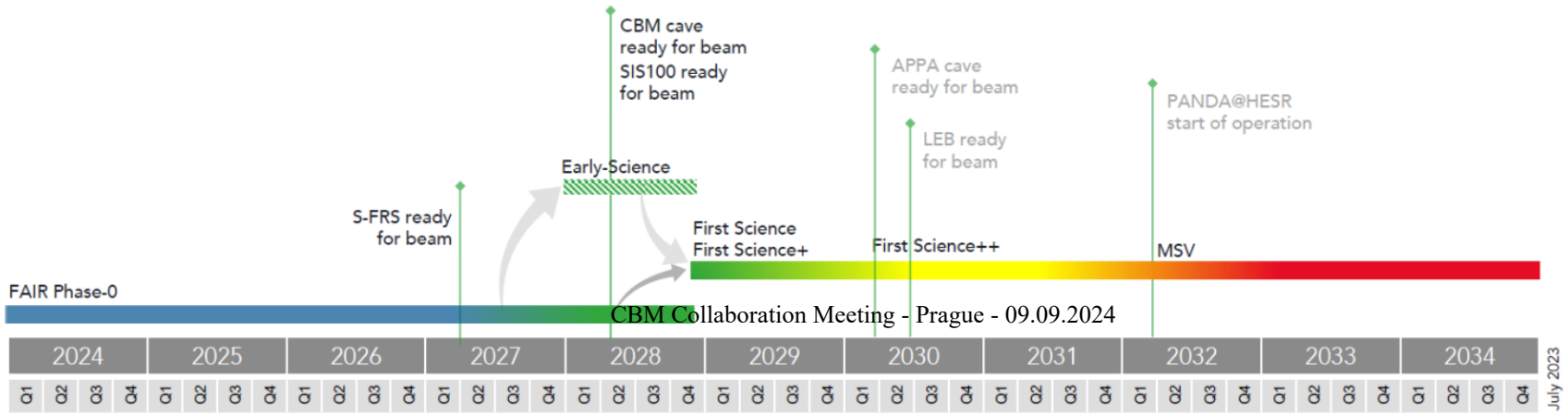
Our objective : FAIR 2028

GSI/FAIR director Jorg Blaurock



bis 2028

nach 2028



Way towards CBM

GSI/FAIR director Jorg Blaurock

- FAIR Council approved the First Science Scope in 2023
- Step-by-step realisation of CBM is agreed and supported by all Shareholders depending on financing
  - ✓ July 2023: Release of CBM Magnet
  - ✓ July 2024: Release of HEBT and vacuum components
  - – Dec 2024: Release of TBI work for the CBM cave + CBM components
  - – July 2025: Release of remaining ACC, EXP and installation work
- The additional contributions of Poland and India is critical to get the full scope of CBM approved by the FAIR Council

GSI/FAIR director Jorg Blaurock

Thank you for your attention !

Beyond „basic infrastructure”

