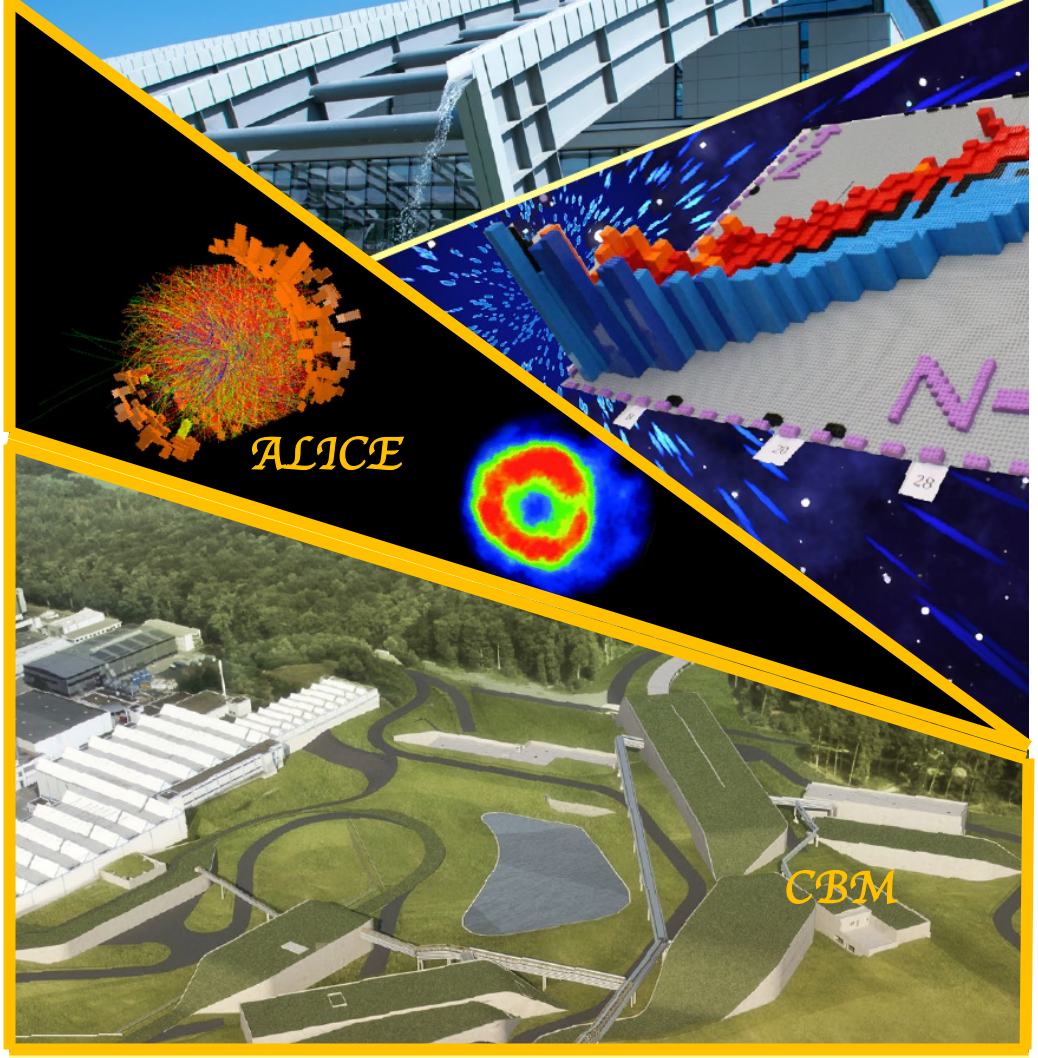

NuPECC

EUROPEAN SCIENCE FOUNDATION

NuPECC Long Range Plan 2017 Perspectives in Nuclear Physics

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IFIN-HH

www.ifin.ro

How to access front end research in a visible and competitive way ?

IFIN-HH/HPD within ALICE & CBM

HADRON PHYSICS DEPARTMENT

Don't start

vast projects

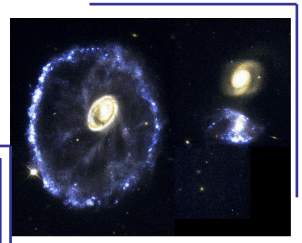
with

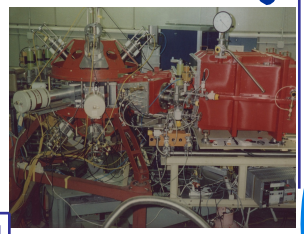
half vast ideas !

&

half experience !

"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

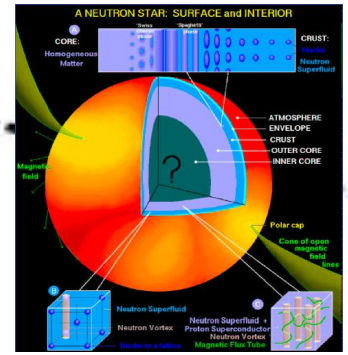
T

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

F

Quark-Hadron continuity:

G

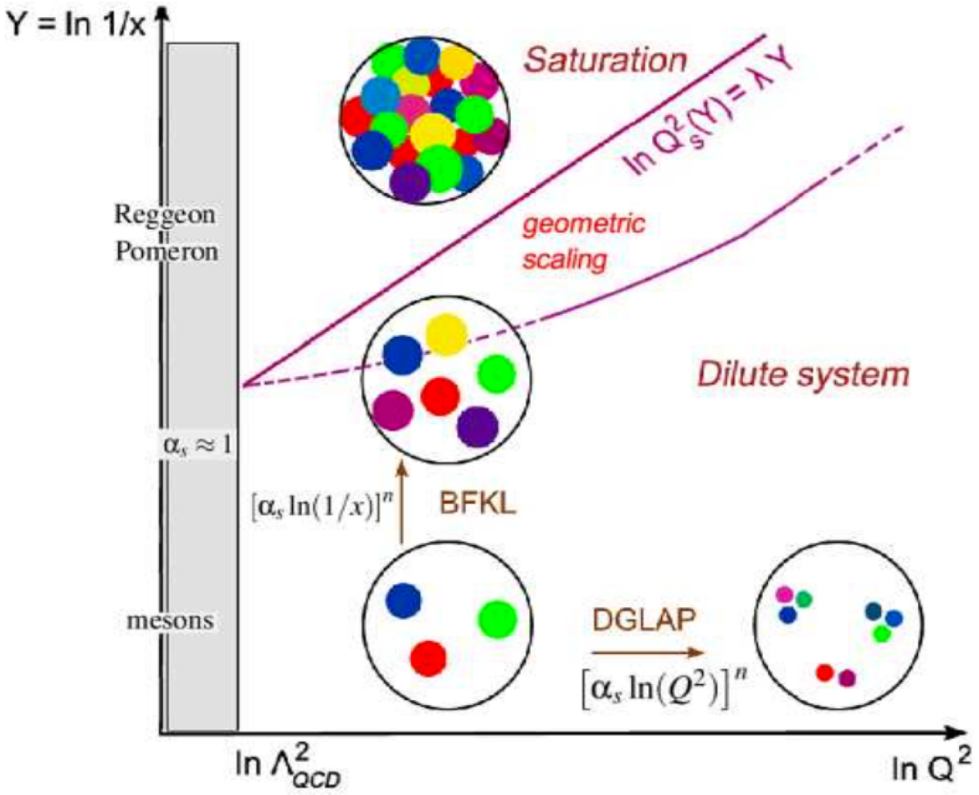
Liquid-gas phase transition:
μ_{NM} ≅ 924 MeV
n_0 = 0.17 fm^{-3}

Superfluid nuclear matter ⇒ *Superconducting quark matter*

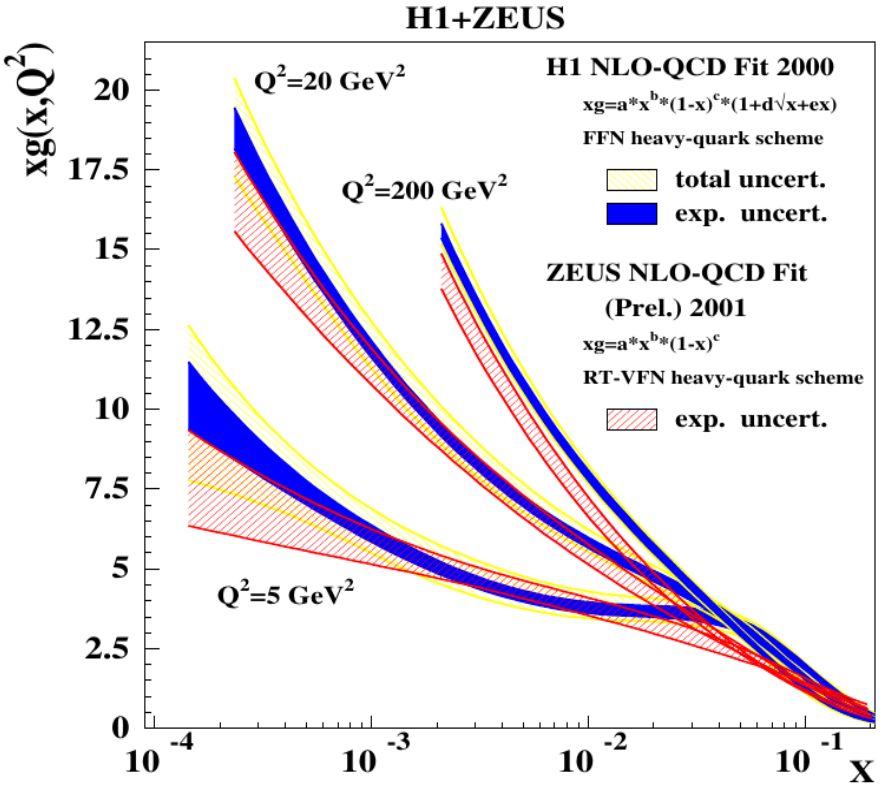
μ_B

K. Fukushima and T. Hatsuda, Rept.Prog.Phys.74(2011)014001

Physics motivation



D. d'Enterria, Eur.Phys.J. A31(2007)816



M.Dittmar et al., Proceedings HERA-LHC Workshop
arXiv:[hep-ph]0511119

Following A.H. Mueller approximations NP A715(2003)20

System	*Au-Au*	*Pb-Pb*	*Pb-Pb*	*pp*
$\sqrt{s}(GeV)$	*200*	*2700*	*5020*	*7000*
$\frac{dN_g^{in}}{dyd^2b}(fm^{-2})$	≈4.7	≈11.8	≈15.9	≈18.7
f_{in}^g	≈0.9	≈2.3	≈3.1	≈3.6

