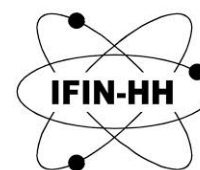




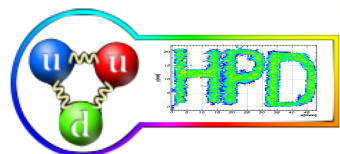
MINISTERUL EDUCAȚIEI ȘI CERCETĂRII



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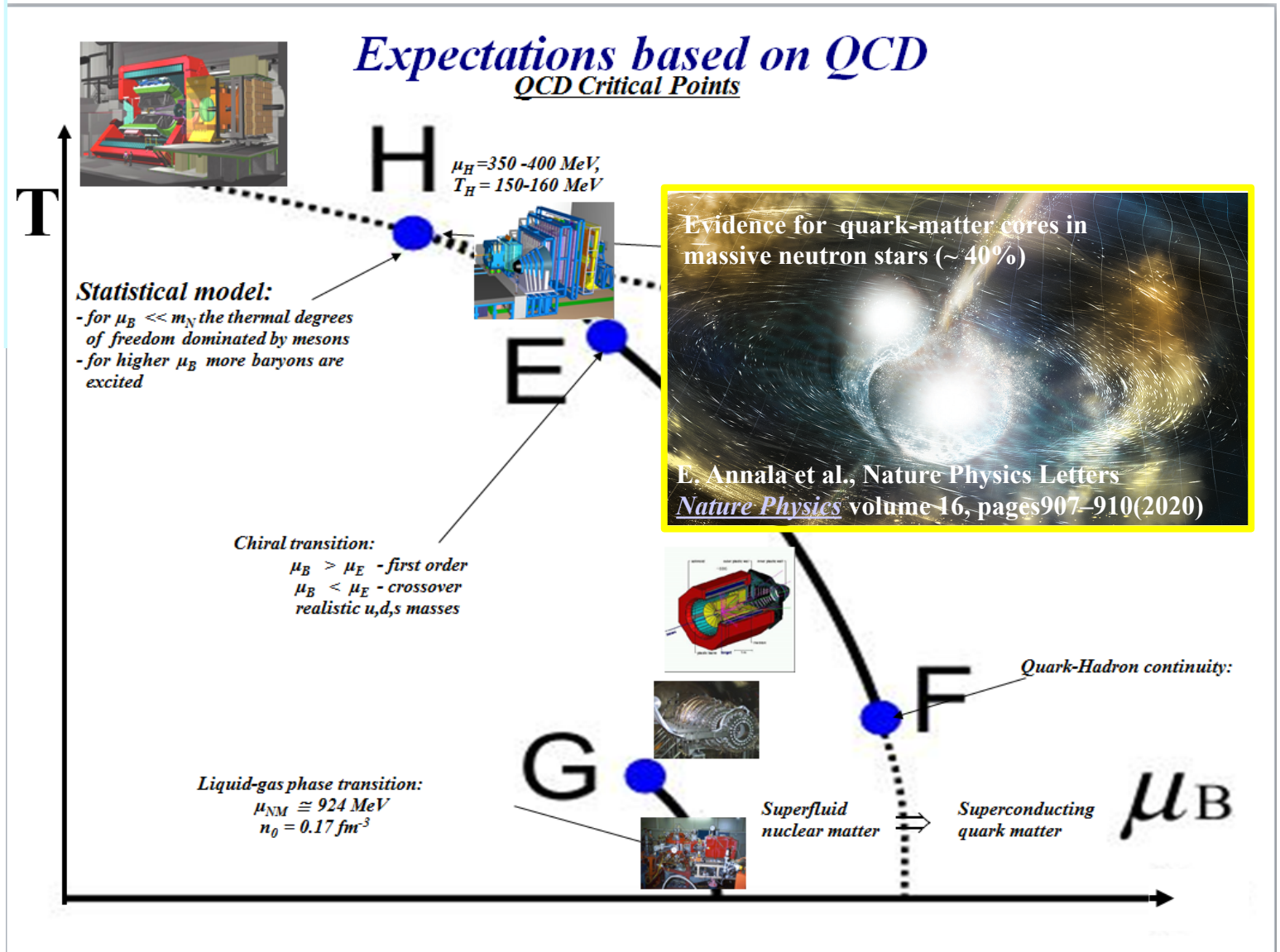
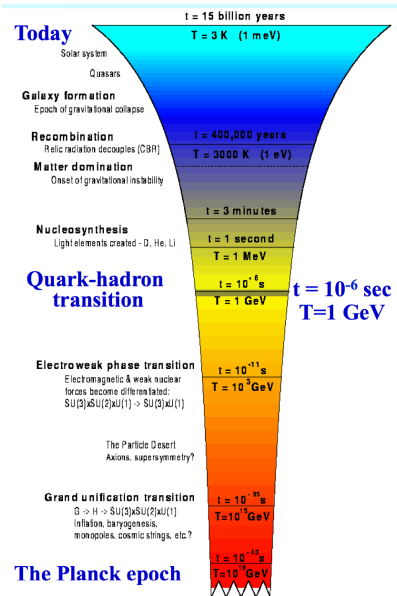
- *Objectives and Results 2016-2019*
- *Publications, Presentations, Contributions to CBM - Progress Reports*
- *Summer Student Program and Outreach*
- *Financial aspects*



HADRON PHYSICS DEPARTMENT

National Institute for Physics and Nuclear Engineering - IFIN-HH

Motivation

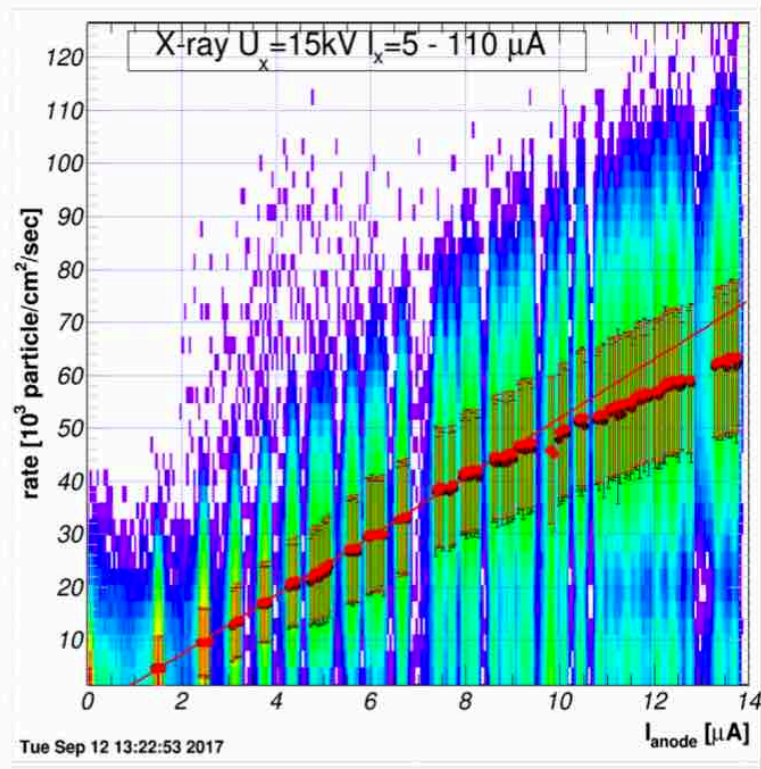
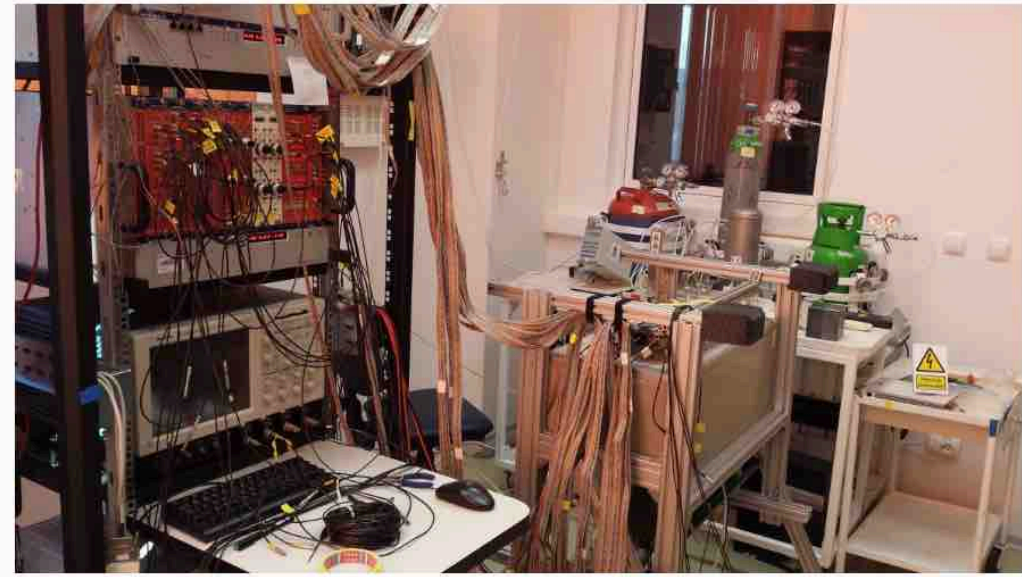


TRD



In-house tests

RPC

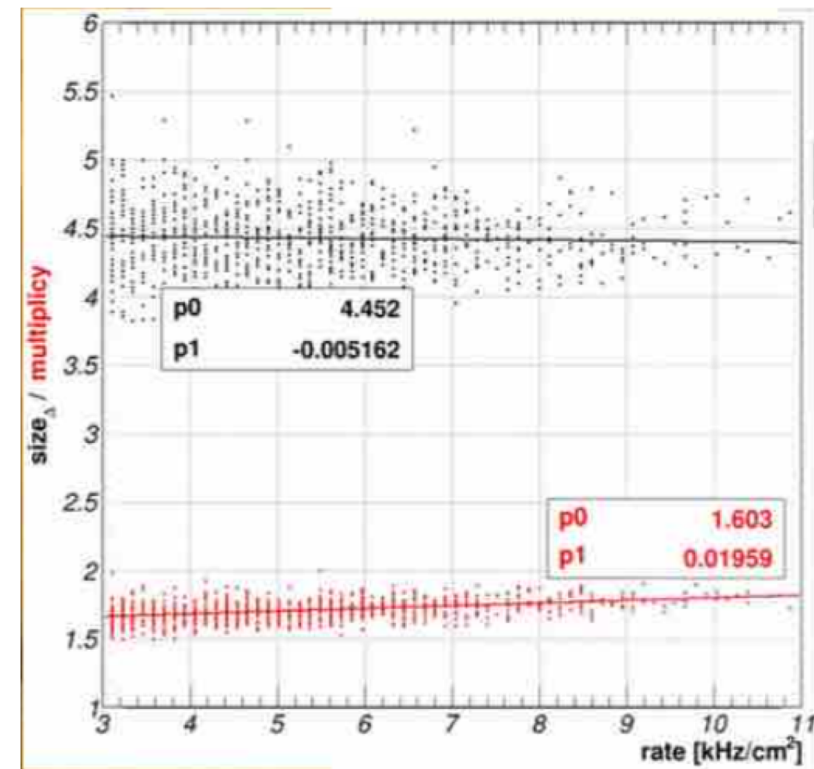
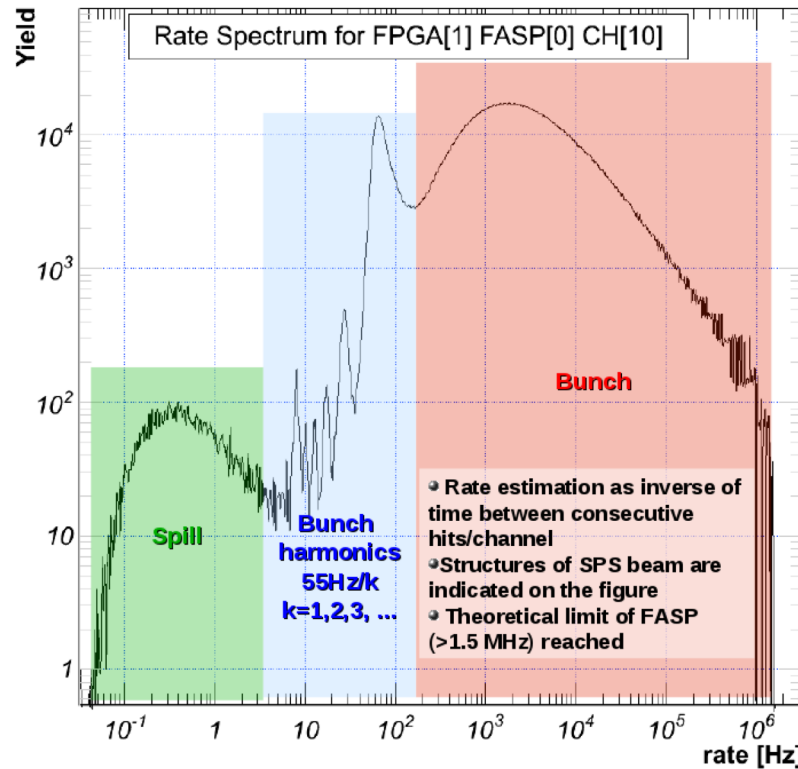