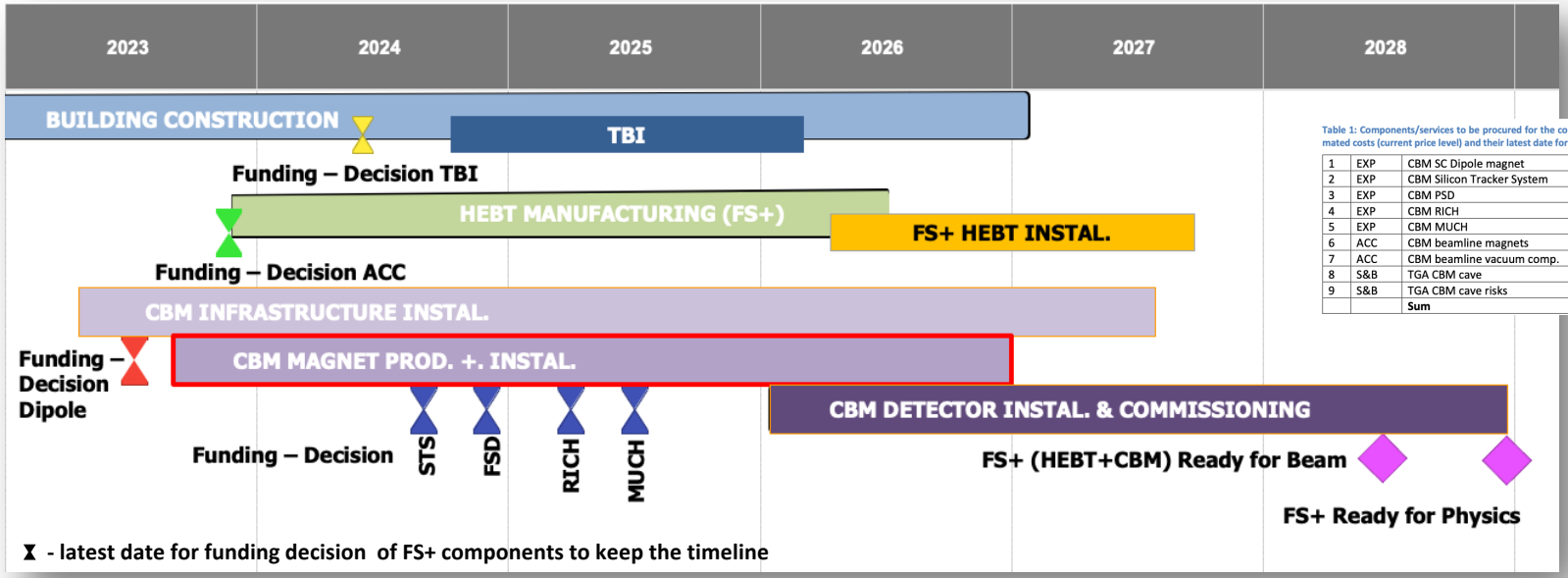


Table 1: Components/services to be procured for the completion of the CBM science programme, their estimated costs (current price level) and their latest date for procurement/expense to keep the timeline.

1	EXP	CBM SC Dipole magnet	4-5 Mio. €	July 2023
2	EXP	CBM Silicon Tracker System	0,9 Mio. €	Q3 2024
3	EXP	CBM PSD	0,5 Mio. €	Q4 2024
4	EXP	CBM RICH	1,0 Mio. €	Q2 2025
5	EXP	CBM MUCH	2,0 Mio. €	Q3 2025
6	ACC	CBM beamline magnets	4,2 Mio. €	Q4 2024
7	ACC	CBM beamline vacuum comp.	2,3 Mio. €	Q4 2024
8	S&B	TGA CBM cave	14,3 Mio. €	Q2 2024
9	S&B	TGA CBM cave risks	7 Mio. €	2024/2025
		Sum	**ca. 37 Mio. €**	

- **FS+ is currently not fully funded** → support of national Funding Agencies is absolutely crucial for the completion of CBM!
- **Strategy**: get subprojects approved **step by step**: magnet procurement accomplished, next step: HEBT (⧗) awaiting shareholder confirmation
- Re-procurement (⧗) of Russian IKCs required for timely installation of CBM experiment (first approach in December Council)
- **Critical for CBM**: timely completion of TBI (⧗) – December ‘24 before the timeline shifts
- **Apart from step-wise execution, need to re-gain priority in GSI (currently focus on ES, FS)**

- ***Progress report for PN - Vasile***

- ***Careful scrutiny of what we need to purchase such to have all the necessary documents until November 15***