Based on long term strategy and and financial support on normal research projects from different national programs, in less than 4 years we succeeded to organize:

- **a detector laboratory**
- **a small seminar room**
- **11 offices**
- **a Data Center**
- **a modest workshop**

"What in 2002 was a wonderful dream, today is a wonderful reality"
Harvey Newman
12.10.2006

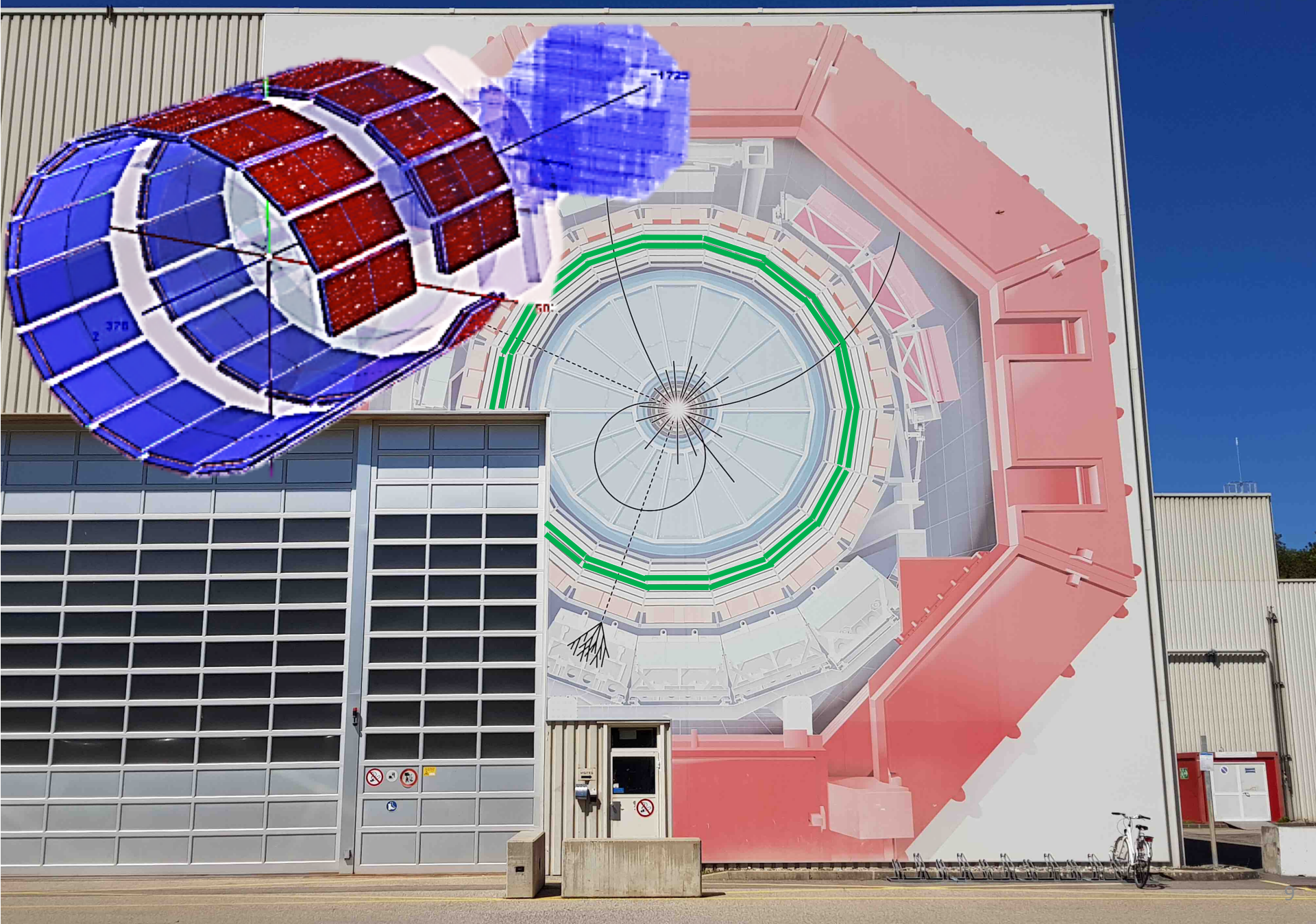








HPD contribution to the ALICE Experiment



Connected to the RoW 24 hours/day, 7 days/week

ALICE

MonALISA Repository for ALICE

My jobs | My home dir | Catalogue browser | LEGO Trains | Administration Section | ALICE Reports | Alert XML Feed | Firefox Toolbar | MonaLisa GUI

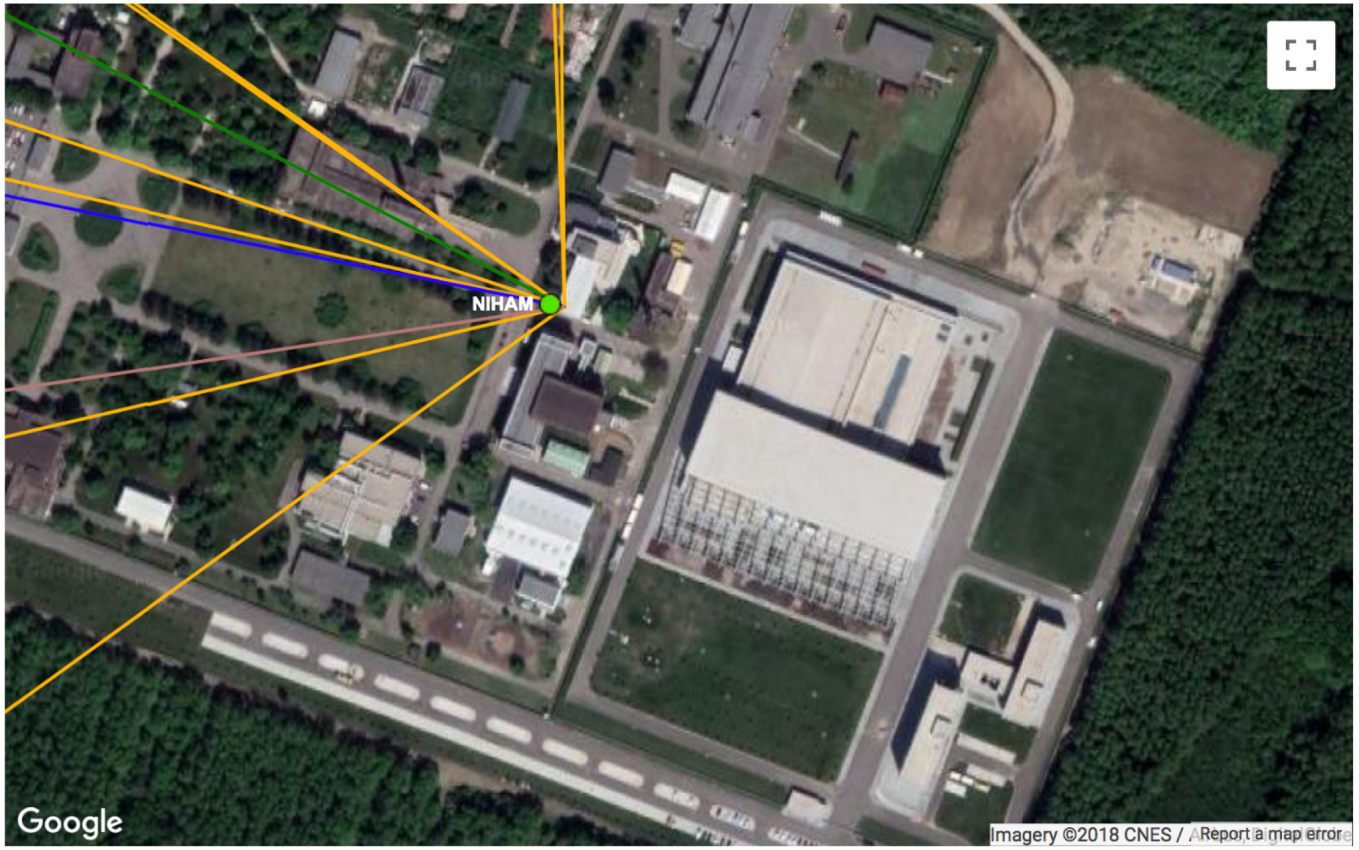
ALICE Repository

- ALICE Repository
  - Google Map
  - Shifter's dashboard
  - Run Condition Table
  - Production Overview
  - Production info
  - Job Information
  - SE Information
  - Services
  - Network Traffic
  - FTD Transfers
  - CAF Monitoring
  - SHUTTLE
  - Build system
  - HepSpec
  - Dynamic charts