$$eff = \frac{RPC \& PMT(1\&2) \& PMT(3\&4)}{PMT(1\&2) \& PMT(3\&4)}$$

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

TRD Prototype Performance : Signal - Particle Rates

*in-beam results measured
@ CERN-SPS for Pb-Pb
150 AGeV*



Feeding pulser signals to the DAQ through

- anode wires/FASP/ADC/GETS

- tested up to 1.3MHz/channel without data corruption

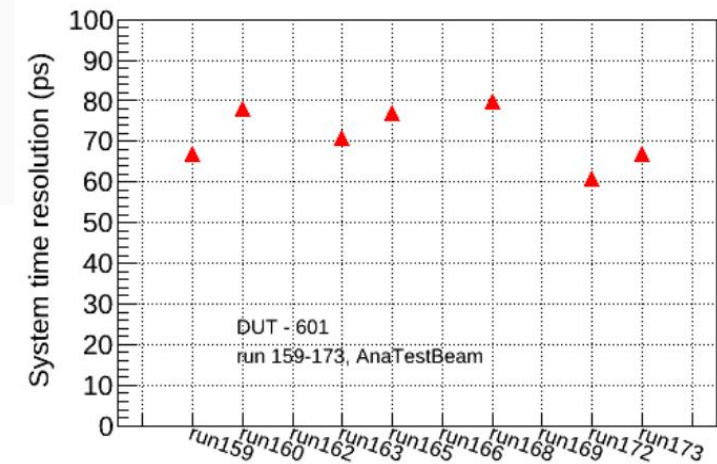
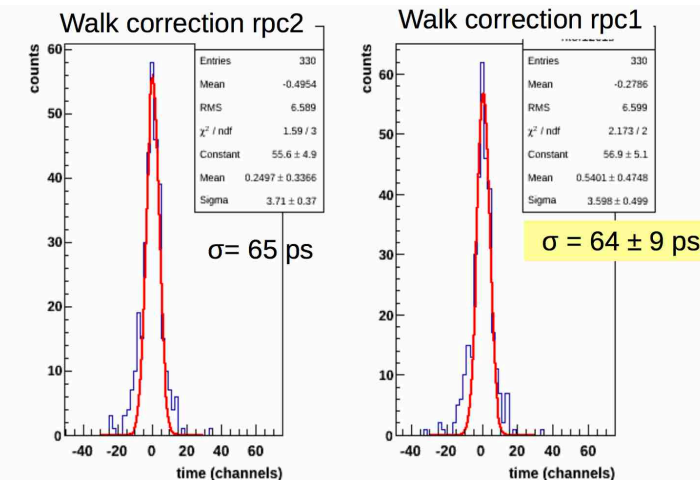
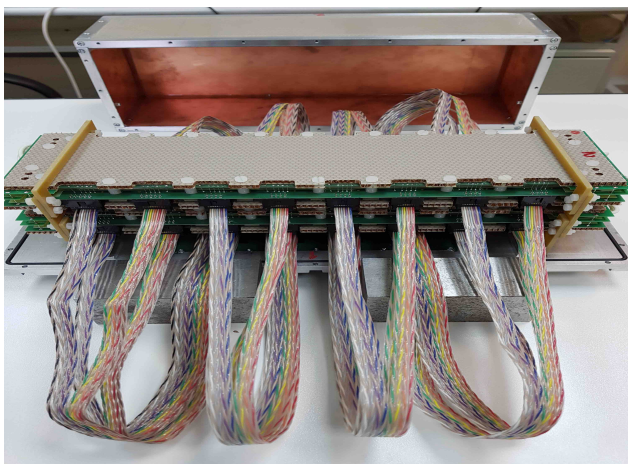
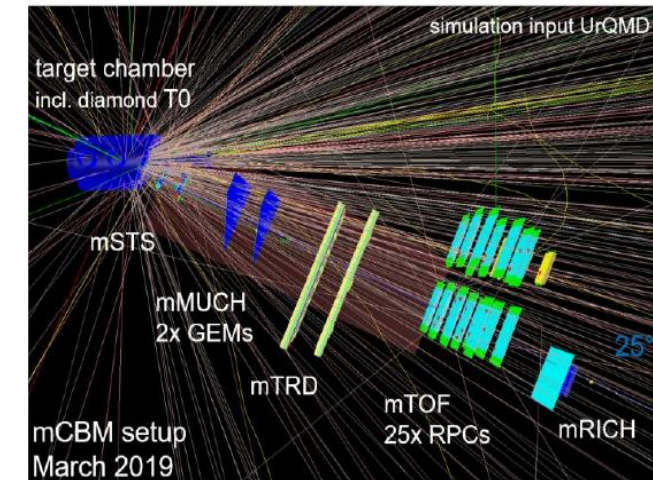
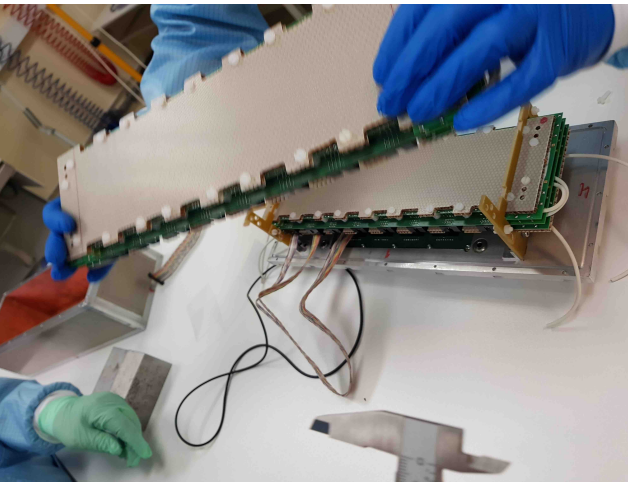
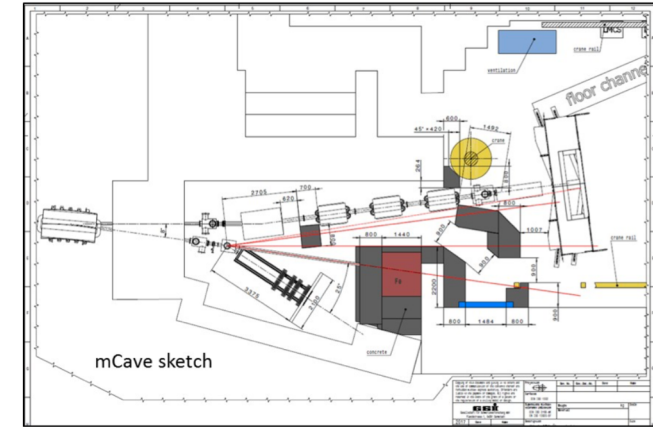
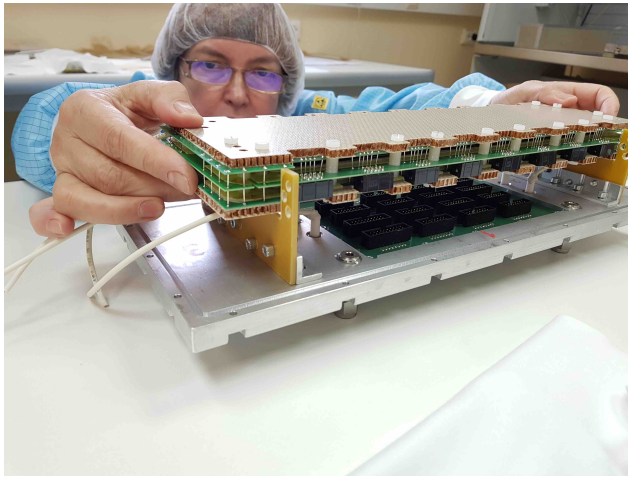
Assembling and tests of 2 new RPC prototypes



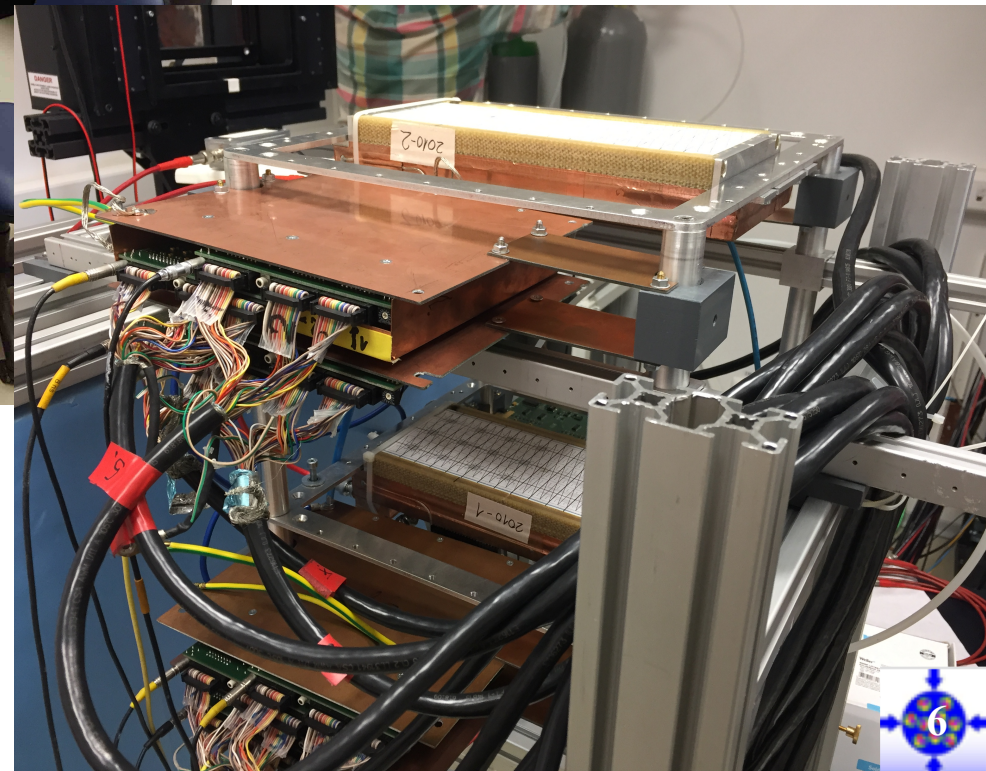
In mCBM

FAIR Phase0 @ SIS18

In house tests

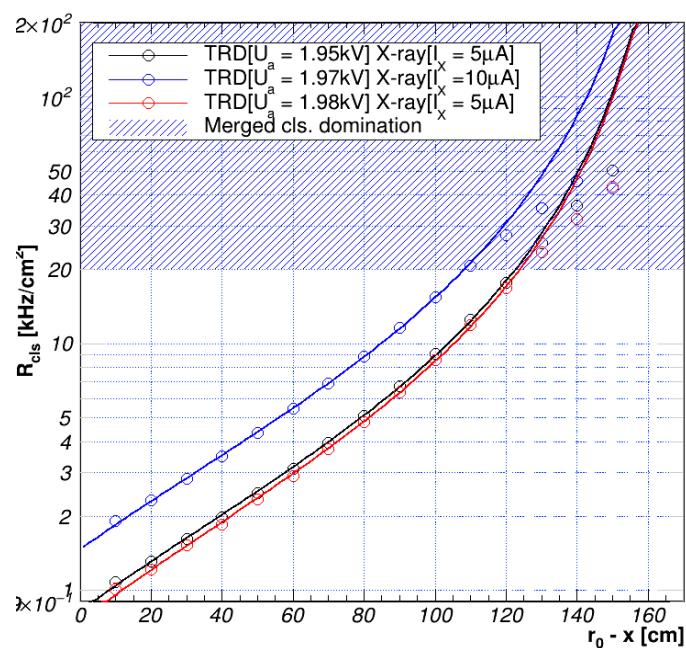


HCR-2D position sensitive TRD



Prototype Performance : Signal - Particle Rates

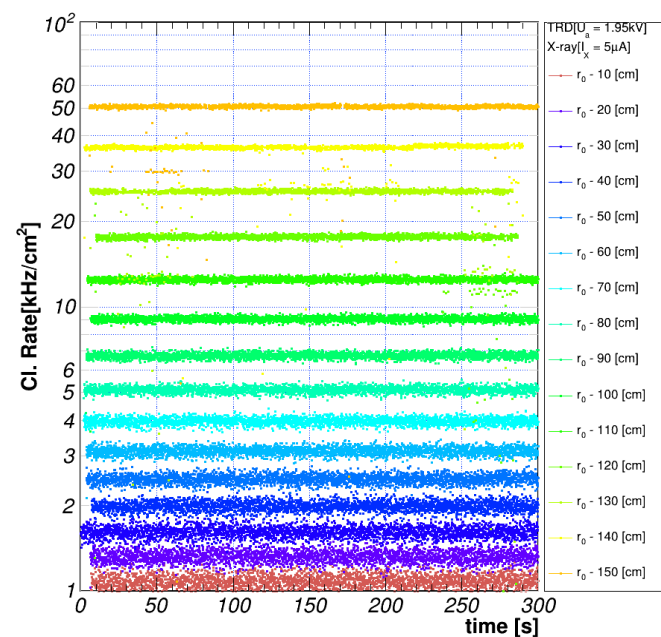
*laboratory results measured for X-rays
irradiation of constant intensity @
variable distance*



χ^2 / ndf	2.655 / 8
I_{off}	-0.8921 ± 0.0501
I_0	$4.861\text{e}+04 \pm 726$
r_0	172 ± 0

χ^2 / ndf	2.017 / 8
I_{off}	-1.491 ± 0.07298
I_0	$8.762\text{e}+04 \pm 1004$
r_0	172 ± 0

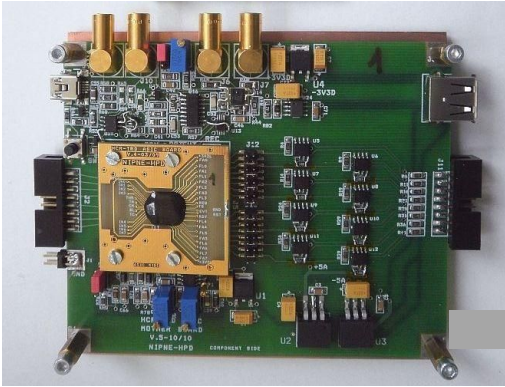
χ^2 / ndf	2.554 / 8
I_{off}	-0.9002 ± 0.04813
I_0	$5.108\text{e}+04 \pm 724.4$
r_0	172 ± 0