- ***Summer Student Program - successfully ended***

➢ ***Outreach***

2024 - year of Anniversaries

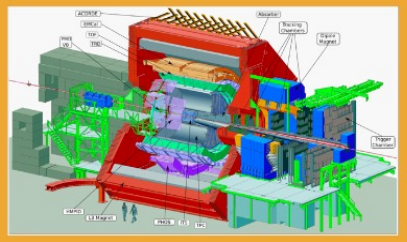
- *75th Anniversary of IFAR - precursor of IFA => IFIN-HH*
- *70th Anniversary of CERN*
- *50th Anniversary of High Energy Heavy-Ion*
- *25th Anniversary of our membership in ALICE @ CERN*
- *20th Anniversary of the DetLab of Hadron Physics Department*
- *20th Anniversary of CBM Collaboration*

HPD COURIER

NUMBER 6 | MAY 2024

CERN 70th Anniversary

Romania in ALICE - 25th Anniversary



HPD COURIER

NUMBER 7 | August 2024

20 years of R&D activities for developing a new generation of RPC & TRD

Electronic version
HPD Couriers can be accessed at:
http://niham.nipne.ro/HPD_Courier.html

Romanian Science Gateway IFA building, 2nd floor

(Title not agreed by IFA director Dr. Florin Buzatu)

ALICE section

Romanian Science Gateway

The message

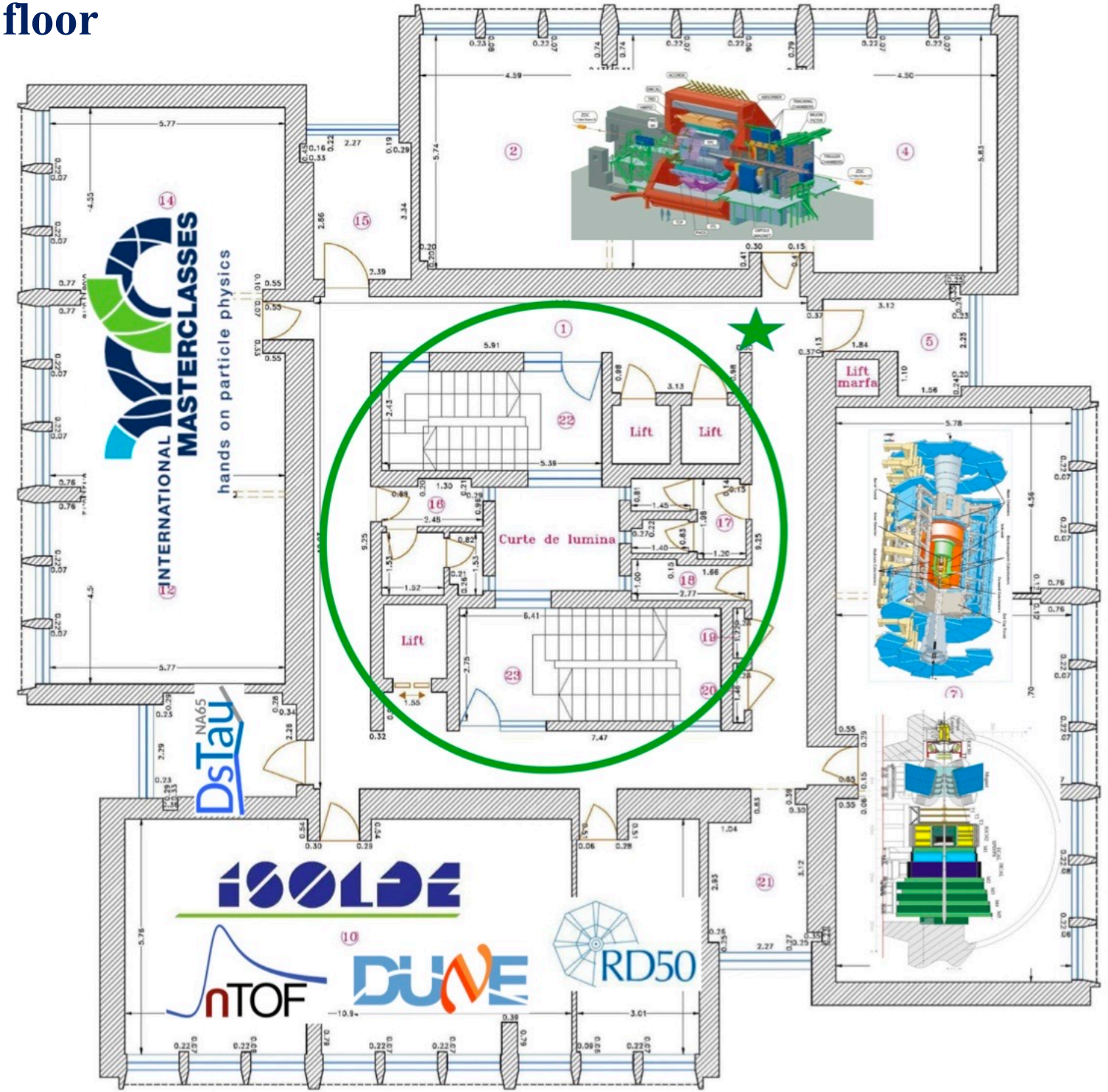
- Could we unravel the History of Universe based on experiments in terrestrial laboratories?