close all

This page: bookmark, URL

Active jobs trend

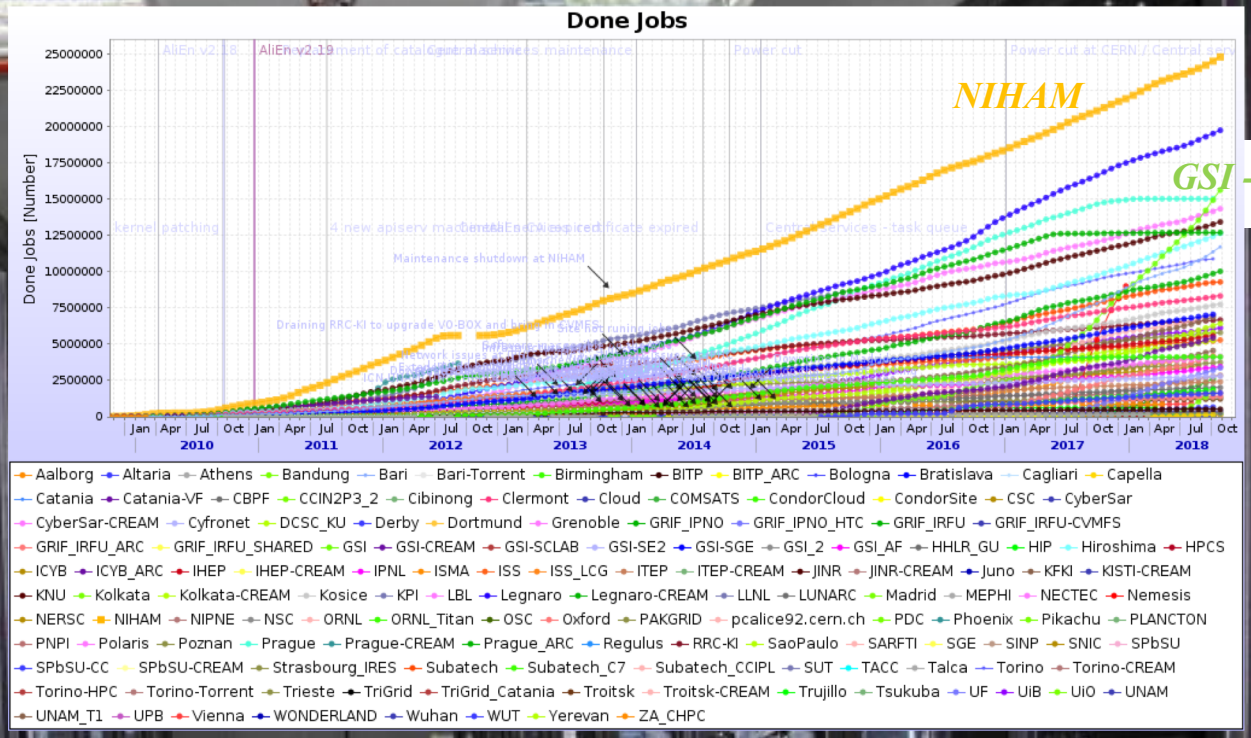


Running jobs | Running jobs but no ML info | Site service problem(s) prevents job execution | No jobs match the site resources | ML service down & no running j

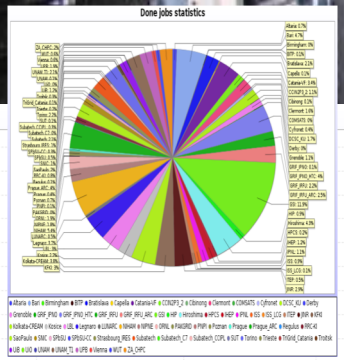
Map options

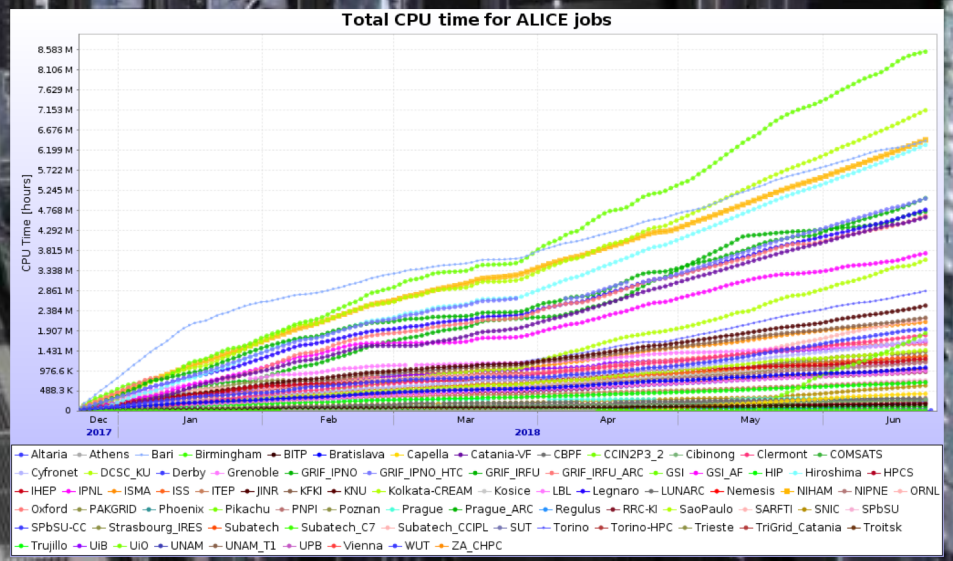
Show xrootd transfers

NIHAM
Tier2 component of ALICE GRID



GSI - Green Cube





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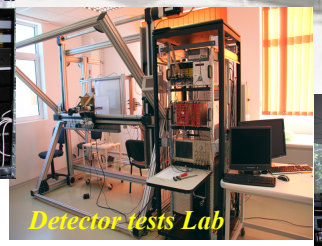
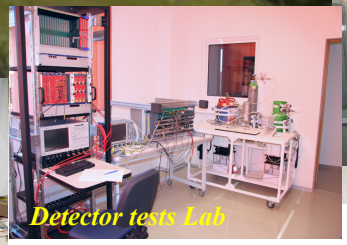
Hadron Physics Department


Data Centre


Detector tests Lab


Detector Lab assembling clean rooms


Technological transfer Lab


Detector tests Lab


Bonding Lab

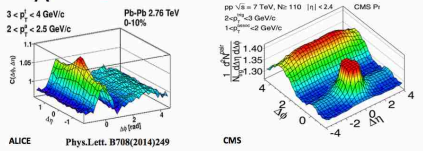
"With no doubt this department has to be ranked excellent as it has an outstanding impact and visibility in both science and technology within the various international collaborations where it is involved" - 2012 International Evaluation Committee

HPD – Physics – within ALICE or related to ALICE

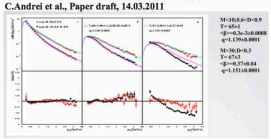
p+p vs. Pb+Pb @ LHC

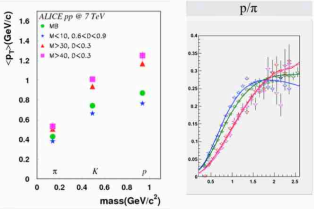
Long range near side correlations

T.Guido and R.Gunther, CERN Seminar, 21.09.2010
J. Phys. G Nucl. Part. Phys. 38(2011)124051



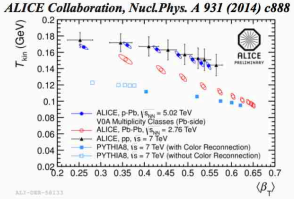
C.Andrei et al., ALICE Week, PWG2-Soft Physics, 9.11.2010
C.Andrei et al., Paper draft, 14.03.2011





Transverse flow – BGBW fits

ALICE Collaboration, Nucl.Phys. A 931 (2014) c888

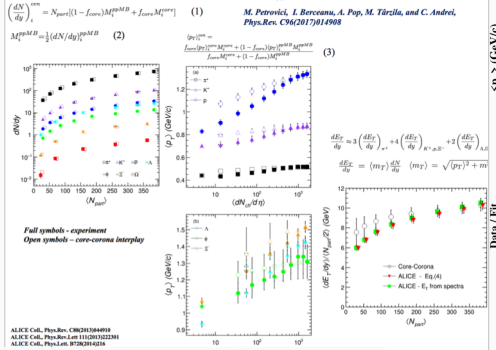


Particle identification in ALICE: a Bayesian approach
ALICE Collaboration, Eur. Phys. J. Plus 131 (2016) 168

Multiplicity dependence of light-flavor hadron production in pp collisions at √s= 7 TeV
ALICE Collaboration, arXiv:1807.11321 [nucl-ex]

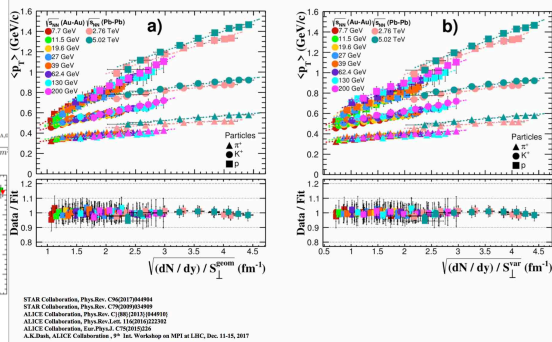
Core-Corona effect

M. Petrovici, I. Berceanu, A. Pop, M. Târzila, and C. Andrei, Phys.Rev. C96(2017)014908



ALICE Coll., Phys.Rev. C88(2013)044910
ALICE Coll., Phys.Rev.Lett 111(2013)222301
ALICE Coll., Phys.Lett. B728(2014)216

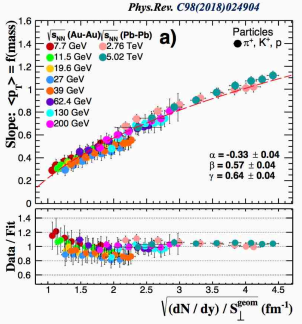
<p_T> vs. [(dN/dy)/S_perp]^1/2

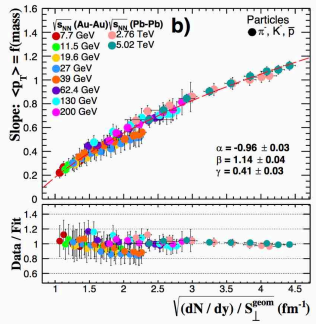


STAR Collaboration, Phys.Rev. C96(2017)044904
STAR Collaboration, Phys.Rev. C79(2009)034909
ALICE Collaboration, Phys.Rev. C(88)(2013)044910
ALICE Collaboration, Phys.Rev.Lett. 116(2016)222302
ALICE Collaboration, Eur.Phys.J. C75(2015)226
A.K.Dash, ALICE Collaboration, 9th Int. Workshop on MPI at LHC, Dec. 11-15, 2017

The slope of <p_T>=f(mass) vs. [(dN/dy)/S_perp]^1/2

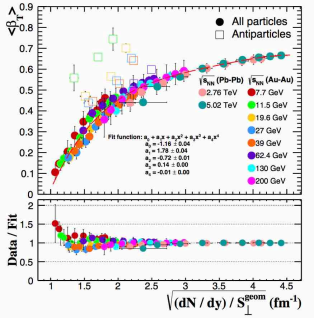
M. Petrovici, A.Lindner, , A. Pop, M. Târzila, and I.Berceanu, arXiv: [hep-ph]1805.04060; Phys.Rev. C98(2018)024904