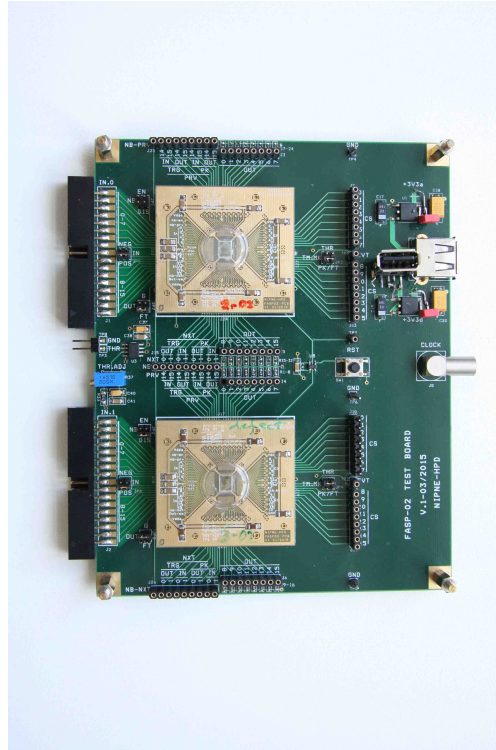
FASP-FEE & free running mode DAQ

CADENCE design

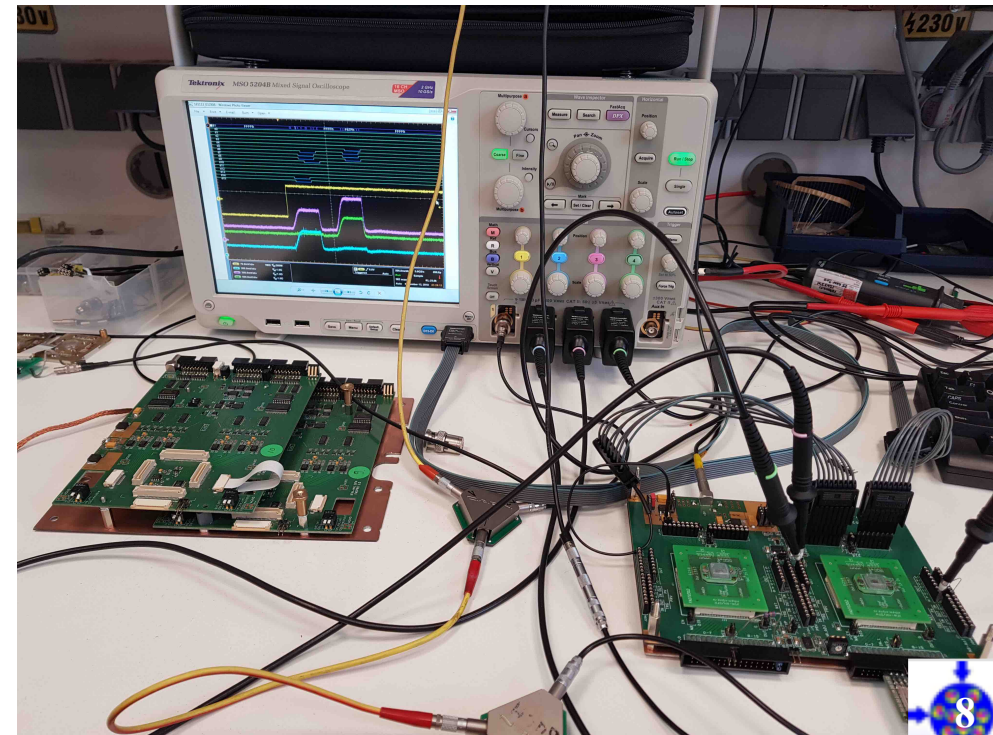
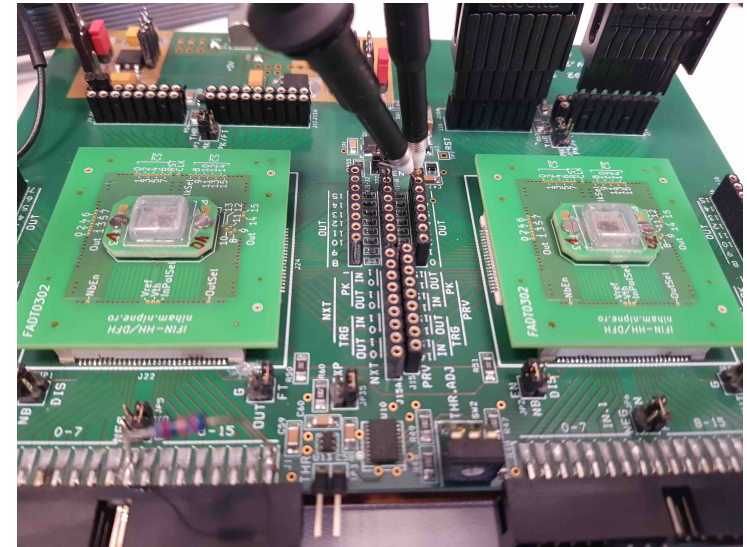
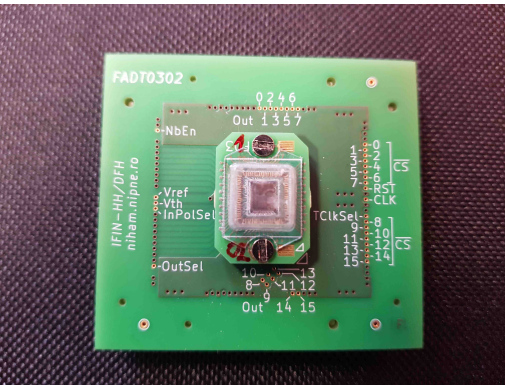
FASP_01



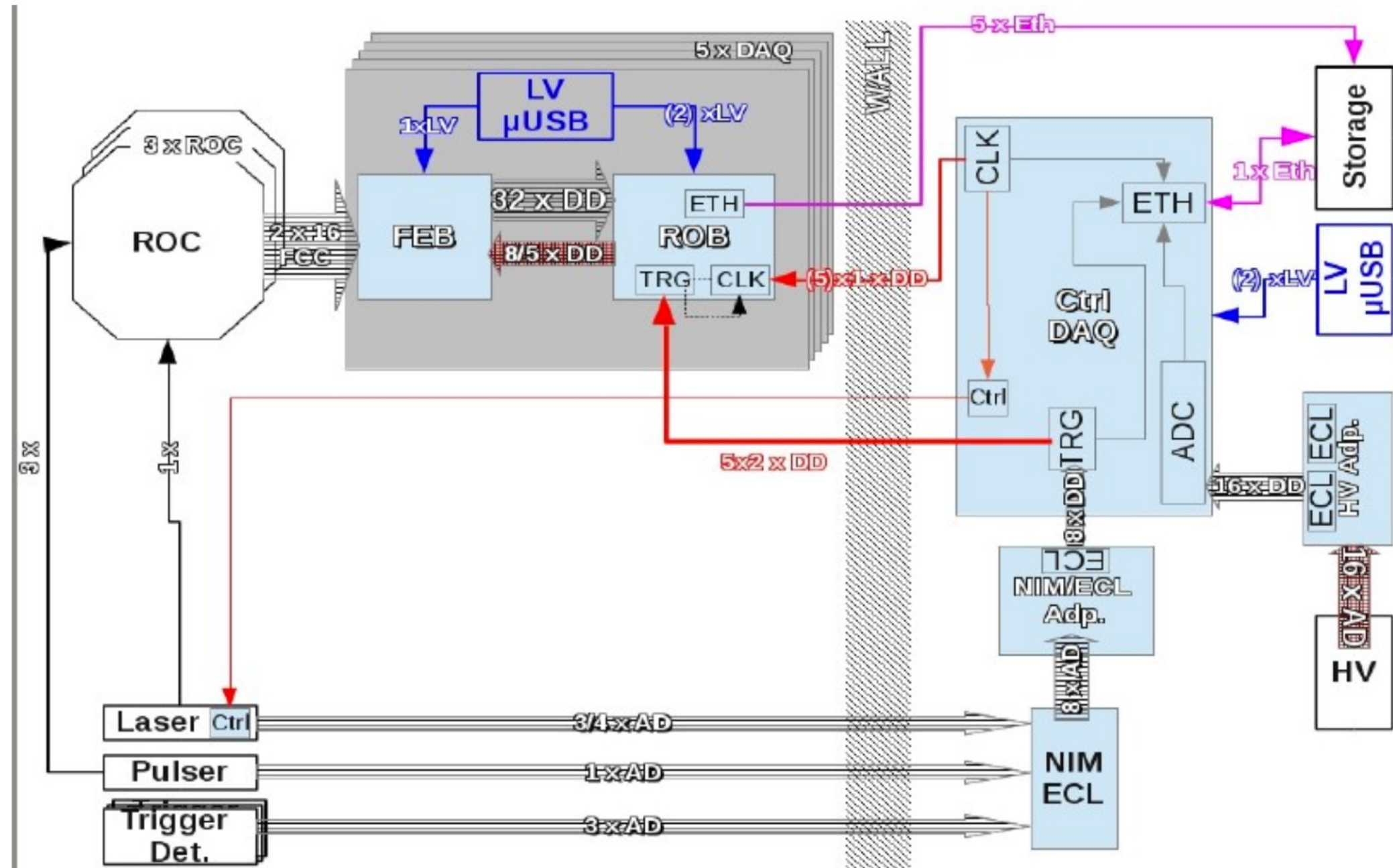
FASP_02



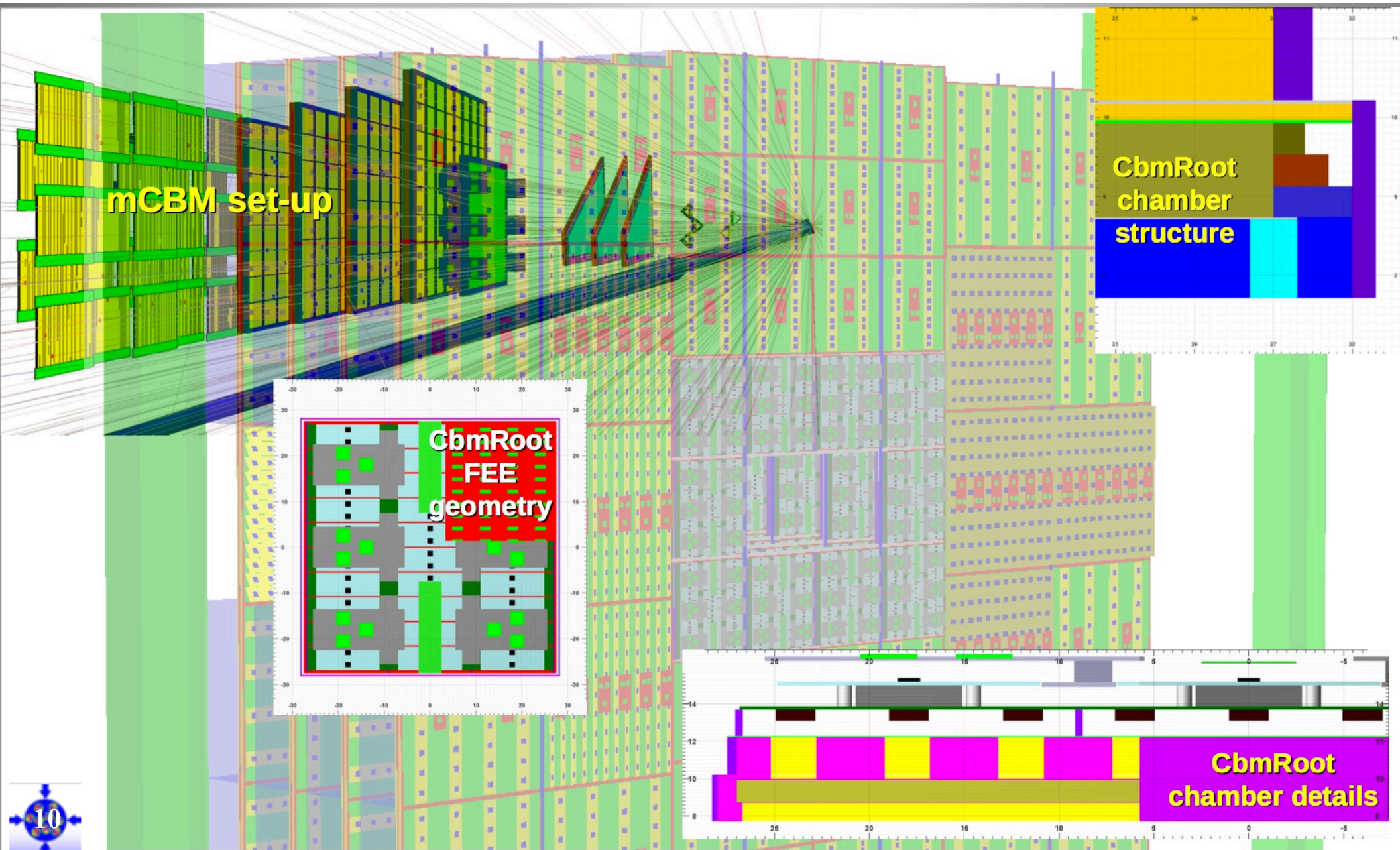
FASP_03



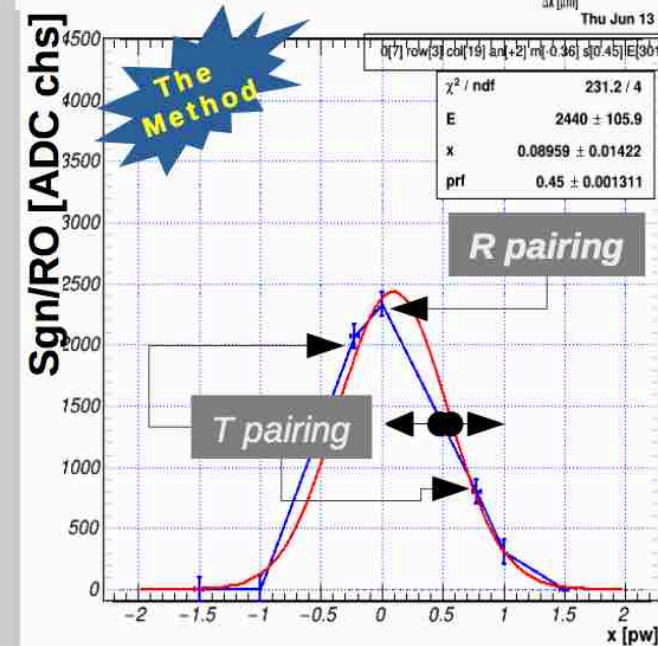
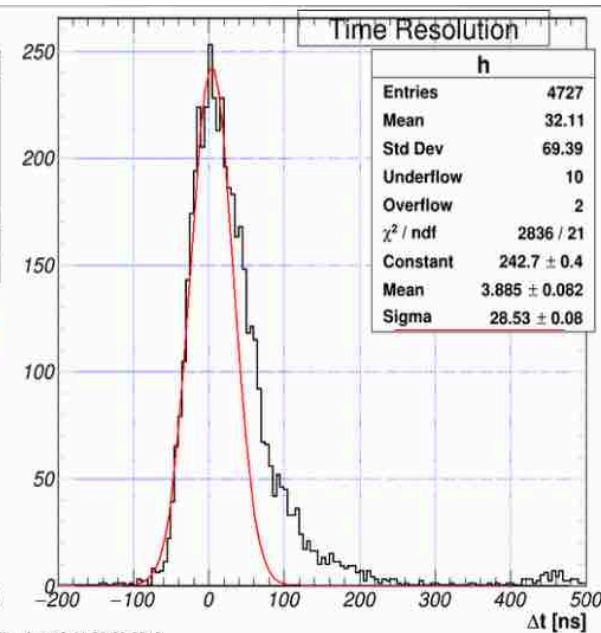
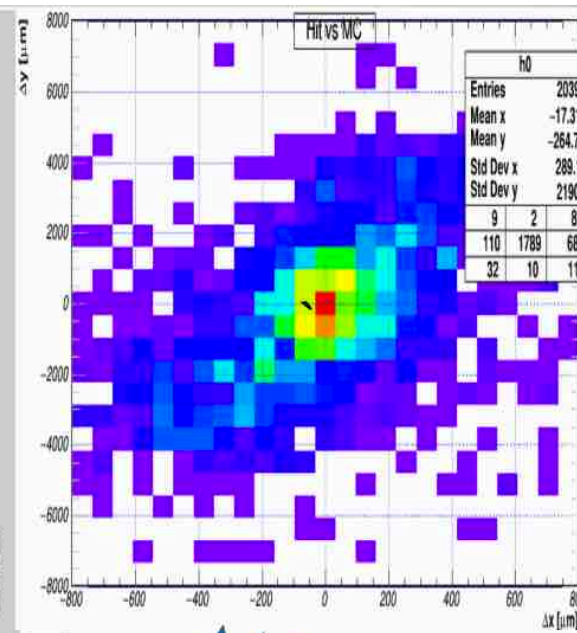
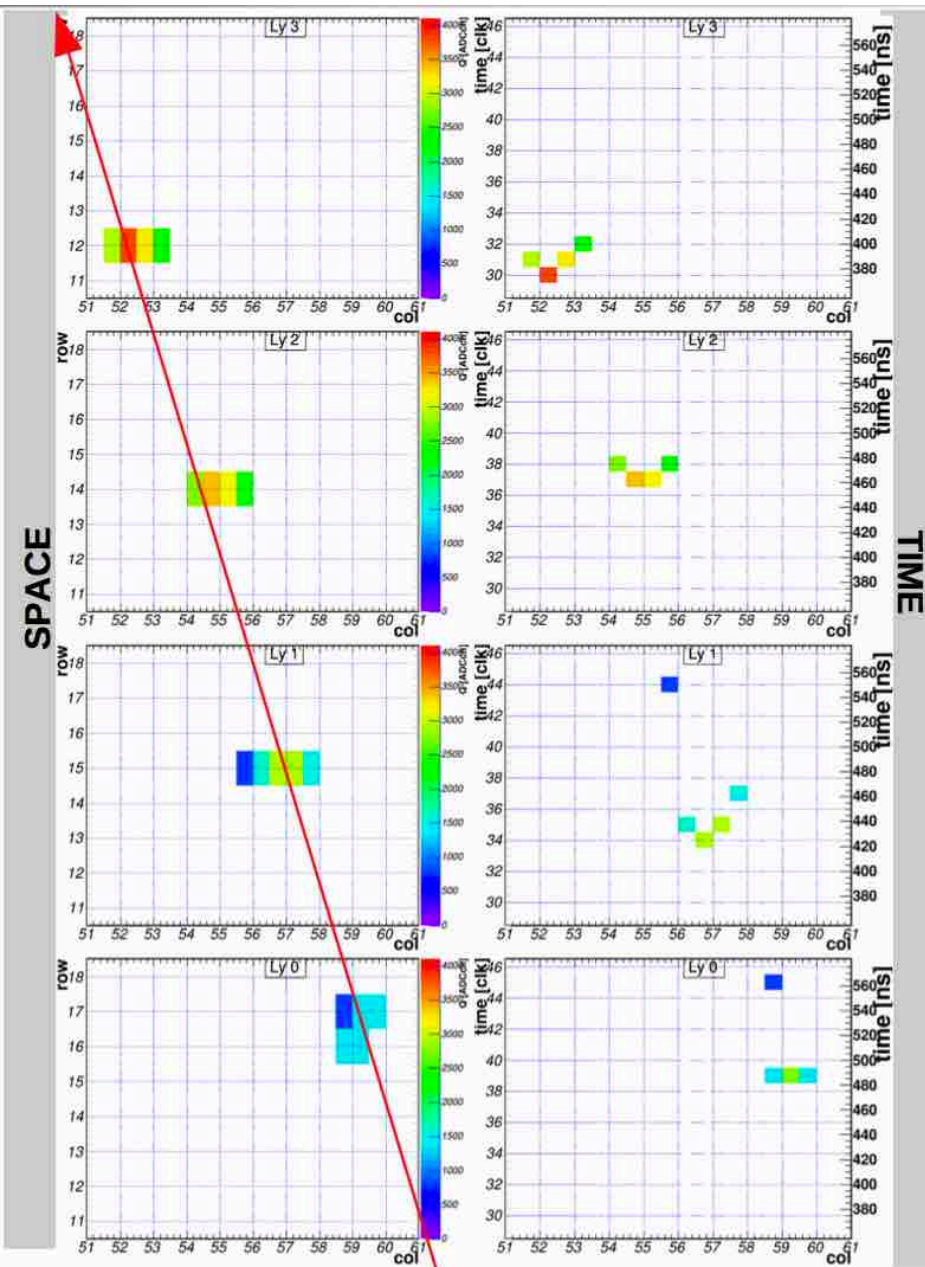
Free running mode DAQ