- How to become visible and competitive in Large Scale International Collaborations

- Developed and produced in Romania for CERN

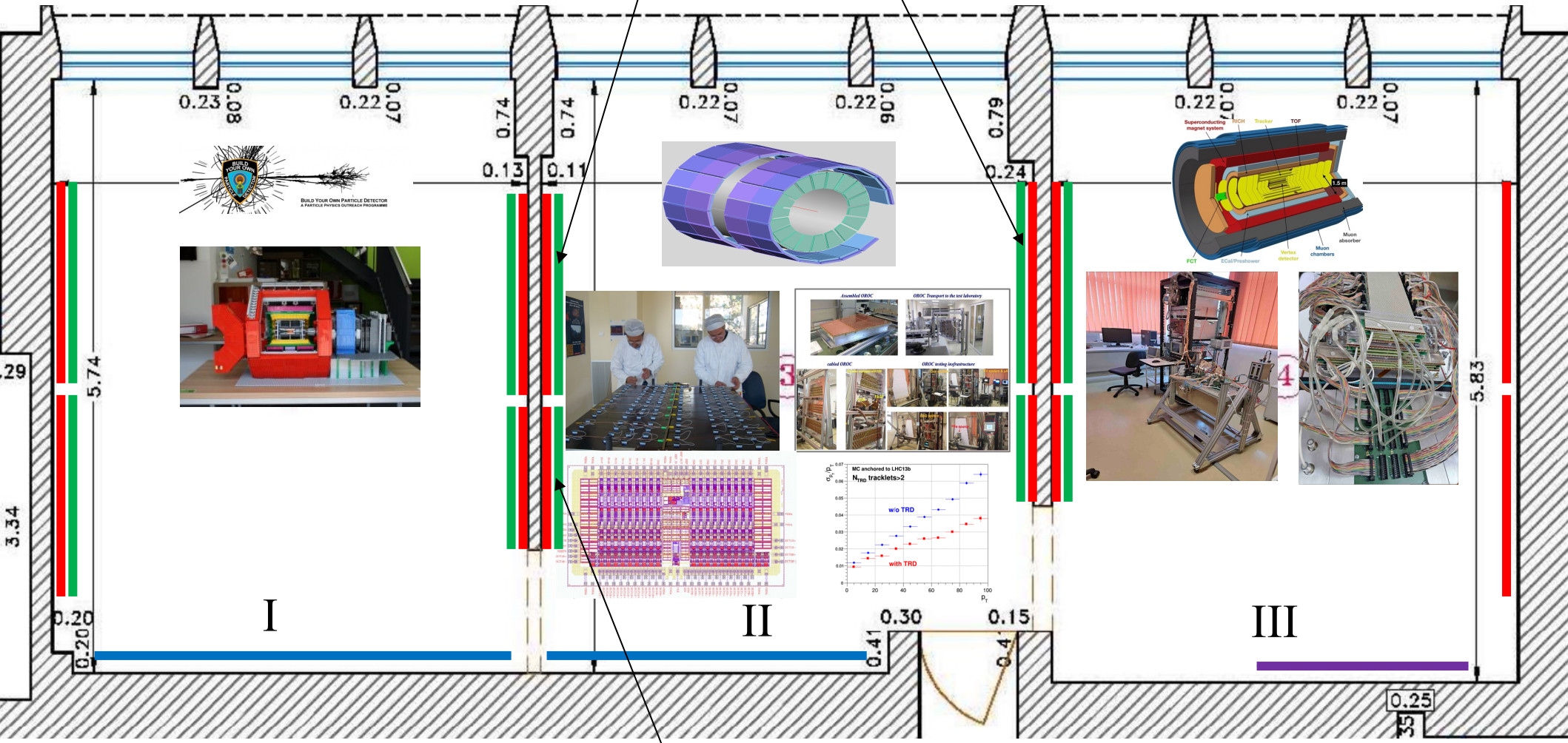
- Would you like to operate by yourself some of the detectors used in CERN experiments ?