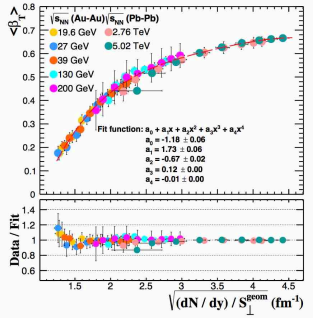




$$Slope_{\langle p_T\rangle=f(mass)} = \alpha + \beta\left(\sqrt{\frac{dN}{dy}}/S_{\perp}^{geom}\right)^{\gamma}$$

<β_T> from BGBW fits vs. [(dN/dy)/S_perp]^1/2



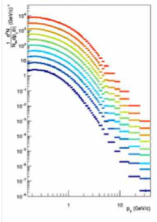


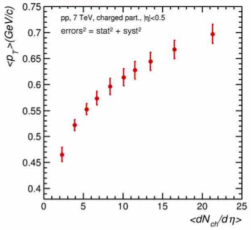
Boltzmann-Gibbs Blast Wave

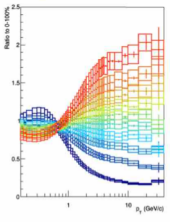
$$\frac{1}{2\pi p_T}\frac{d^2N}{dydp_T} \propto \int_0^R r dr m_T I_0\left(\frac{p_T \sinh\rho}{T_{kin}}\right) K_1\left(\frac{m_T\cosh\rho}{T_{kin}}\right)$$

$$\rho = \tanh^{-1}\beta_T = \tanh^{-1}\left[\left(\frac{r}{R}\right)^n \beta_s\right]$$

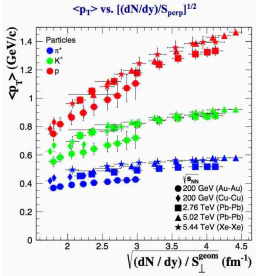
p_T spectra, ratios, $\langle p_T\rangle$ of unidentified charged hadrons

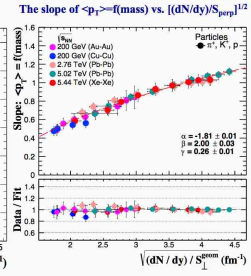


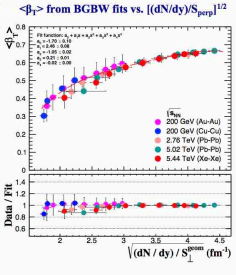




Cu-Cu; Au-Au @ RHIC vs. Xe-Xe and Pb+Pb @ LHC

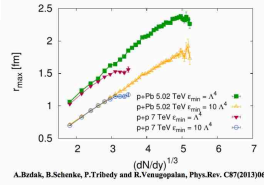






BRAHMS Collaboration, arXiv:[nucl.ex]1602.01183
F.Bellini, ALICE Collaboration, QM2018
STAR Collaboration, Phys.Rev. C79(2009)034909
ALICE Collaboration, Phys.Rev. C)[88]{2013}{044910}

p+p vs. Pb+Pb @ LHC



A.Bzdak, B.Schenke, P.Tribedy and R.Venugopalan, Phys.Rev. C87(2013)064906

$S_{\perp}^{pp} = \pi R_{pp}^2$ $R_{pp} = 1fm$ ***f_pp*** - maximal radius for which the energy density of the Yang-Mill fields is larger than $\varepsilon = \alpha\Lambda_{QCD}^4$ $(\alpha \in [1,10])$

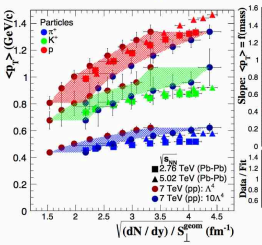
α=1 $f_{pp} = \begin{cases} 0.387 + 0.0335x + 0.274x^2 - 0.0542x^3 & \text{if } x < 3.4 \\ 1.538 & \text{if } x \geq 3.4 \end{cases}$

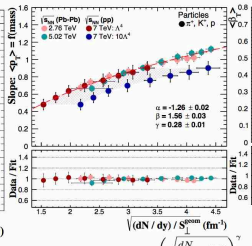
$x = (dN_g/dy)^{1/3}$

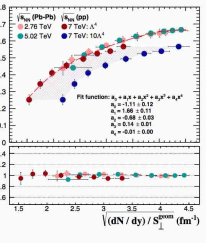
$dN_g/dy \approx dN/dy$

McLarren, M.Praszalowicz and B.Schenke, Nucl.Phys. A916(2013)210

α=10 $f_{pp} = \begin{cases} -0.018 + 0.3976x + 0.095x^2 - 0.028x^3 & \text{if } x < 3.4 \\ 1.17 & \text{if } x \geq 3.4 \end{cases}$



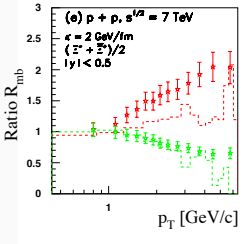


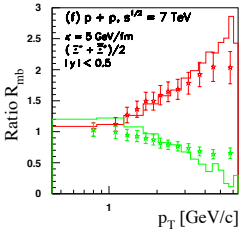


ALICE Collaboration, Nucl.Phys. A931(2014)c888

$Slope_{\langle p_T\rangle=f(mass)} = \alpha + \beta\left(\sqrt{\frac{dN}{dy}}/S_{\perp}^{geom}\right)^{\gamma}$

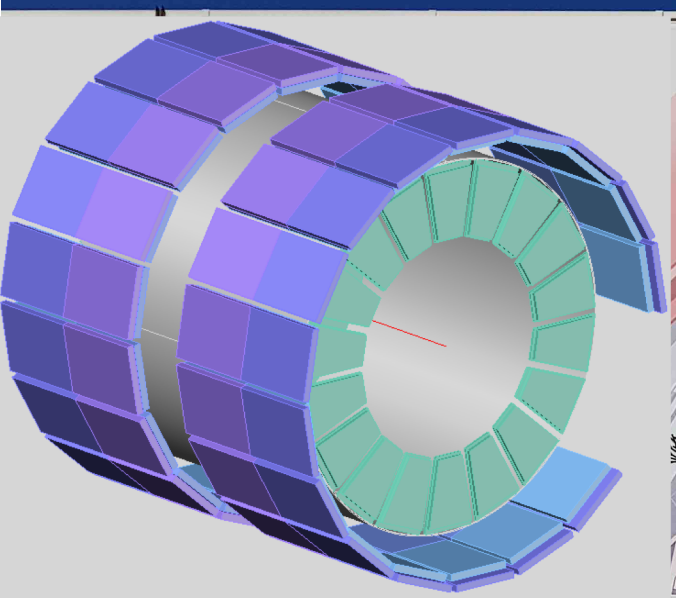
pp - Pb+Pb similarities @ LHC within HIJING/BB v2.0 model