Buch-TRD geometry and chamber + FEE signal characteristics integration in CbmRoot

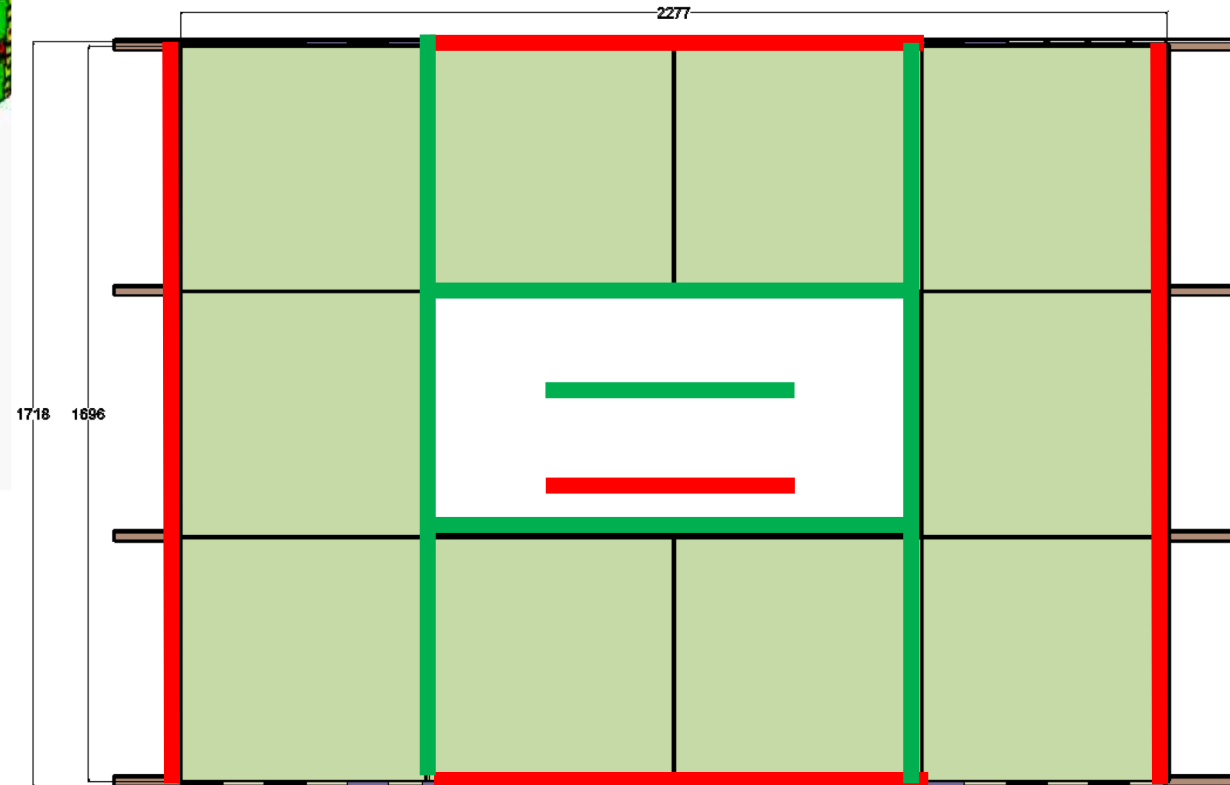
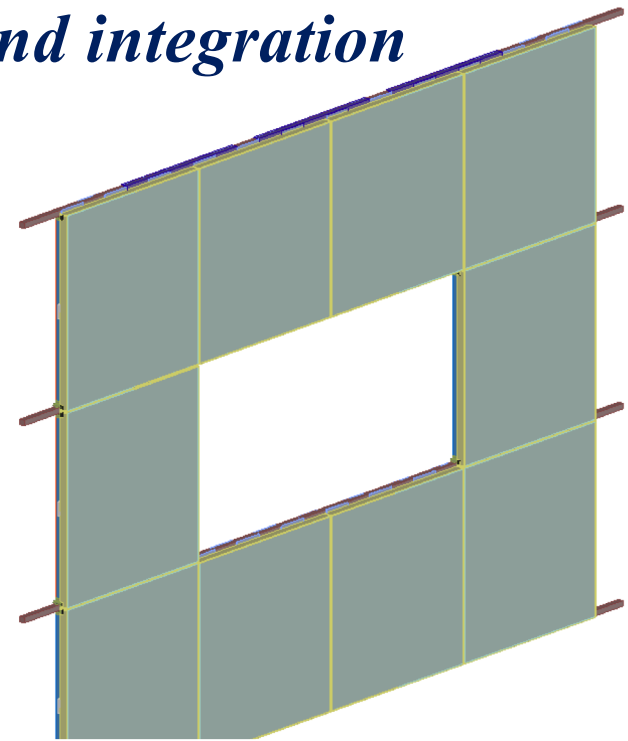
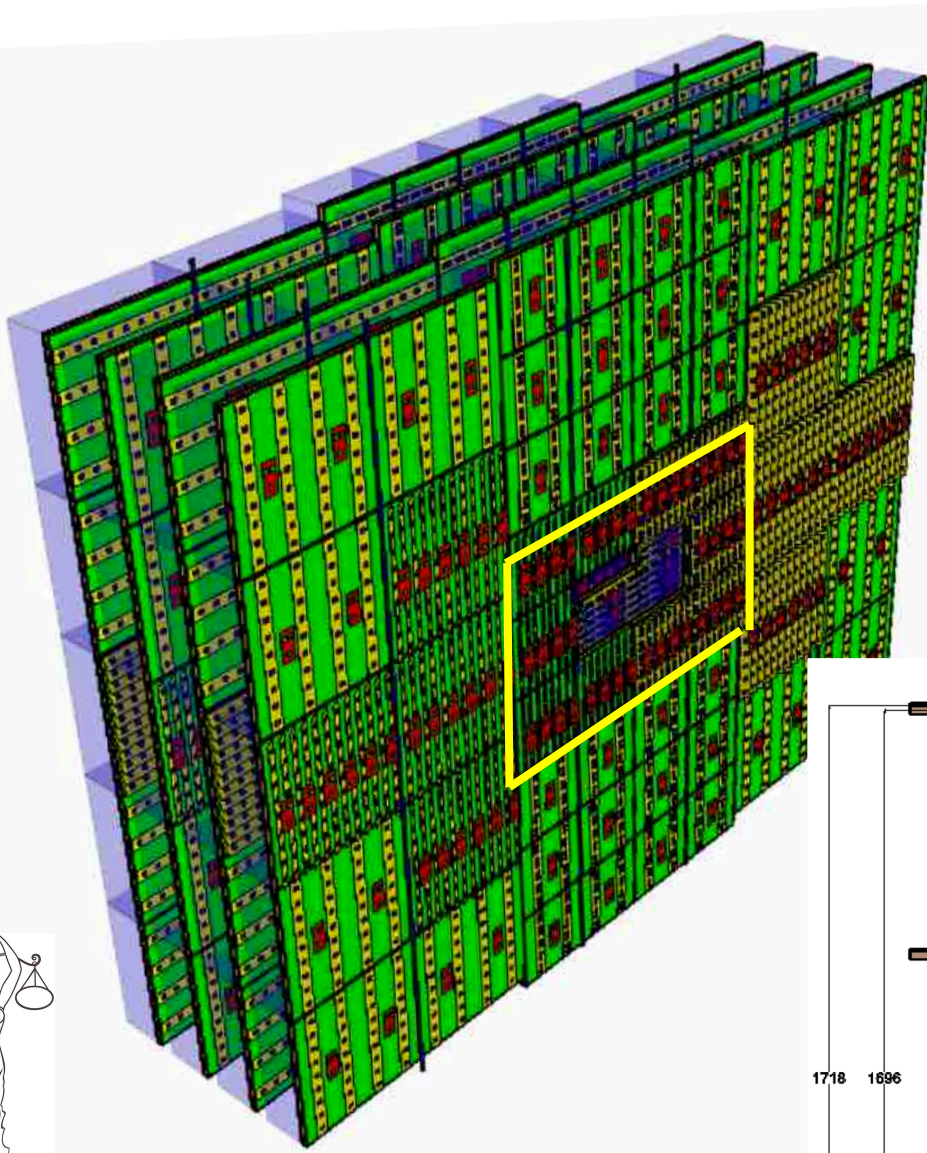


Hit reconstruction performance



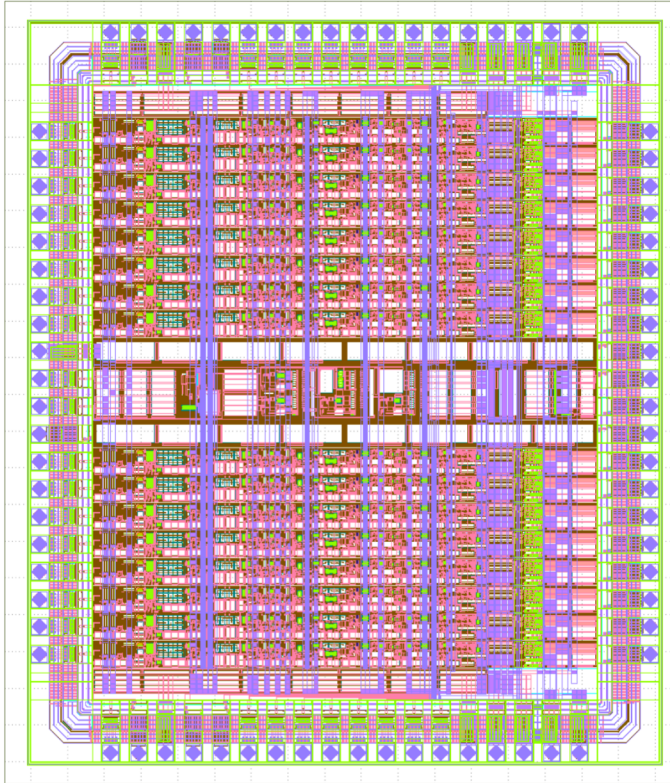
- ✓ $\sigma_x = 114 \mu\text{m}$ single-row
 - ✓ $\sigma_y = 1.6 \text{ mm}$ single row
 - ✓ $\sigma_y = 0.9 \text{ mm}$ row cross
 - ✓ $\sigma_t = 30 \text{ ns}$
- wrt MC info !

CBM-TRD inner zone design and integration

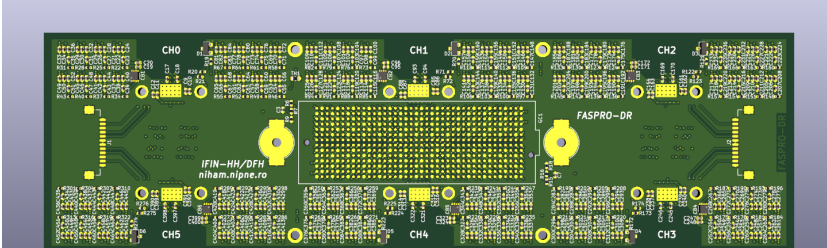
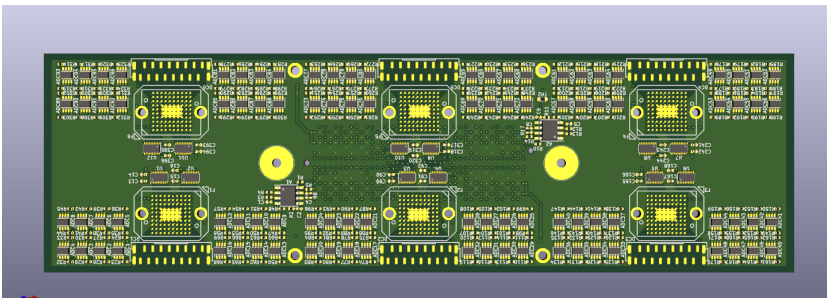


HCR-2D position sensitive TRD – FEE & DAQ

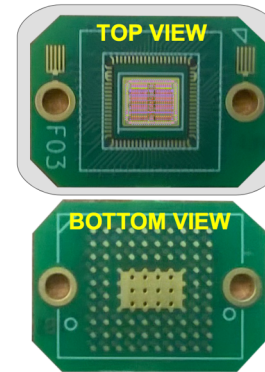
FASP_03



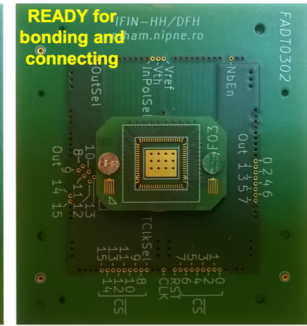
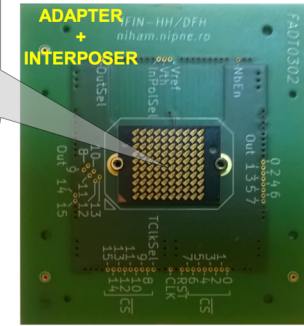
FASPRO - FASP Read Out