Second floor



ALICE exhibition entrance

ALICE exhibition



large monitors

posters

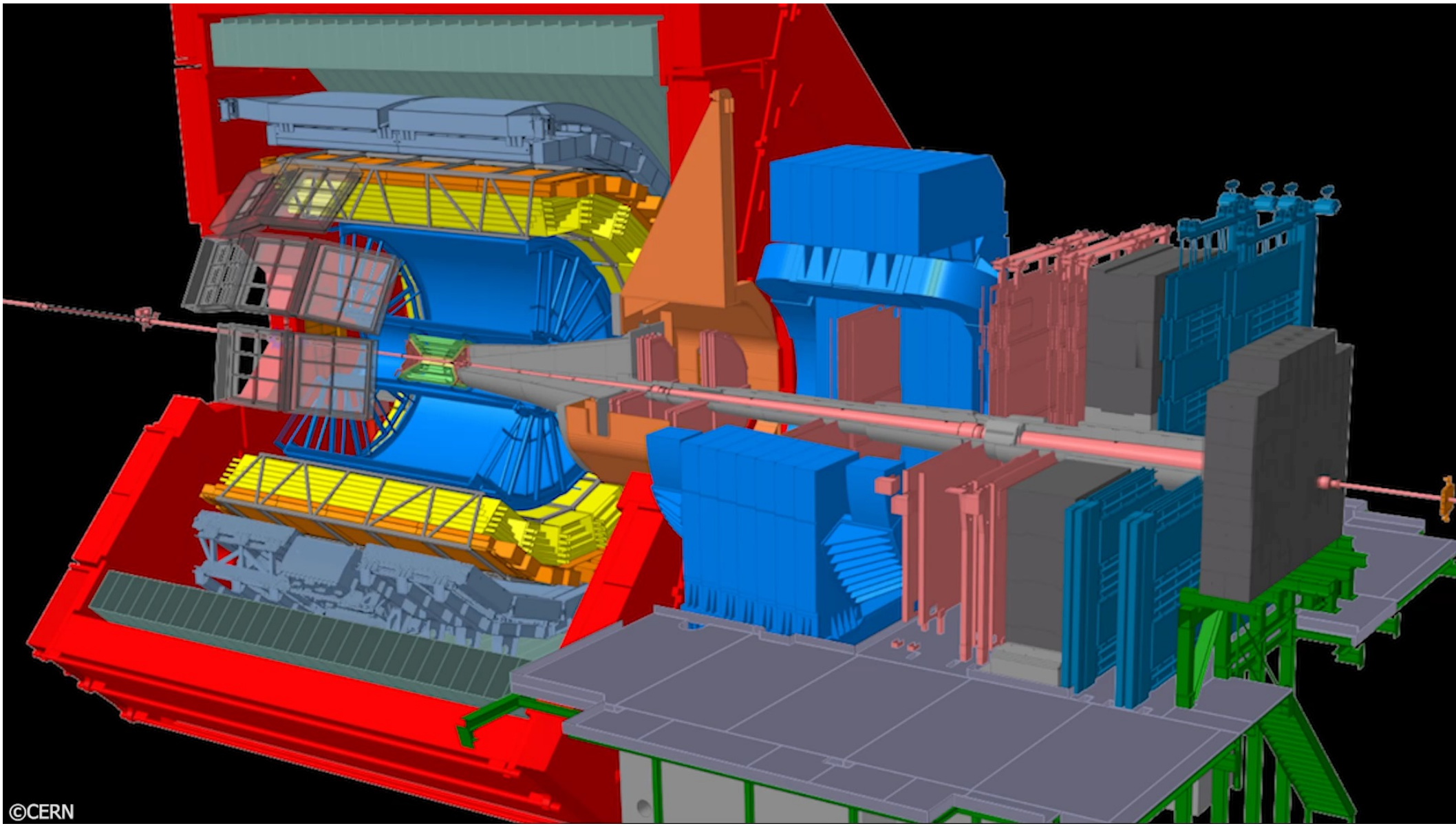
short throw projector

intelligent board

ALICE exhibition I

short throw projector

short throw projector Section I

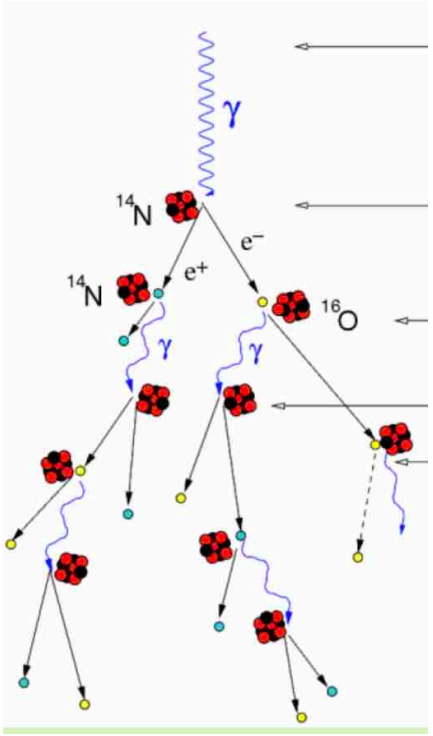


Section II

From precursors up to the state of the art detectors used in the ALICE Experiment at LHC for which development, construction and operation the Romanian groups had and have an essential contribution