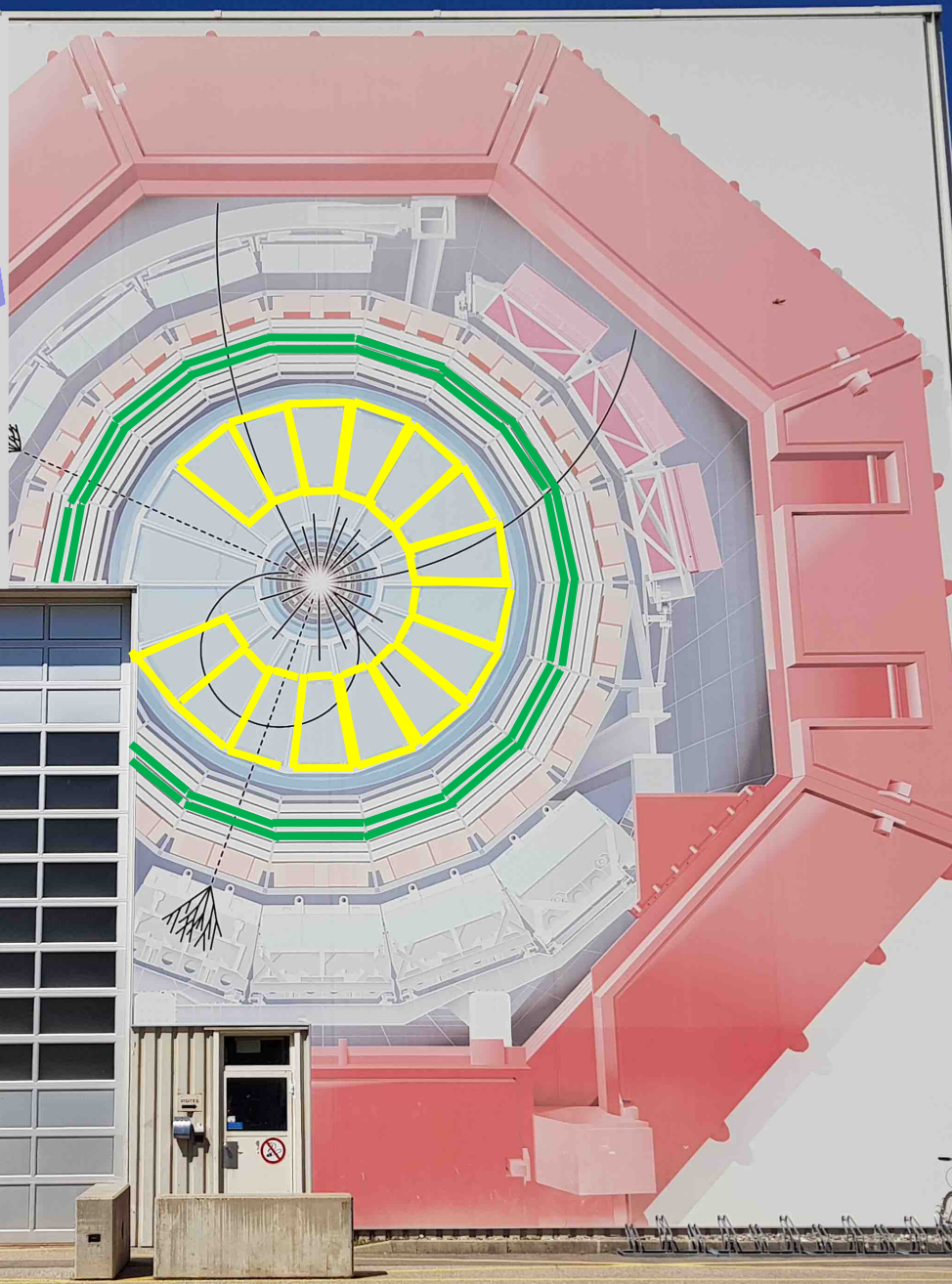




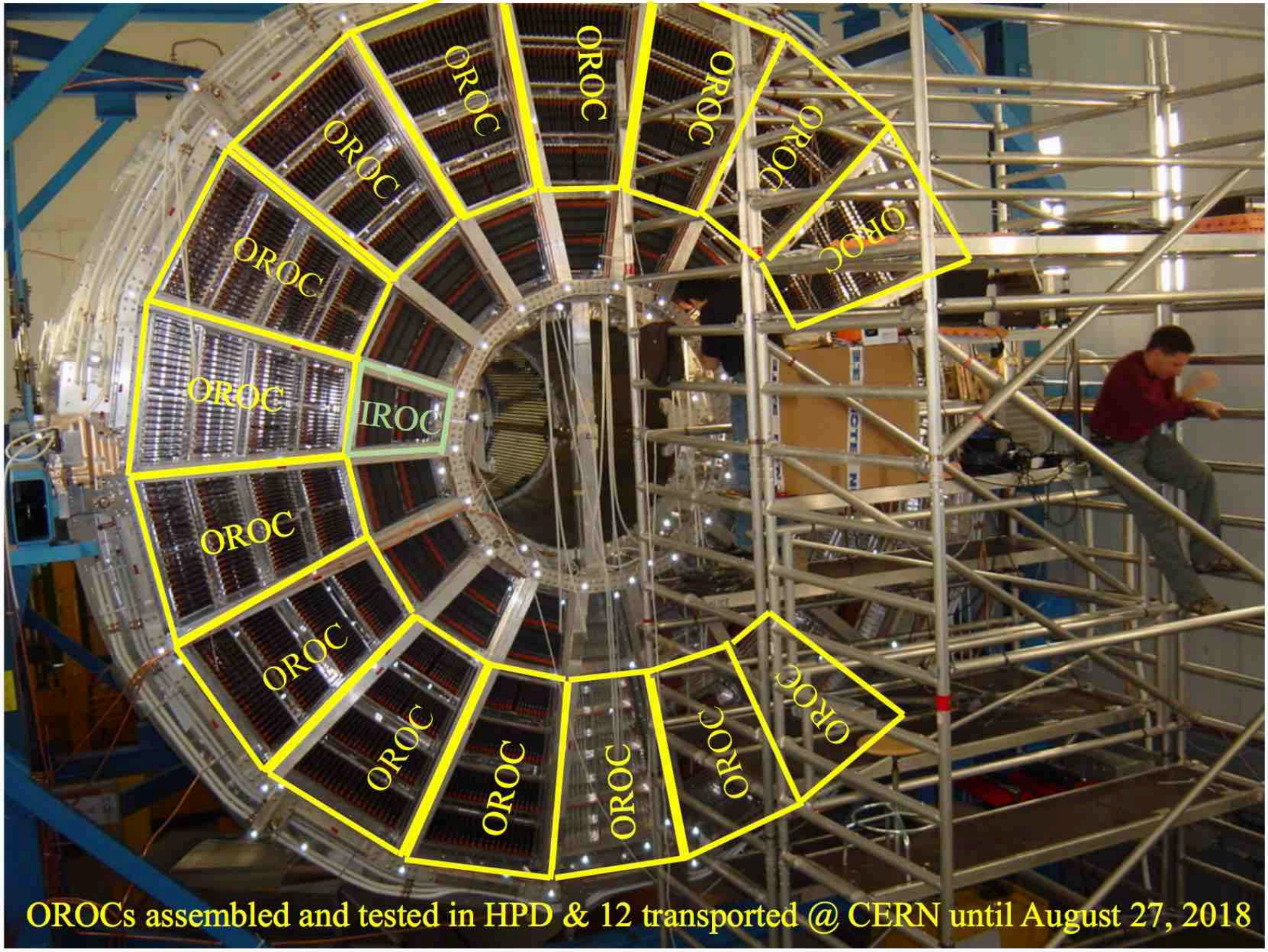
V.Topor Pop and M.Petrovici, arXiv:[hep-ph]1806.00359

HPD contribution to the ALICE Experiment

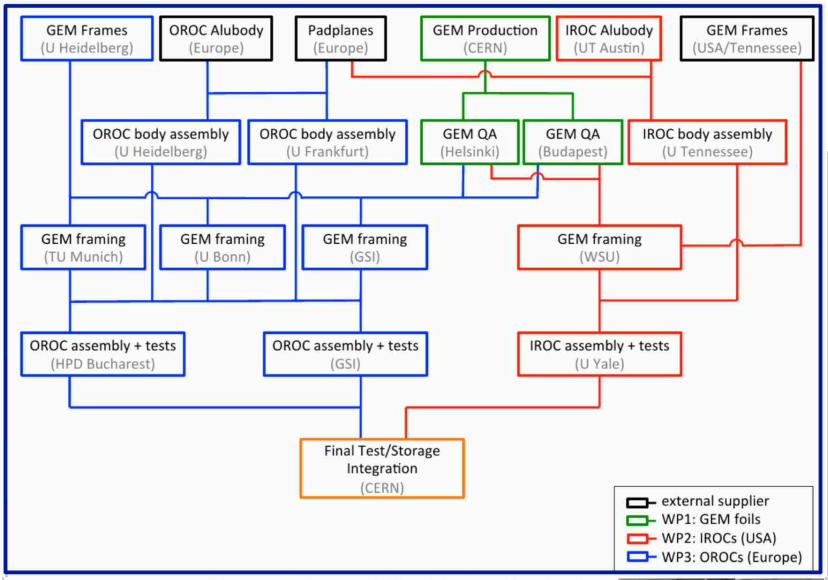


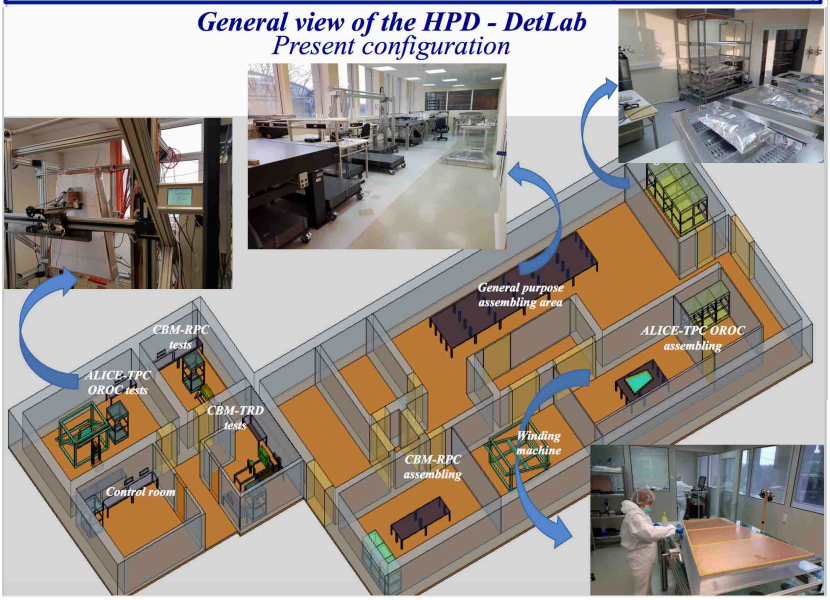


ALICE-TPC - Upgrade

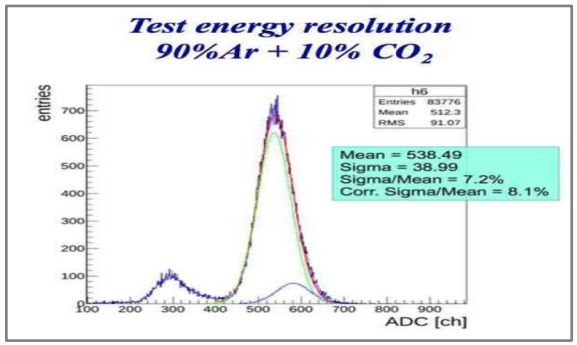


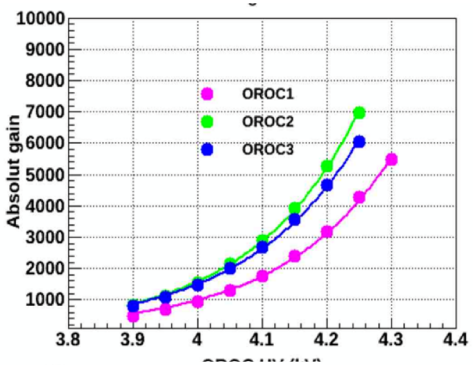
HPD contribution to the ALICE Experiment