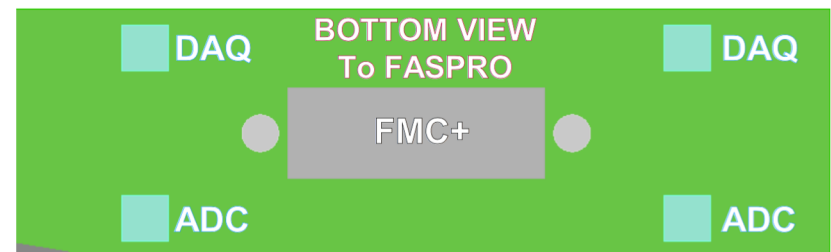
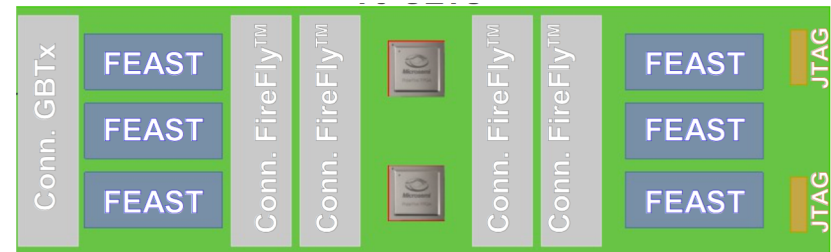
FASP board



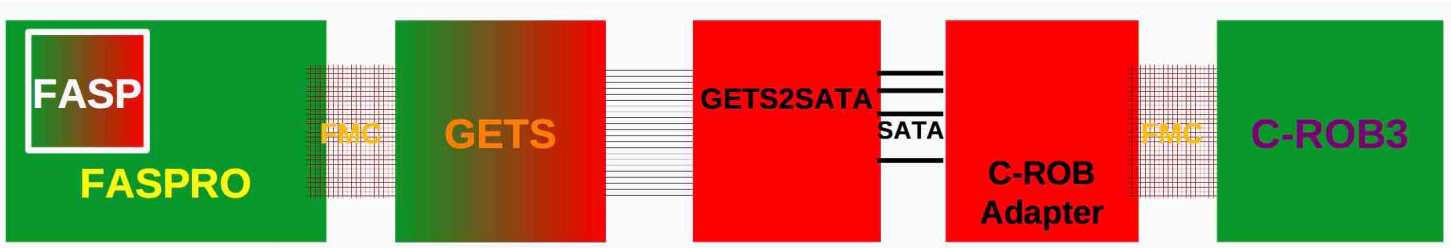
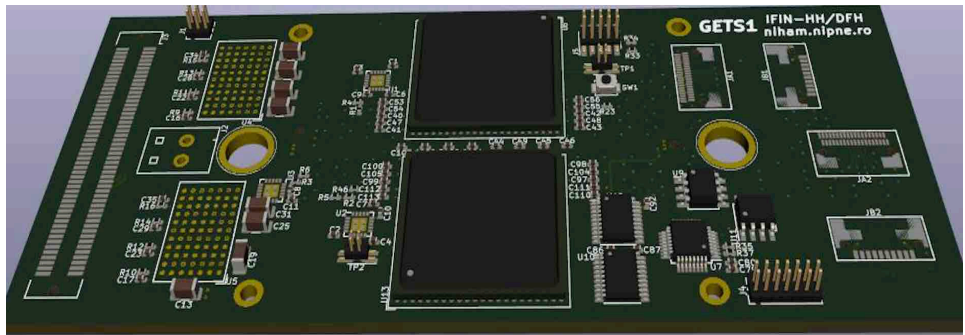
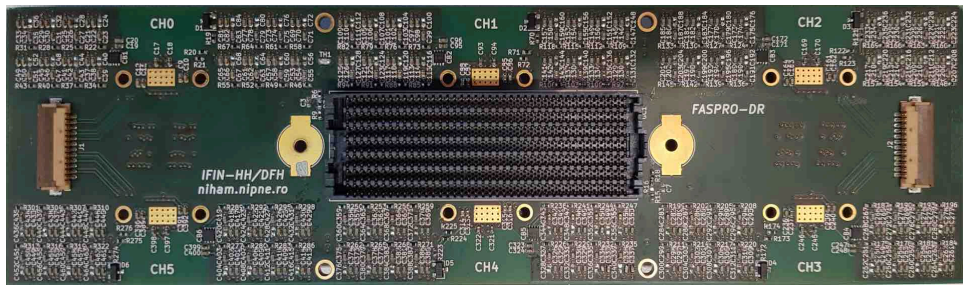
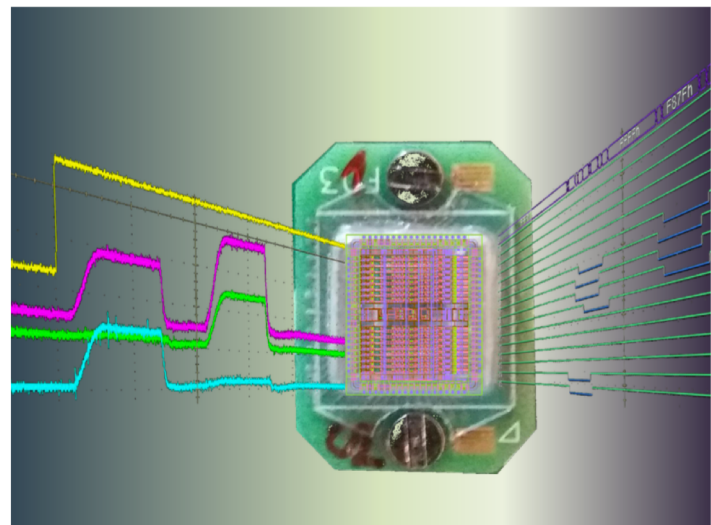
FASP adaptor



GETS - General Event Time Serializer

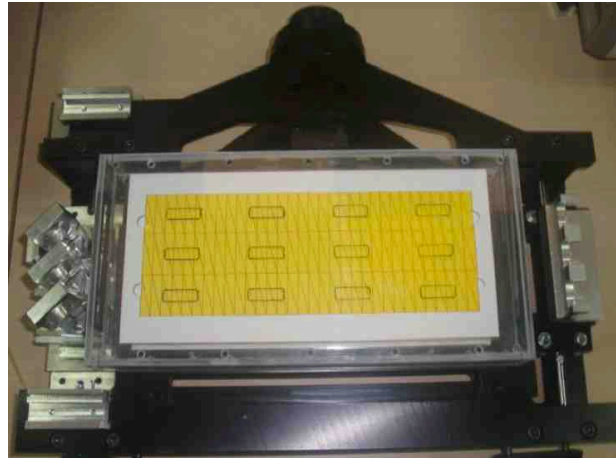
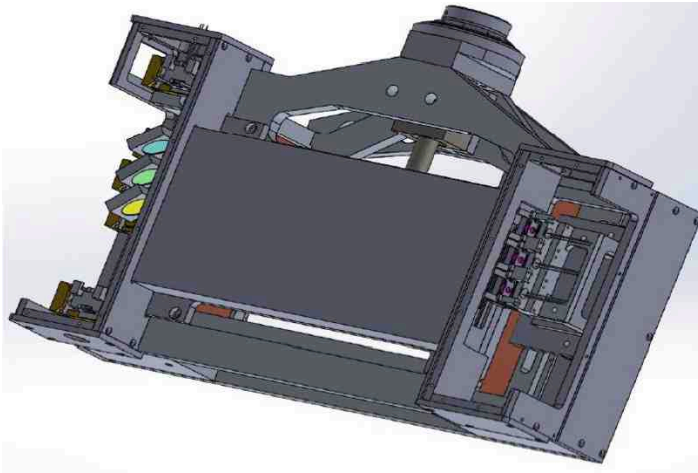
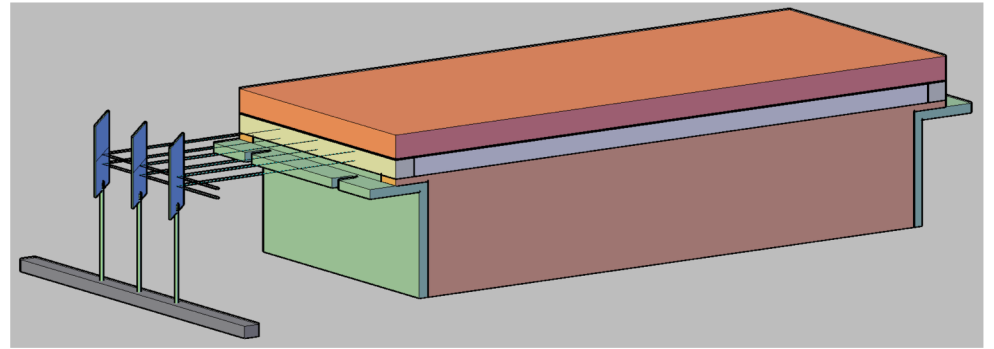
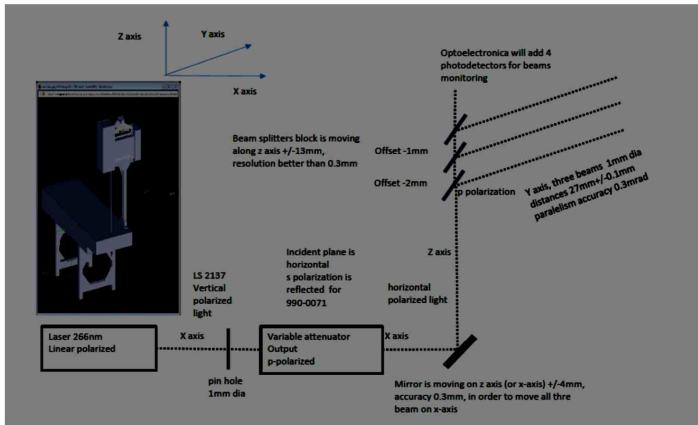


Hdw chain (PCBs) to connect FASP FEE to the C-ROB3 and their realization status



ready	FASP : Production ready for up to 80 pcs (45 % of 1 module) Bonding in progress
in progress	FASPRO : tested, fixed, 9 pcs available.
missing	GETS : Design ready; components available (PolarFire) Production ready (details solved)
	GETS2SATA : Connector board Convert I/O to 4 SATA cables Design not started (1 month)
	C-ROB Adapter : Maps 5x4 SATA input cables to FMC connector on C-ROB Design not started (1 month)
	C-ROB3 : 1 pcs available in Bucharest We might need another one

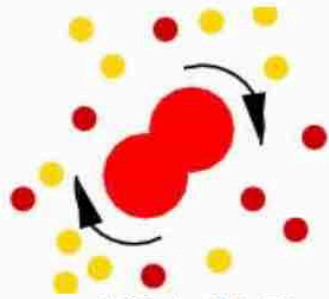
Laser system



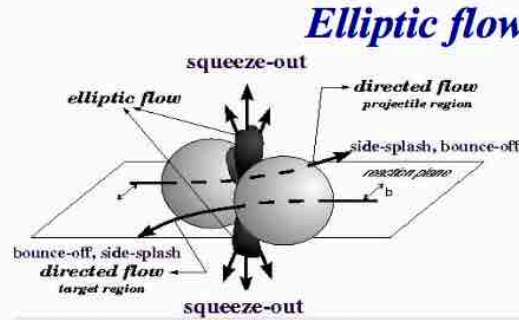
HPD Physics within CBM

SIS-100 accelerator will deliver:

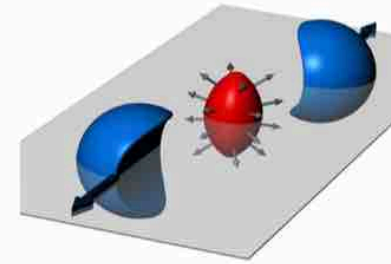
- heavy ions (Au) up to 11A GeV
 $\sqrt{s_{NN}} = 4.7$ GeV
- light ions (e.g. Ca) up to 14A GeV
 $\sqrt{s_{NN}} = 5.3$ GeV
- protons up to 29 GeV
 $\sqrt{s_{NN}} = 7.5$ GeV



< 100 A·MeV

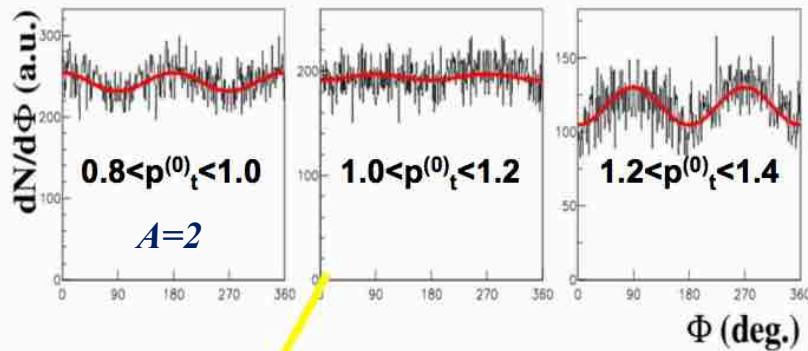


100 A·MeV - ~600
A·MeV

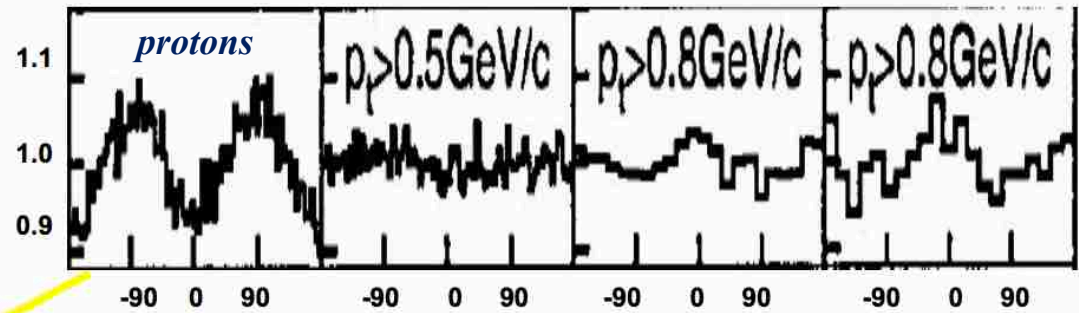


~4 A·GeV

Au+Au 120 MeV/u, CM3



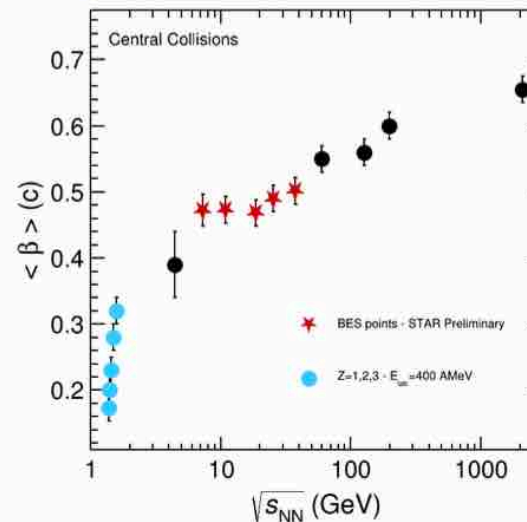
A.Andronic, G.Stoicer, M.Petrovici & FOPI Coll. NPA679(2001)765