Section II

Section III



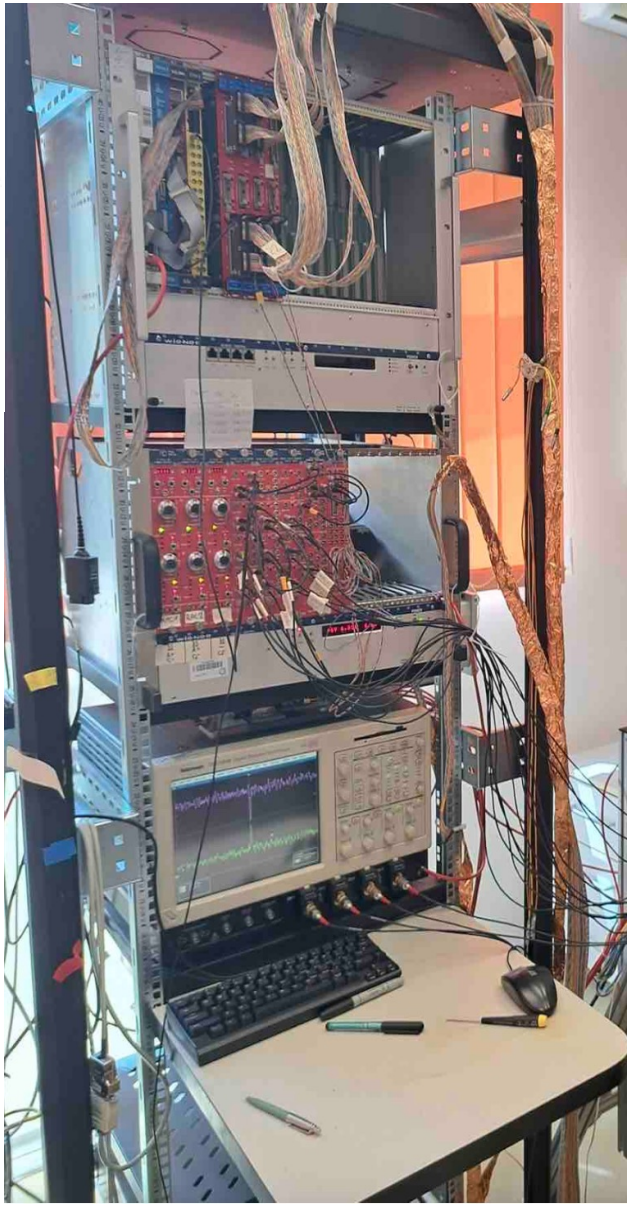
Primary particle (gamma ray)

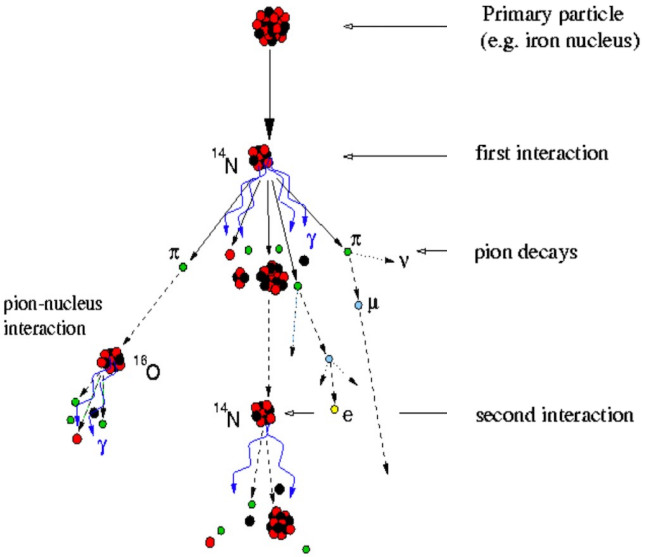
first interaction with nucleus in air (pair production)