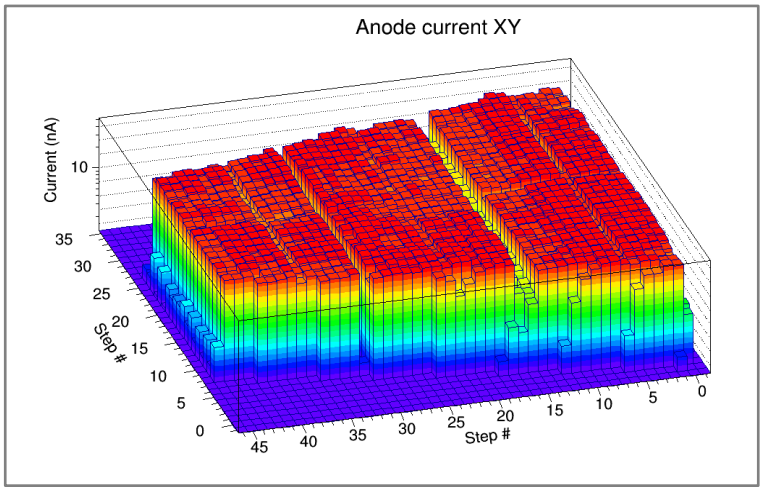


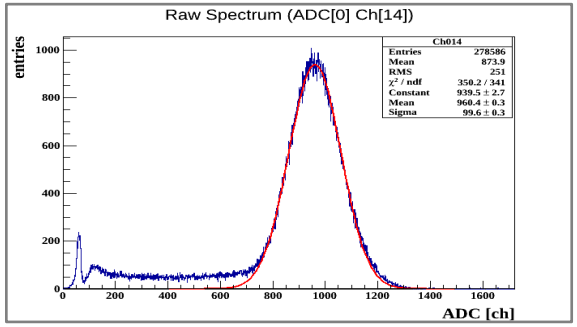


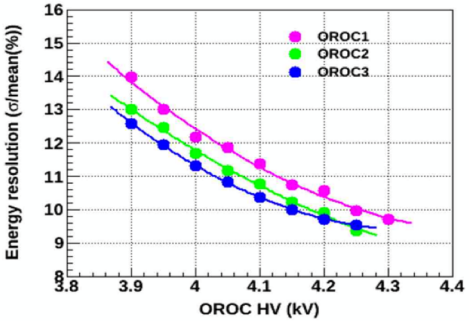
ALICE-TPC - Upgrade - HPD activities







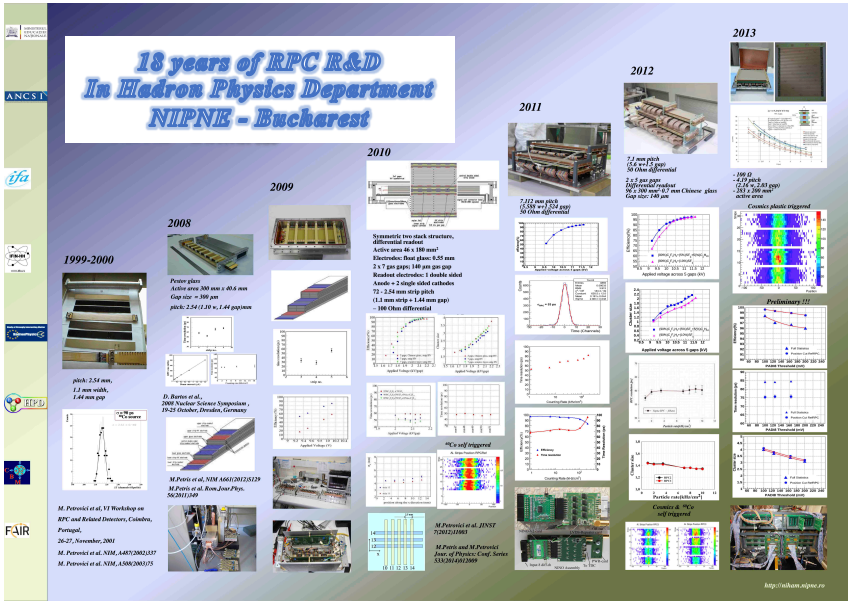


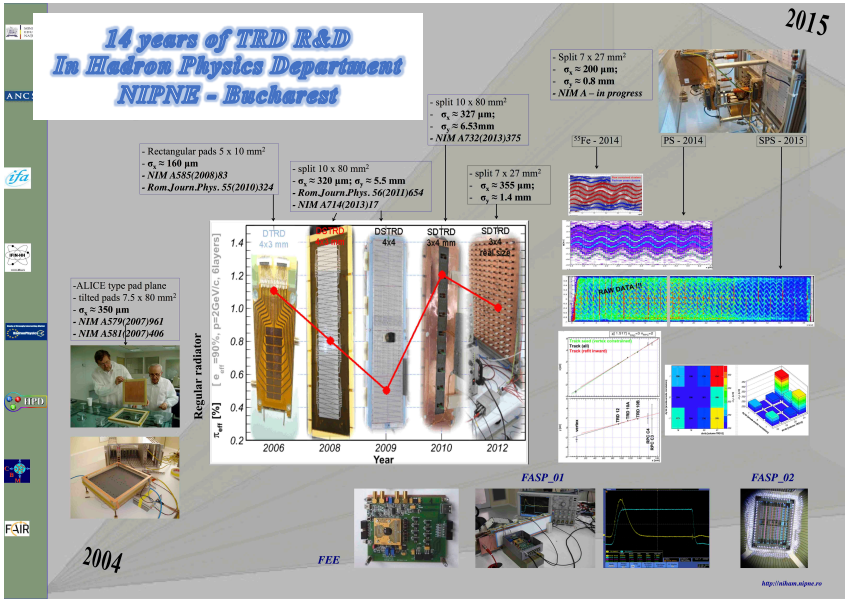


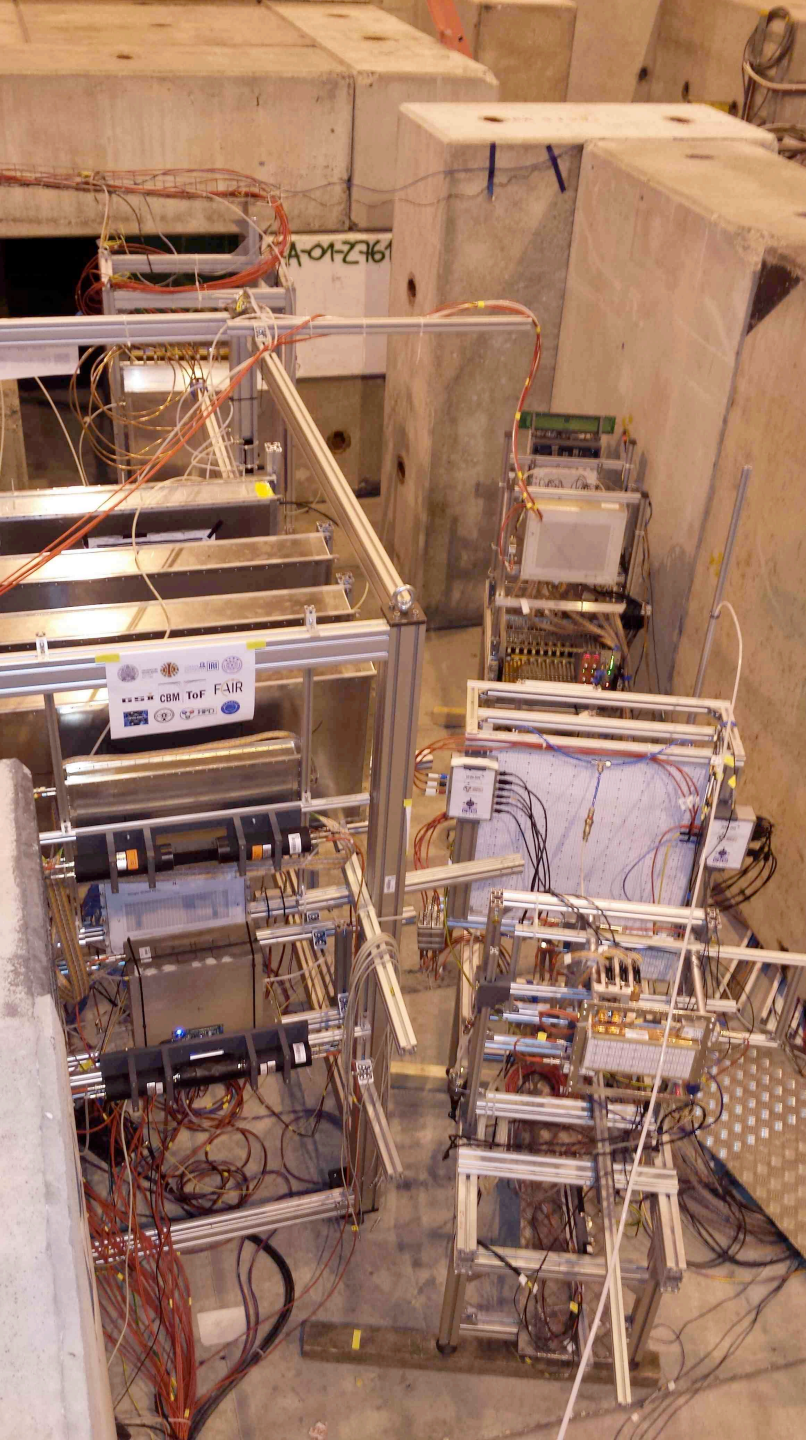
https://youtu.be/ZHBgGKamUc8

Highly compact summary of our contribution in developing a new generation of:

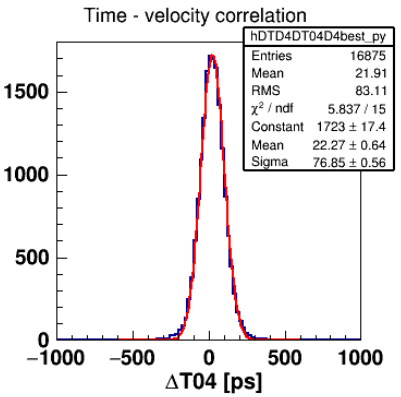
- *High counting rate RPCs*
- *High counting rate TRD*
- *TRD - FEE*