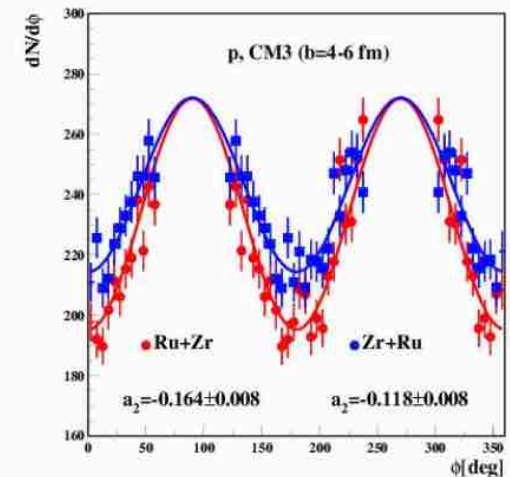
C.Pinkenburt & EOS Coll. Phys.Rev.Lett. 83(1999)1295

"Radial flow"

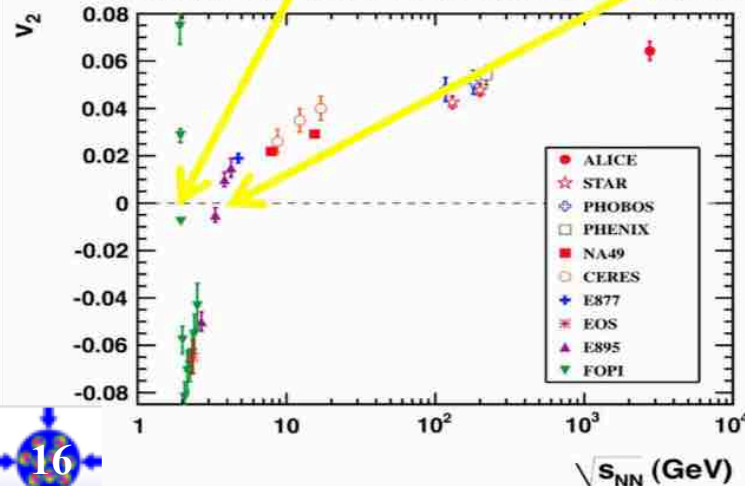
M. Petrovici Carpathian Summer School 2007



Isospin effects

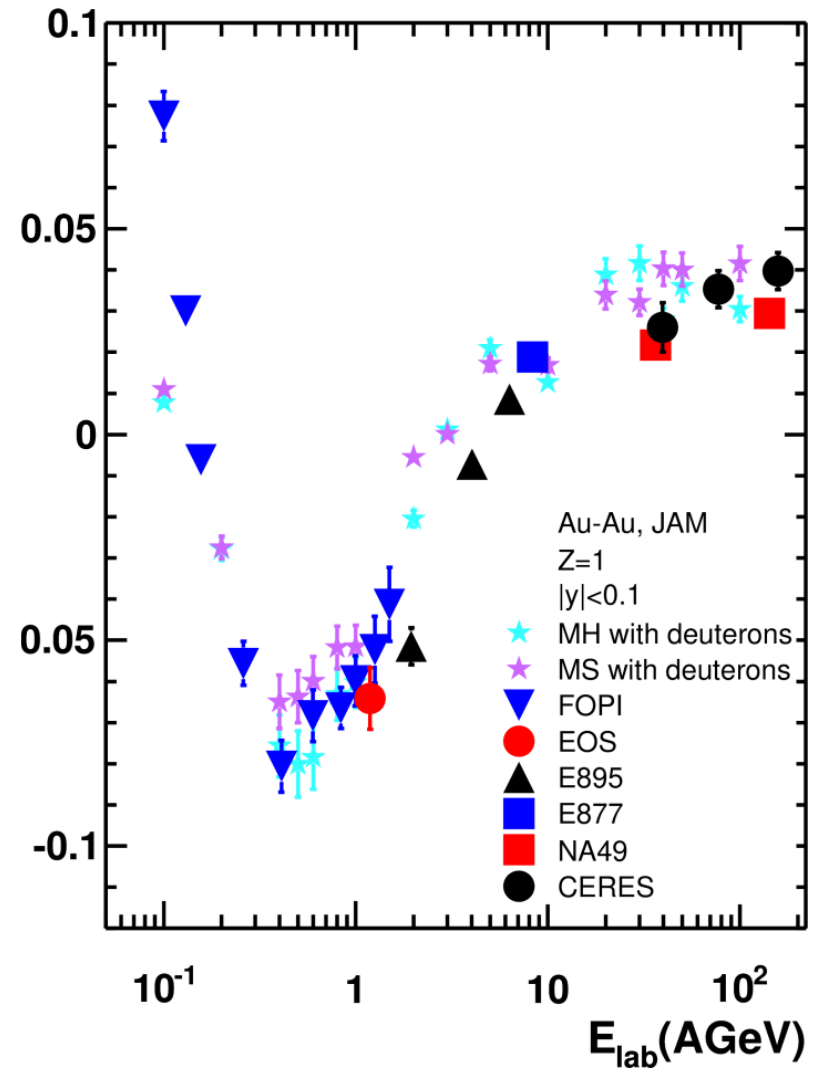
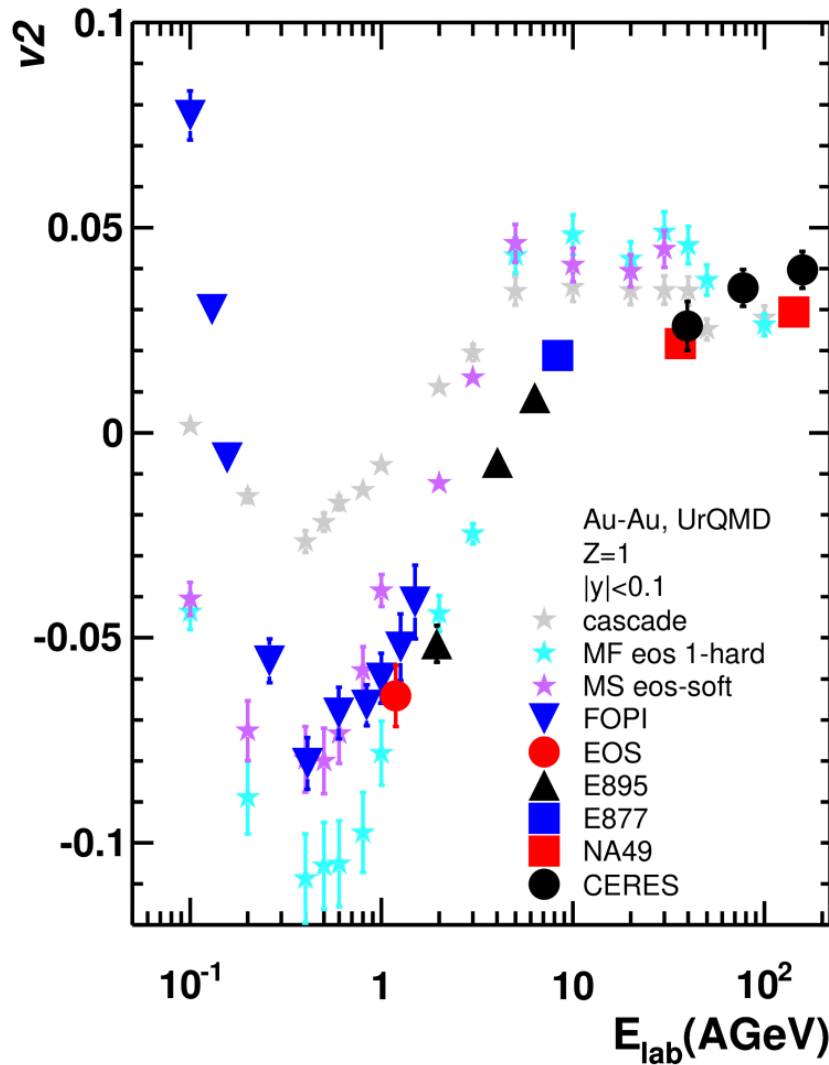


K. Aamodt et al, ALICE Collaboration PRL105(2010)252302



Physics topics prepared for data analysis @ CBM

Au-Au



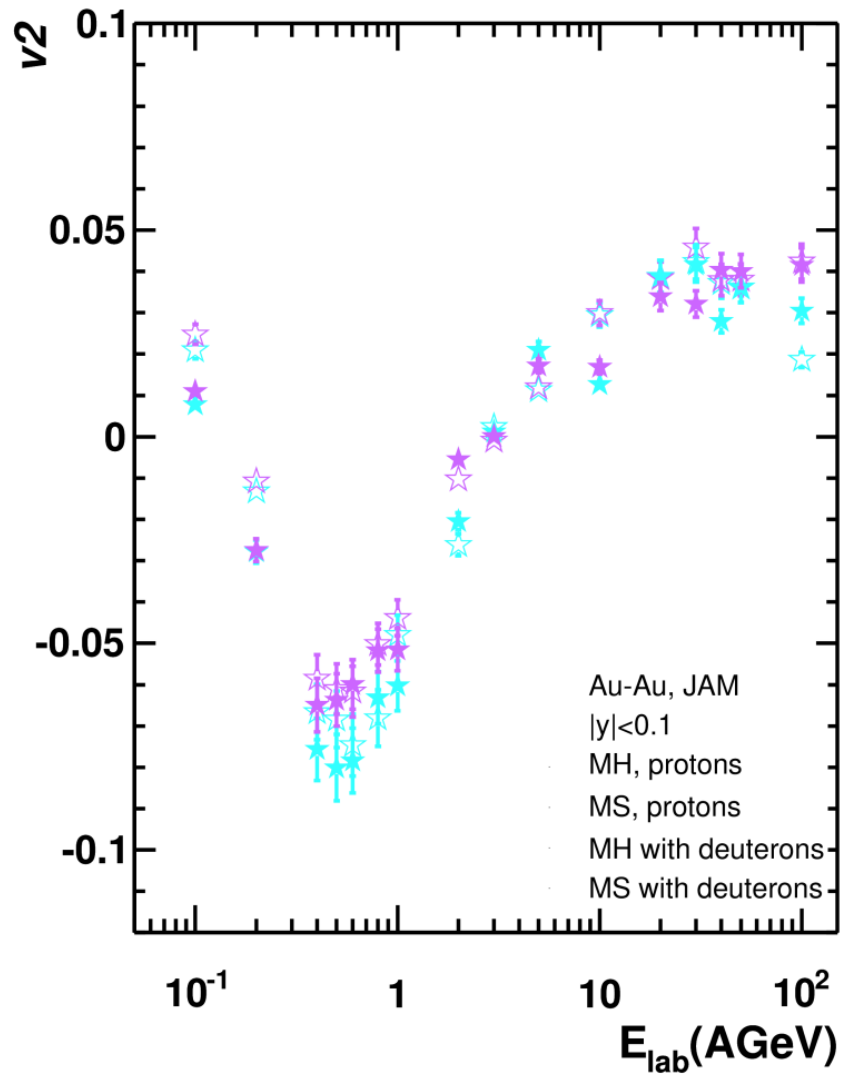
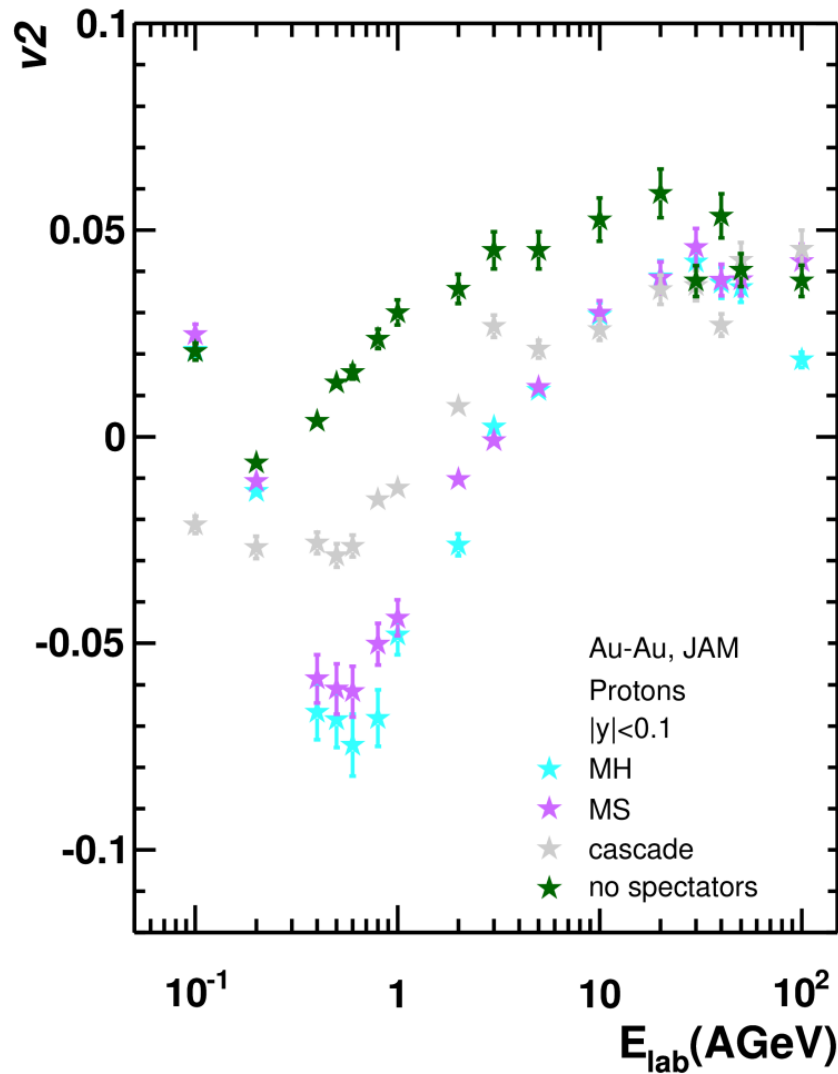
UrQMD