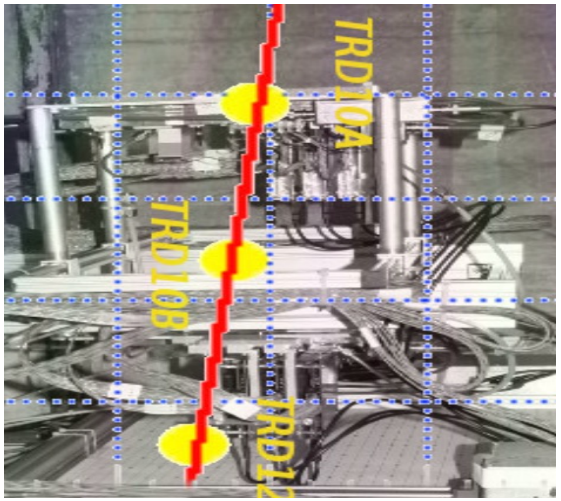
bremsstrahlung on nucleus in air

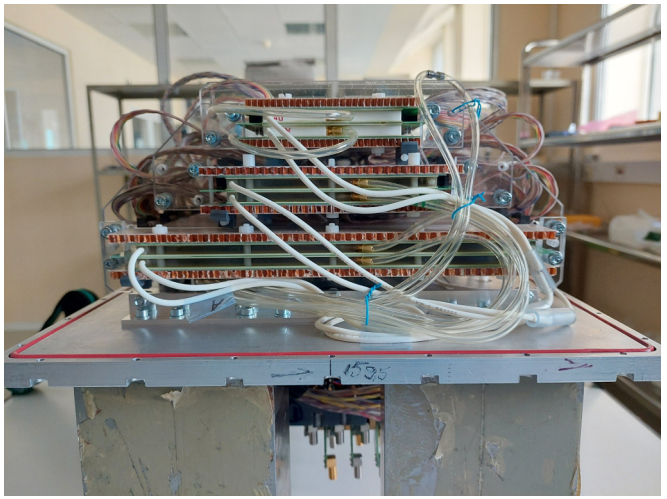
pair production

bremsstrahlung



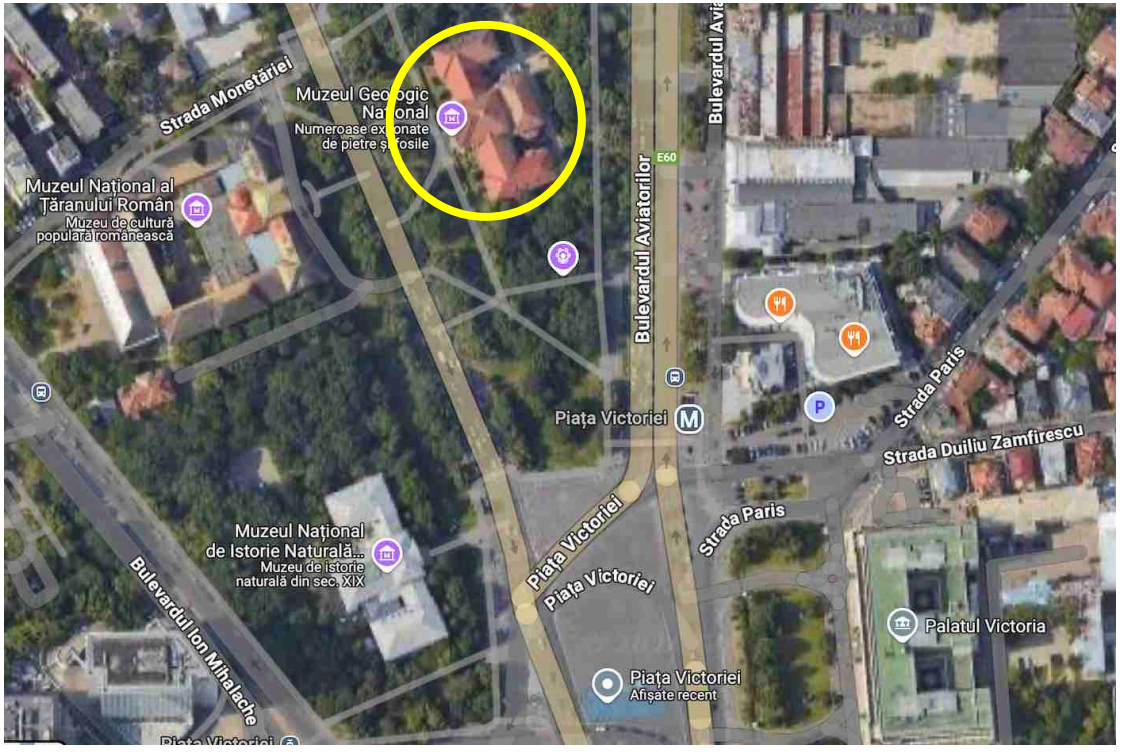






Muzeul de Geologie

Piata Victoriei



A short journey through heavy ion physics

"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