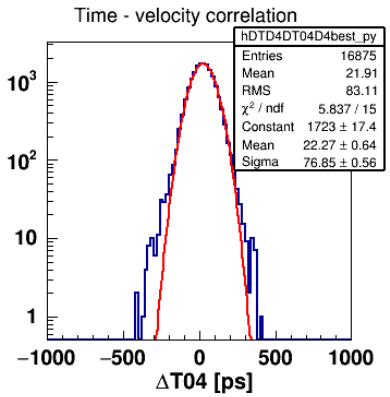




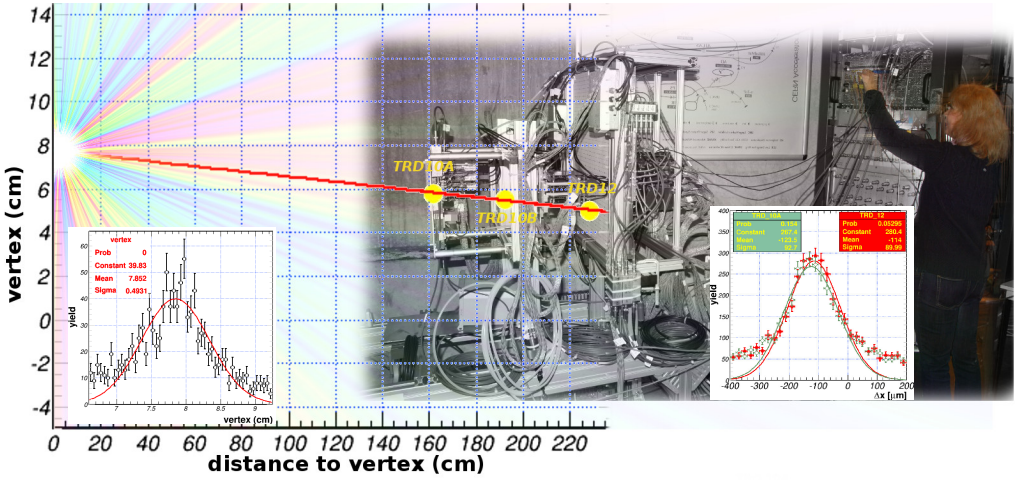


In-beam tests @ SPS, Nov.-Dec. 2015



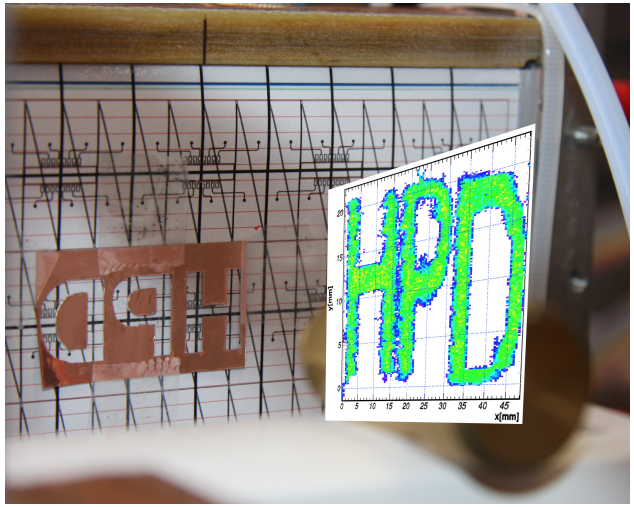


δt ~ 50-60 psec
Cluster size ~ 1.8-2 strips
ε ≥ 90%

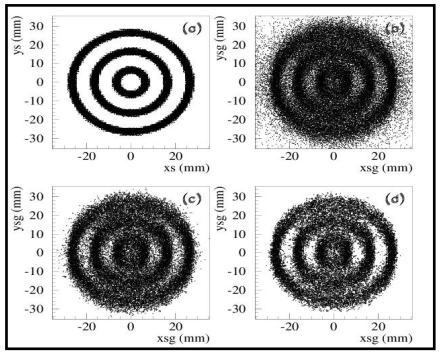


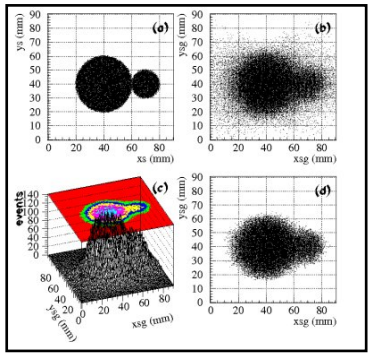
Input for → *Applied research* → *Technological transfer*

Application: high sensitivity whole–body PET imaging



MC simulations based on the measured performance





$\varepsilon_{MIP} > 95\%$

$\varepsilon_{\gamma} \sim 2\text{-}3\%$

Some of the publications from inventing MGMSRPC architecture

[1] Multistrip,Multigap,Symetric RPC
M.Petrovici
VI Workshop on Resistive Plate Chambers and Related Detectors, Coimbra, Portugal, 26-27 November, 2001

[2] Large - area glass-resistive plate chamber with multistrip readout
M. Petrovici, N. Herrmann, K.D. Hildenbrand, G. Augustinski, M. Ciobanu, I.Cruceru, M. Duma, O. Hartmann, P. Koczon, T. Kress, M. Marquardt, D. Moisa, M. Petris, C. Schroeder, V. Simion, G. Stoicea, J. Weinert
Nuclear Instruments and Methods in Physics Research A 487(3):337-345, (Jul 21 2002)

[3] Multistrip Multigap Symmetric RPC
M. Petrovici, N. Herrmann, K.D. Hildenbrand, G. Augustinski, M. Ciobanu, I.Cruceru, M. Duma, O. Hartmann, P. Koczon, T. Kress, M. Marquardt, D. Moisa, M. Petris, C. Schroeder, V. Simion, G.Stoicea, J. Weinert
Nuclear Instruments and Methods in Physics Research A 508 (1-2):75-78(Aug 2003

[4] Time Resolution of Radiation Hard Resistive Plate Chambers for the CBM Experiment at FAIR
D.Bartos, G.Caragheorgheopol, F.Dohrmann, K.D.Hildenbrand, B.Kampfer, R.Kotte, L.Naumann, M.Petris, M.Petrovici, V.Simion, M.C.S.Williams, J.Wustenfeld
IEEE Dresden 19-25 October 2008

[5] Strip Readout RPC Based on Low Resistivity Glass Electrodes
M.Petris, M.Petrovici, V.Simion, D.Bartos, G. Caragheorgheopol, F. Dorhmann, K.D. Hildenbrand, B. Kaempfer, R. Kotte, L. Naumann, D. Stach, M.C.S. Williams, J. Wuenstenfeld
Rom. Journ. Phys.56:349-358, 2011

[6] A Multi-strip Multi-gap RPC Barrel for Time-of-Flight Measurements
M.Kis, M.Ciobanu, I.Deppner, K.D.Hildenbrand, N.Herrmann, T.I.Kang, Y.J.Kim, P.Koczon, Y.Leifels, M.Marquardt, M.Petrovici, K.Piasecki, M.S.Ryu, A.Scuttauf, V.Simion, J.Weinert, X.Zhang, Nucl.Instr. and Meth. in Phys.Res. A646(2011)27

[7] Toward a high granularity and high counting rate, differential readout timing MRPC
M. Petris, M. Petrovici, V. Simion, D. Bartos, G. Caragheorgheopol, I. Deppner, K. Doroud, N. Herrmann, M. Kiss, P. Loizeau, Y. Zhang, M.C.S. Williams
Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Vol. 661, Suppl.1, 1 January 2012, S129-S133

[8] The CBM time-of-flight wall
I. Deppner, N. Herrmann, D. Gonzalez-Diaz, V. Ammosov, J. Cheng, M. Ciobanu, V. Gapienko, K.D. Hildenbrand, A. Kiseleva, M. KiÅ¡, D. Kresan, R. Kotte, C. Huangshan, Y. Leifels, J. Fruehauf, C. Li,Y. Li, P.-A. Loizeau, L. Naumann, M. Petrovici, M. Petris, A. Semak, V. Simion, D. Stach, Y. Sun, Yu. Sviridov, Z. Tang, E. Usenko, J. Wang, Y. Wang, K. Wisniewski, J. Wuenstenfeld, L. Xu, V. Zaets, Y. Zhang, X.Zhu
Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Vol. 661, Suppl.1, 1 January 2012, S121-S124, 2012

[9] High counting rate, two-dimensional position sensitive timing RPC
M.Petrovici, M.Petris et al. Journal of Instrumentation Volume 7 Nov. 2012 (JINST 7 P11003)

[10] Multi-Strip RPC for high counting rate experiment
M. Petris and M. Petrovici, Journal of Physics: Conference Series, Volume 533, 012009, 2014

[11] The CBM Time-of-Flight wall — a conceptual design
I. Deppner, N Herrmann, A Akindinov, D Bartos, A Balaceanu, S Belogurov, P Cao, G Caragheorgheopol, H Chen, J Cheng, M Ciobanu, F Constantin, Z Deng, H Deppe, V Duta, H Fan, H Flemming, J Frühauf, J Gebelein, K Heidel, K Hildenbrand, U Kebschull, M Kiš, S Kiselev, K.Koch, P Koczon, R Kotte, A Laso Garcia, J Lehrbach, C Li, Y Li, P -A Loizeau, P Lv, D Malkevich, S Manz, L Naumann, A Nedosekin, W Niebur, A Oancea, M Petris, M Petrovici, V Plotnikov, M. Prokudi, L Radulescu, M Shao, V Simion, C Simon, R Sultanov, Y Sun, Z Tang, Y Wang, J, Wüstenfeld, C Xiang, N Xu, Y Zhang, D Zhou and X Zhu
2014 JINST 9 C1001 2014

[12] Technical Design Report for the CBM Time-of-Flight System (TOF),
CBM-TOF Collaboration, Report No.: GSI-2015-01999, 2015

[13] Prototype with the basic architecture for the CBM-TOF inner wall tested in close to real conditions
M. Petris, D. Bartos¸, G. Caragheorgheopol, F. Constantin, M. Petrovici, L. Radulescu, V. Simion , I. Deppner, N. Herrmann, C. Simon , J. Fruhauf, M. Kis, P-A. Loizeau
Journal of Physics: Conference Series 724 (2016) 012037

[14] *Time and position resolution of high granularity, high counting rate MRPC for the inner zone of the CBM-TOF wall", M. Petris, D. Bartos, G. Caragheorgheopol, I. Deppner, J. Fruenhauf, N. Herrmann, M.Kis, P-A. Loizeau, M. Petrovici, L. Radulescu, V. Simion, C. Simon Journal of Instrumentation, Volume 11, September 2016 (2016 JINST 11 C09009)*

[15] A Method to Adjust the Impedance of the Signal Transmission Line in a Multi-Strip Multi-Gap Resistive Plate Counter
D. Bartos¸ M. Petris¸ M. Petrovici, L. Rădulescu, V. Simion
Romanian Journal of Physics 63, 901 (2018)