- M. Bleicher et al., *J. Phys. G* 25(199)1859

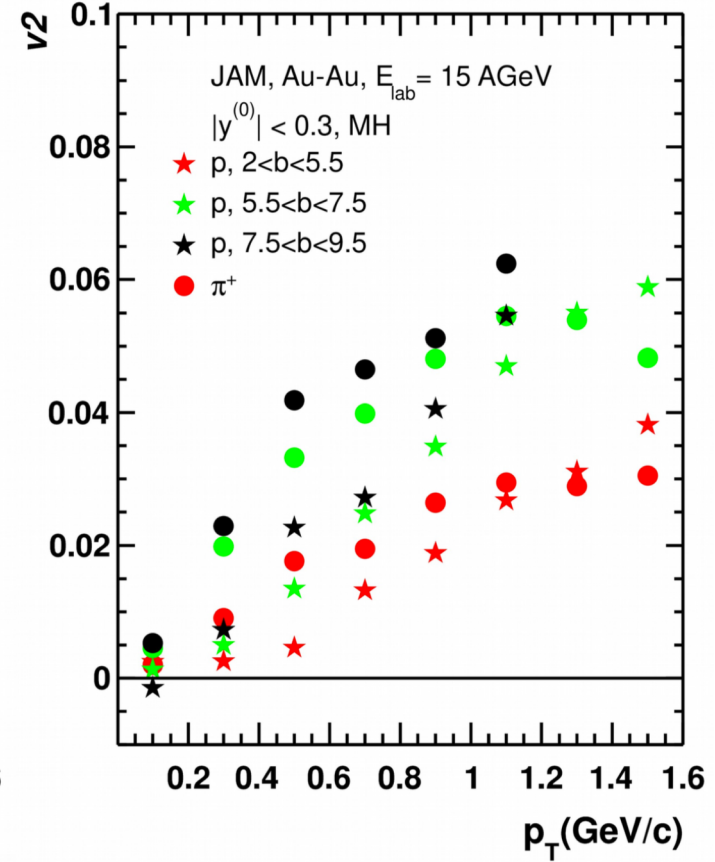
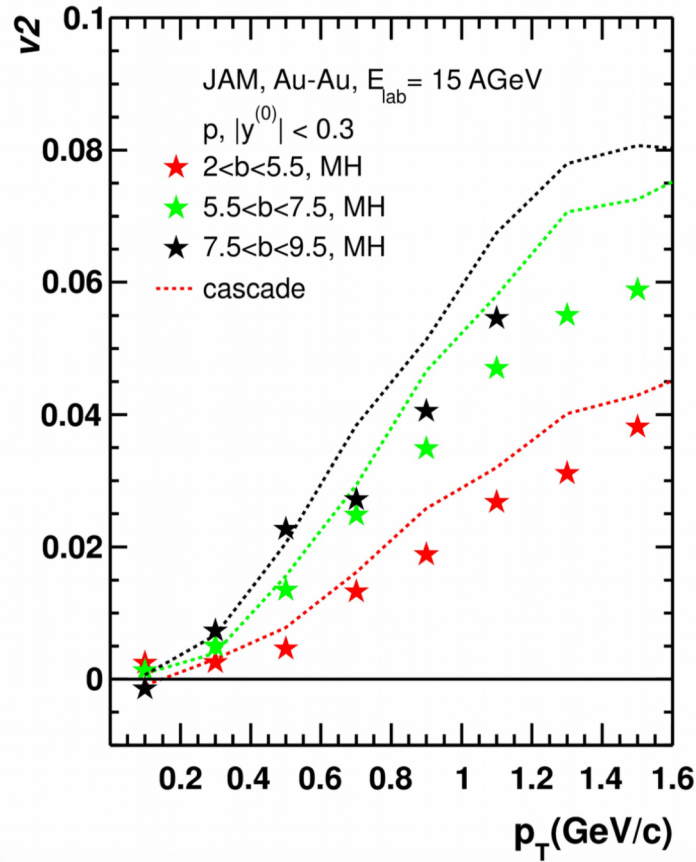
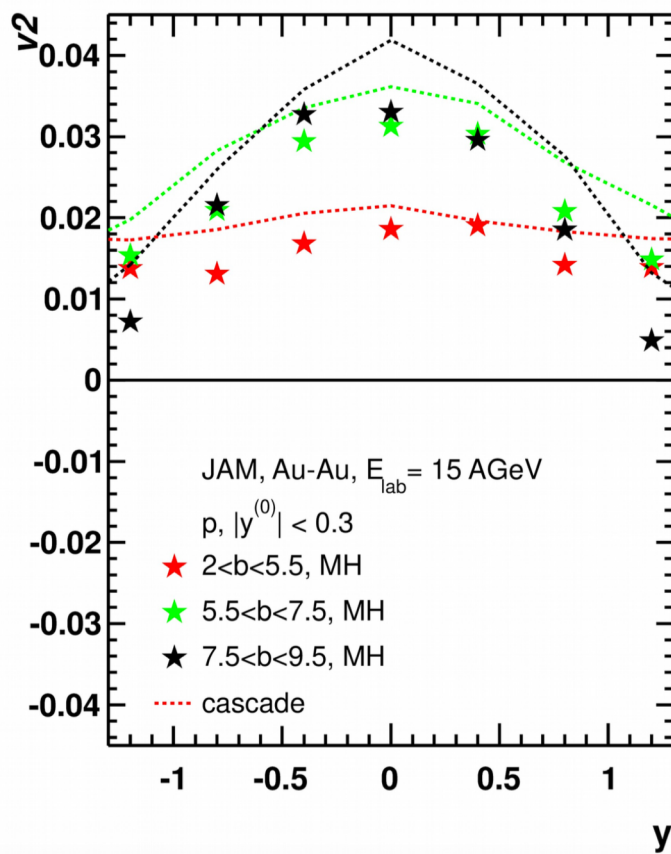
JAM

- Y. Nara, *EPJ Web of Conf.* 208(2019)11004
- M. Isse et al., *Phys. Rev. C* 72(2005)064908
- C. Zang et al., *Eur. Phys. J. Phys. Rev. C* 97(2018)064913
- Y. Nara et al., *Eu. Phys. J. A* 54(2018)1

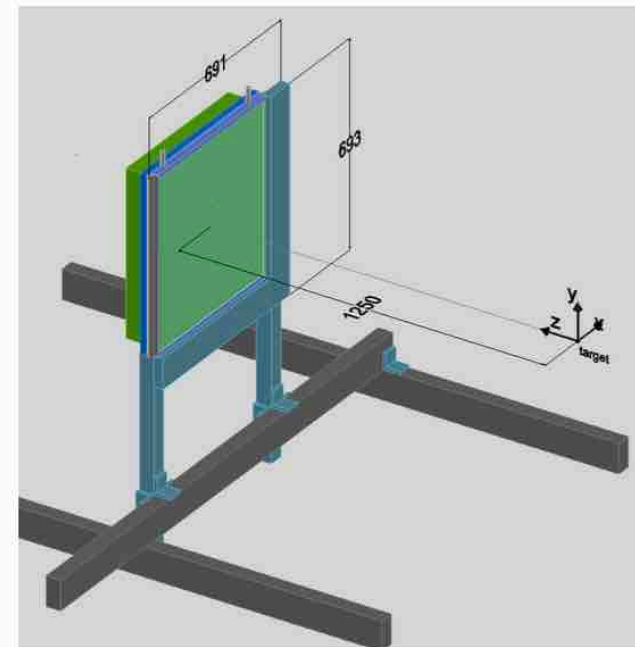
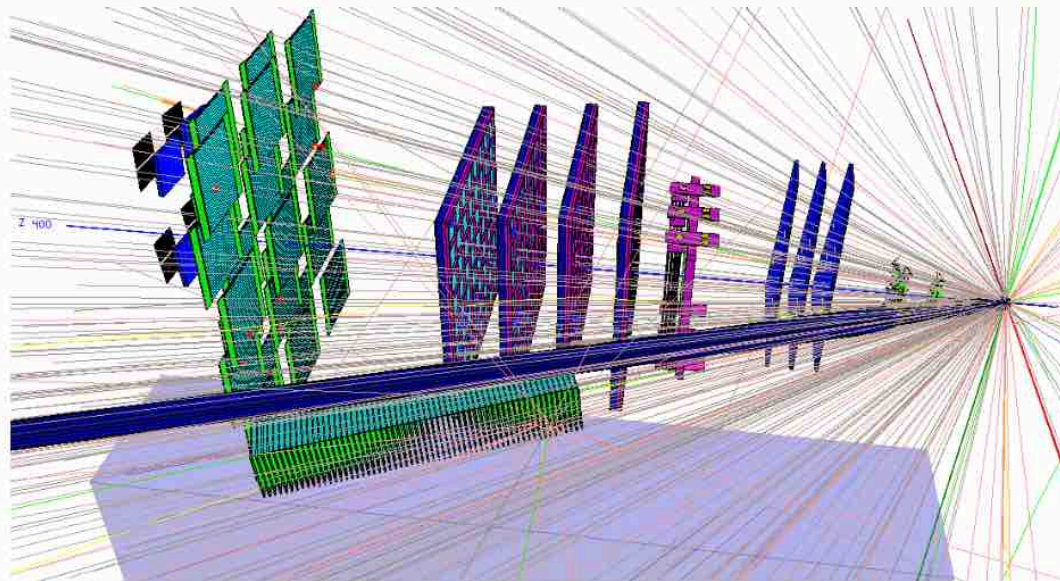
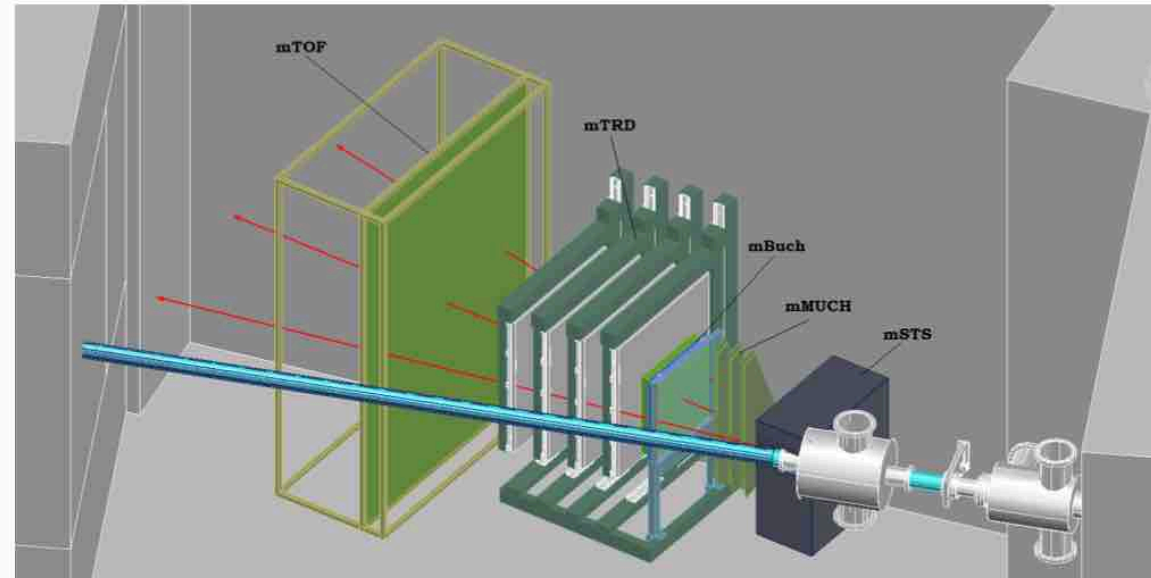
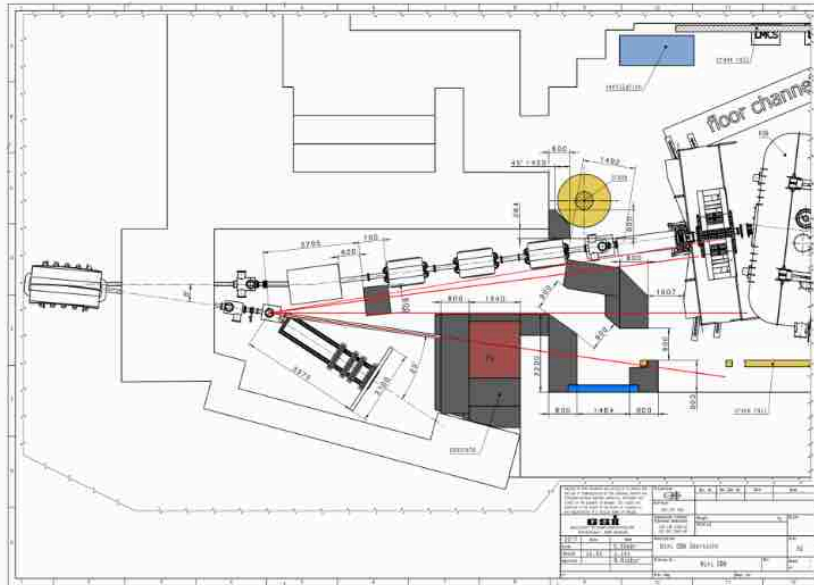
Au-Au



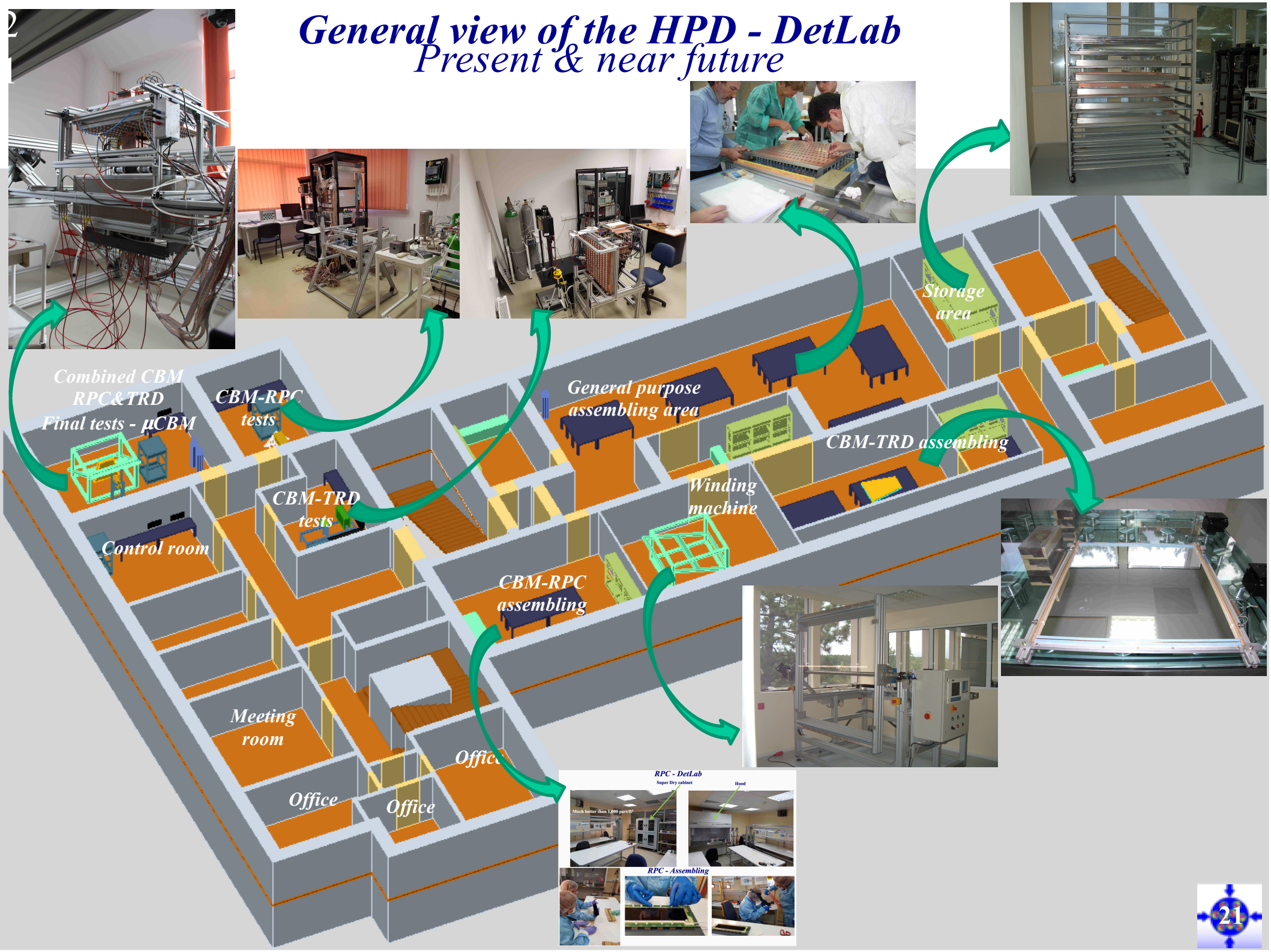
Physics topics prepared for data analysis @ CBM



Integration of Bucharest TRD in mCBM Experiment @ SIS18 FAIR Phase0



General view of the HPD - DetLab Present & near future



Training & teaching



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>

QR code and building image.