[16] In-beam test of the RPC architecture foreseen to be used for the CBM-TOF wall,
M. Petris, D. Bartos, L.Radulescu, V.Simion, I Deppner, N. Herrmann, C. Simon, J. Fruehauf, M. Kiss, P.Loizeau
Journal of Physics:Conference Series, Vol. 1023(2018), 012007

1 patent

1 bronze medal at the International Salon of Inventions - Geneva

Some of the publications from inventing HCR-TRD architecture

[1] Development of a Two Dimensional Position Sensitive Transition Radiation Detector for High Counting Rate Experiments
M. Petris, M. Petrovici, V. Catanescu
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)

[2] TRD detector development for the CBM experiment
M. Petriş, M. Petrovici, V. Cătănescu, M. Târzilă, V. Simion, D. Bartoş, I. Berceanu, A. Bercuci, G. Caragheorgheopol, F. Constantin, L. Rădulescu, J. Adamczewski-Musch, S. Linev
Nuclear Instruments and Methods in Physics Research A 732 (2013)375

[3] Two-dimensional position sensitive transition radiation detector
M. Petriş, M. Petrovici, V. Cătănescu, V. Simion, D. Bartoş, I. Berceanu, A. Bercuci, G. Caragheorgheopol, F. Constantin, M. Târzilă, C. Bergmann, D. Emschermann, S. Linev, W.F.J. Müller, J.P. Wessels
Nuclear Instruments and Methods in Physics Research Section A714(2013)

[4] A Two-Dimension Position Sensitive High Efficiency Transition Radiation Detector for High Counting Rate Environment
M. Petrovici, V. Simion, M. Petris, V. Aprodu, D. Bartos, G. Caragheorgheopol, V. Catanescu, A. Herghelegiu, L. Prodan, A. Radu, C. Bergmann, M. Klein-Boesing, J. P. Wessels
Rom. Journ. Phys. 56(2011)654

[5] Rate Capability of a High Efficiency Transition Radiation Detector
M. Petris, M. Petrovici, D.Bartos, I. Berceanu, V. Simion, A. Radu, A. Andronic, C. Garabatos, M.Klein-Boesing, R. Simon, F. Uhlig, J.P. Wessels, A. Wilk
Rom. Journ. Phys., 55(2010)324

[6] Position resolution of a high efficiency Transition Radiation Detector for high counting rate environment
M. Klein-Boesing, A. Andronic, D. Bartos, I. Berceanu, V. Catanescu, C. Garabatos, N. Heine, A. Herghelegiu, C. Magureanu, D. Moisa, M. Petris, M. Petrovici, A. Radu, V. Simion, F. Uhlig, J.P. Wessels, A Wilk
Nuclear Instruments and Methods in Physics Research A 585(2008)83

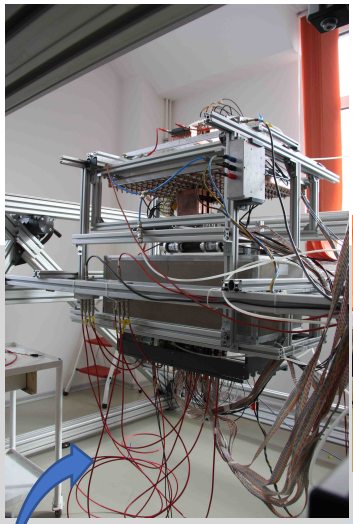
[7] A high-efficiency Transition Radiation Detector for high-counting-rate environments
M. Petrovici, M. Petris, I. Berceanu, V. Simion, D. Bartos, V. Catanescu, A. Herghelegiu, C. Magureanu, D. Moisa, A. Radu, M. Klein-Boesing, J.P. Wessels, A. Wilk, A. Andronic, C. Garabatos, R. Simon, F. Uhlig
Nuclear Instruments and Methods in Physics Research A579(2007)961

[8]. High counting rate transition radiation detector
M. Petris, M. Petrovici, V. Simion, I. Berceanu, D. Moisa
Nuclear Instruments and Methods in Physics research A581(2007)406

1 patent

1 silver medal at the International Salon of Inventions - Geneva

General view of the HPD - DetLab
Present & near future



ALICE-related international events

Organized by us in Romania

CBM-related international events

Organized by us in Romania

16th CBM Collaboration Meeting

27 September – 1 October 2010

Mamaia, Romania

Topics

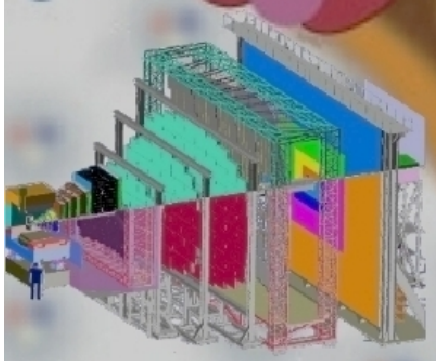
R&D, Monte Carlo Simulations:
- Electromagnetic Calorimeter
- Micro-Vertex Detector
- Muon Chambers
- Resistive Plate Chambers
- Ring Imaging Cherenkov Detector
- Silicon Tracking Detector
- Spectator Detector
- Transition Radiation Detector

Physics:
- Equation of State
- Phase Transitions
- Critical Point

Front-End Electronics

Data Aquisition, Fast Online Event Selection

Online and Offline Software, Computing Model



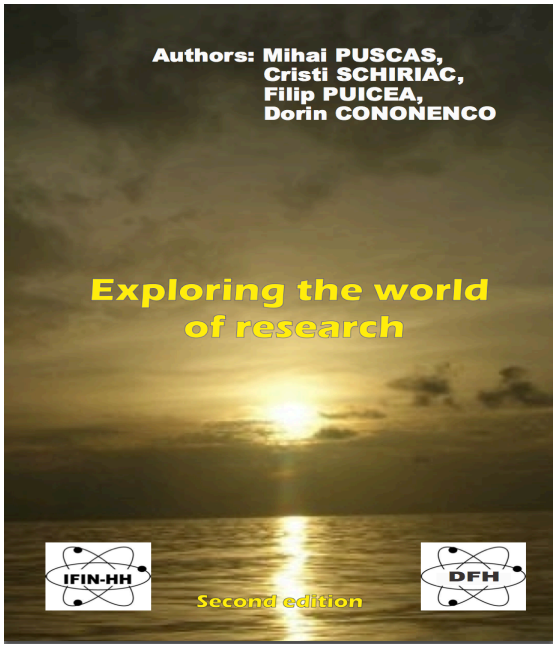
Organizing Committee:

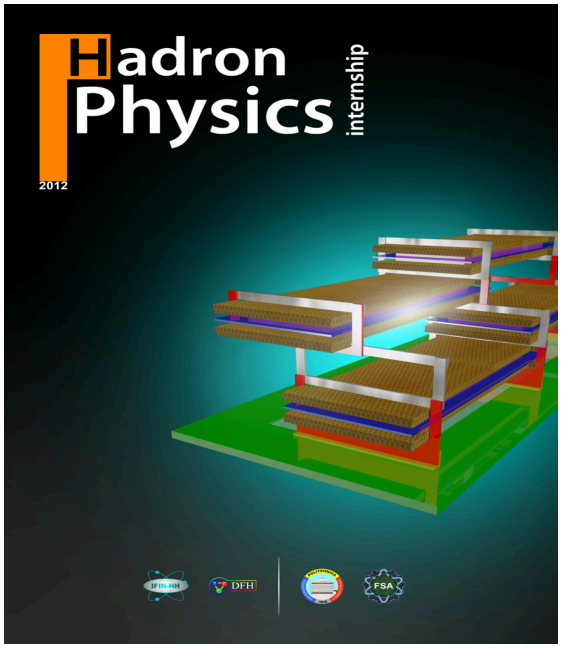
Dan Cozma
Jürgen Eschke
Volker Friese
Walter F.J. Müller
Mihai Petrovici
Peter Senger

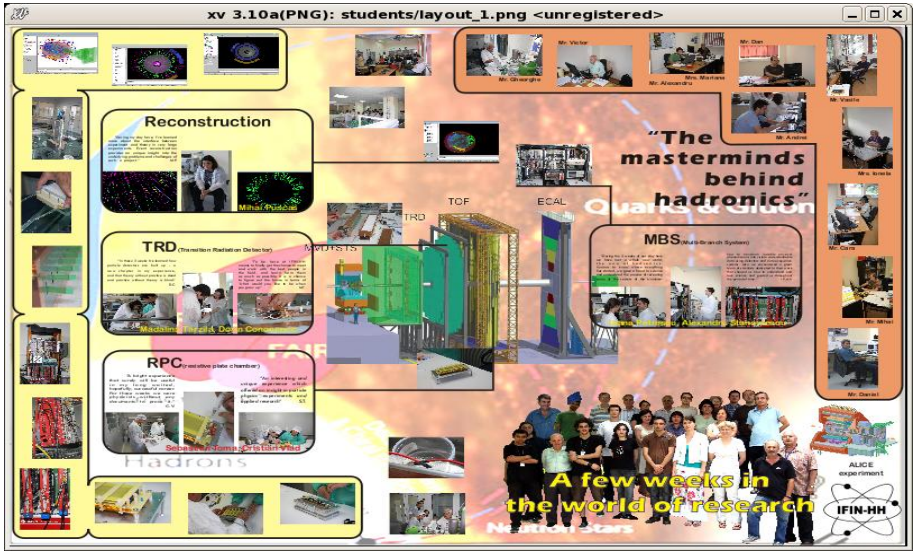
Sponsors:

http://niham.nipne.ro/cbm2010

Training & teaching







They are the main actors !

"Leadership and management must go hand in hand.
They are not the same thing.
But they are necessarily linked, and complementary.
Any effort to separate the two is likely to cause more problems than it solves."

"The manager's job is to plan, organize and coordinate.
The leader's job is to inspire and motivate."

"The Wall Street Journal Guide to Management" by Alan Murray

Thank you !

https://niham.nipne.ro
https://www.youtube.com/watch?v=OJd4fA0xUh0
https://www.facebook.com/Hadron-Physics-Department-211078852968333/
https://www.youtube.com/watch?v=ZHBgGKamUc8&feature=youtu.be
https://niham.nipne.ro/Booklet_14.html
https://niham.nipne.ro/ALICE_c.html
https://niham.nipne.ro/CBM_c.html
https://niham.nipne.ro/DFH_c.html