Outreach

*Paolo Giubellino,
Managing Scientific Director GSI/FAIR*

*Ursula Bessler, Deputy Director IN2P3
President of the CERN Council | CERN*



Romanian Radio broadcast - Live



Training & teaching

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

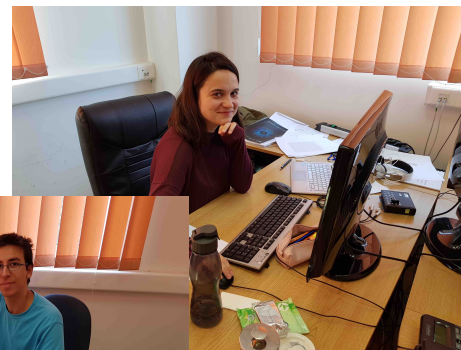
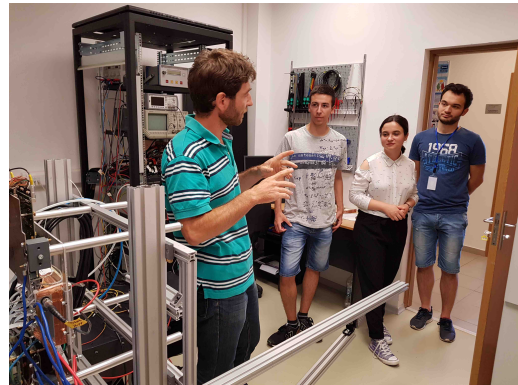
High Energy Physics
Nuclear Astrophysics
Particle Detection Systems
Front-End Electronics & IT

Summer Student Program 2019

Dedicated to advanced undergraduate level (3rd to 5th year of study, i.e. last year of Bachelor or during Master studies)

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

Duration: July 15 - September 15 / Deadline for application: March 31, 2019
Contact: 0040-21-4046135, mpetro@niham.nipne.ro
For further information visit the Training / Summer Student Program at <http://niham.nipne.ro>

Summer Student Program 2019

FROM HIGH DENSITY BARYONIC MATTER TO THE COLLISION OF HIGHLY PACKED GLUONIC SYSTEMS.



HORIA HULUBEI NATIONAL INSTITUTE FOR PHYSICS AND NUCLEAR ENGINEERING
HADRON PHYSICS DEPARTMENT

Outreach

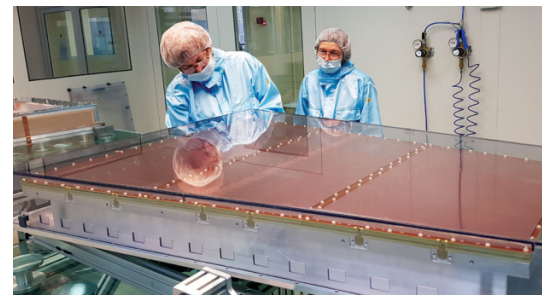
International group of Post Docs
PhD and Master students

http://niham.nipne.ro/HPD-Courier_electronic-version.pdf

Winners of
International Competitions in Physics



CERN Courier January 24, 2019
ALICE revitalised



HPD COURIER

NUMBER 1 | JANUARY 2019



ASSEMBLED & TESTED
130 TRD-MWPs (24%)
20 TPC ORCs (54%)
based on GEM technology

DESIGNED
3rd version of FASP
first ALICE Run Period
fully operational

23



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*

HPD Courier

https://niham.nipne.ro/HPD_Courier.html

HPD COURIER

NUMBER 1 | JANUARY 2019

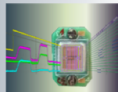


ASSEMBLED & TESTED | DESIGNED



130 TRD-MWPs (24%)
20 TPC OROCs (50%)
based on GEM technology

3rd version of FASP
(Fast Analog Signal Processor)
fully operational



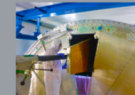
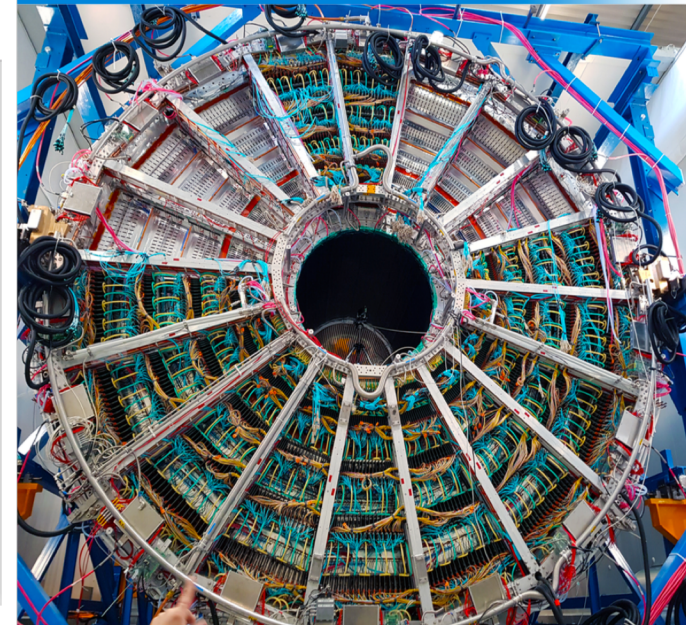
HPD COURIER

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70th IFAR Anniversary



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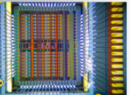
NUMBER 3 | APRIL 2020



ROCs | FASP

Assembling of ROCs
based on GEMs in
the ALICE-TPC

New version of
Fast Signal Processor
(FASP) for CBM-TRD



Publications

1. CBM Collaboration

*“Challenges in QCD matter physics - The scientific programme of the Compressed Baryonic Matter experiment at FAIR”,
Eur. Phys. J. A 53, 60 (2017) (DOI: 10.1140/epja/i2017-12248-y)*

2. D. Bartos, M. Petris, M. Petrovici, L. Radulescu, V. Simion

*“A method to adjust the impedance of the transmission line in a Multi-Strip Multi-Gap Resistive Plate Counter”
Romanian Journal of Physics 63, 901 (2018)*

3. M. Petris, D. Bartos, M. Petrovici, L. Radulescu, V. Simion, I. Deppner, N. Herrmann, C. Simon, J. Fruehauf, M. Kiss, P. Loizeau

*“In-beam test of the RPC architecture foreseen to be used for the CBM-TOF wall”
Journal of Physics: Conference Series, Vol. 1023 (2018), 012007*

4. M. Petris, D. Bartos, M. Petrovici, L. Radulescu, V. Simion, J. Fruehauf, M. Kis, P-A. Loizeau, I. Deppner, N. Herrmann, C. Simon

*“Performance of a two-dimensional position sensitive MRPC prototype with adjustable transmission line impedance”
Nucl. Instr. And Meth. A , 920(2019), 100*

5. M. Petris, D. Bartos, M. Petrovici, L. Radulescu, V. Simion, J. Fruehauf, P-A. Loizeau, I. Deppner, N. Herrmann, C. Simon

*“Performance tests of the MSMGRPCs using a free streaming readout”
PoS ICHEP2018(2019) 663 (SISSA (2018-11-15))
DOI: 10.22323/1.340.0663*

Conferences

1. M.Petris et al.

“Performance in heavy -ion beam tests of a high time resolution and two-dimensional position sensitive MRPC with transmission line impedance matched to the FEE”

XXXIX International Conference on High Energy Physics (ICHEP2018), July 4-11, 2018, Seoul, Korea;

<https://indico.cern.ch/event/686555/contributions/2973828/>

2. L.Radulescu et al.

“Integration of the HPD detectors in the mCBM experiment using CAD”

18th International Balkan Workshop on Applied Physics and Material Science, July 10-13, 2018, Constanta, Romania.

<http://ibwap.ro/#program>

3. M. Petris, D. Bartos, M. Petrovici, L. Radulescu, V. Simion, J. Fruehauf, I. Deppner, N. Herrmann

“High time resolution, two-dimensional position sensitive MSMRPC for high energy physics experiments”, EPS-HEP2019, Ghent, Belgium, 10 – 17 July, 2019

https://indico.cern.ch/event/577856/contributions/3420134/attachments/1878453/3094031/MPetris_eps-hep2019_Ghent.pdf

4. 2D Imaging in High Rate Environment with HPD-TRD for CBM@FAIR

Laura RADULESCU, Alexandru BERCUCI, Mihai PETROVICI

19th International Balkan Workshop on Applied Physics, IBWAP, Constanta, July 16-19, 2019

CBM-Collaboration Meetings

1. M. Petris et al.

“Lessons learned from building and testing 24% of ALICE-TRDs and 50% of ALICE-OROCs”

CBM-Retreat Meeting, 27 – 29 March 2019, Schloss Waldthausen, Mainz, Germany

<https://indico.gsi.de/event/8186/contributions>

<https://indico.gsi.de/event/8186/session/0/contribution/11>

2. M. Petris et al.

“Laboratory infrastructure in Bucharest”

CBM-Retreat Meeting, 27 – 29 March 2019, Schloss Waldthausen, Mainz, Germany

<https://indico.gsi.de/event/8186/contributions>

<https://indico.gsi.de/event/8186/session/6/contribution/4>

CBM-Collaboration Meetings

3. *L. Radulescu, A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, C. Schiaua, V. Simion*
“Inner-zone of the TRD wall - Construction details for the Bucharest-solution”
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4. *L. Radulescu, A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, C. Schiaua, V. Simion*
“Structural analysis of the TRD assembly procedure and gas flow operation for the Bucharest-solution”
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5. *A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, L. Radulescu, C. Schiaua, V. Simion*
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6. *A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, L. Radulescu, C. Schiaua, V. Simion*
“Measurements, Results & Performances for the Bucharest-solution of the CBM-TRD”
CBM-Retreat Meeting, 27 – 29 March 2019, Schloss Waldthausen, Mainz, Germany
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7. *A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, L. Radulescu, C. Schiaua, V. Simion*
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<https://indico.gsi.de/event/8186/session/13/contribution/16>

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8. *A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, L. Radulescu, C. Schiaua, V. Simion*

“Cluster reconstruction in high counting rate environment”

33rd CBM Collaboration Meeting, 1 – April 2019, GSI Darmstadt, Germany

<https://indico.gsi.de/event/8068/other-view?view=nicecompact>

9. *L. Radulescu, A. Bercuci, V. Aprodu, D. Bartos, Ch. Caragheorgheopol, V. Catanescu, V. Duta, M. Petris, M. Petrovici, L. Prodan, A. Radu, C. Schiaua, V. Simion*

“Buch-TRD chamber and wall geometry”

33rd CBM Collaboration Meeting, 1 – April 2019, GSI Darmstadt, Germany

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10. *M. Petris, V. Aprodu, D. Bartos, Gh. Caragheorgheopol, V. Duta, M. Petrovici, L. Prodan, L. Radulescu, V. Simion, J. Fruenhaus, I. Deppner, N. Herrmann, N. Heyer*

“In-house cosmic-ray test of the MGMSRPC2018 prototype for the inner zone of the CBM-TOF wall”

33rd CBM Collaboration Meeting, 1 – April 2019, GSI Darmstadt, Germany

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11. *M. Petrovici, V. Aprodu, D. Bartos, Gh. Caragheorgheopol, V. Duta, M. Petris, L. Prodan, L. Radulescu, V. Simion*

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12. *M. Petris et al.,*

[*Status of the activities for the inner zone of the CBM-TOF wall*](#)

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13. *Alexandru Bercuci, Gheorghe Caragheorgheopol, Vasile Catanescu, Mariana Petris, Mihai Petrovici, Laura Radulescu, Claudiu Schiaua*

Physics Motivation for an Optimized Position Resolution design in the TRD Inner-Zone [for the TDR Addendum]”

34th CBM Collaboration Meeting 29 Sep → 3 Oct 2019, Bose Institute, Kolkata, India

<https://indico.gsi.de/event/7101/contributions/32165/attachments/23198/29088/TRD-Buch-Phys.pdf>

14. *L. Radulescu, D. Bartos, A. Bercuci, M. Petrovici*

Towards the engineering design of the 2D position sensitive inner zone for the TRD-TDR addendum”

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- 15. Alexandru Bercuci, Gheorghe Caragheorgheopol, Vasile Catanescu, Mariana Petris, Mihai Petrovici, Laura Radulescu, Claudiu Schiaua
"Software Integration and Performances of the Optimized Position Resolution design for the TRD Inner-Zone [for the TDR Addendum]"
34th CBM Collaboration Meeting 29 Sep → 3 Oct 2019, Bose Institute, Kolkata, India*

<https://indico.gsi.de/event/7101/contributions/32232/attachments/23184/29071/TRD-Buch-QA.pdf>

- 16. Alexandru Bercuci, Gheorghe Caragheorgheopol, Vasile Catanescu, Mariana Petris, Mihai Petrovici, Laura Radulescu, Claudiu Schiaua
"FASP FEE Integration and Readiness for CBM DAQ [for the TDR Addendum]"
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Bucharest - Current status and next steps

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45. M. Petris et al.

A short review related to the e/π rejection performance using different entrance windows and radiators - based only on experimental data

CBM-TRD retreat meeting, 19-21 August 2020, Haus Mariengrund, Germany

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1. *A Bercuci et al.*

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CBM Progress Report 2017 ISBN 978-3-9815227-5-4, (2018) 186;

2. *A Bercuci et al.*

“Laboratory tests of the TRD Bucharest prototype in close to realistic high counting rates environment”
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3. *M. Petris et al.,*

“Performance tests of the MGMSRPCs using a free streaming readout”
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4. *L. Radulescu et al.*
“Mechanical design of the CBM-TOF inner wall”
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5. *L. Radulescu et al.*
“CAD integration of the mCBM systems”
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6. *M. Petris et al.*
“High granularity timing RPC prototype for the inner zone of the CBM TOF wall”
CBM Progress Report 2018 ISBN 978-3-9815227-6-1, (2019),
7. *A. Bercuci et al.,*
“FEE readiness of Bucharest TRD chamber for mCBM”
CBM Progress Report 2018 ISBN 978-3-9815227-6-1 (2019), 79
8. *A. Bercuci et al.,*
“Data format and long term tests for FASP/GETS FEE in view of mCBM integration”
CBM Progress Report 2018 ISBN 978-3-9815227-6-1 (2019), 81
9. *A. Bercuci et al.,*
“Energy resolution and gain measurements for the TRD chamber configuration proposed for the inner zone of the CBM-TRD”
CBM Progress Report 2018 ISBN 978-3-9815227-6-1 (2019), 87
10. *A. Bercuci et al.,*
“Realistic response of the Bucharest TRD for mCBM simulations at top rates”
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11. *M. Petris et al.*
“Test results of high granularity MSMGRPC prototype for CBM – TOF wall”
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12. *V. Aprodu et al.*
“Efficiency investigation of a high granularity MSMGRPC prototype for the inner zone of the CBM – TOF wall”,
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14. *L. Radulescu et al.,
"Studies of mechanical stress for the high resolution TRD"
CBM Progress Report 2019 ISBN 978-3-9815227-8-5 (2020), 112*
15. *A. Bercuci et al.,
"Reconstruction performance of High position Resolution TRD, modelled in CbmRoot framework"
CBM Progress Report 2019 ISBN 978-3-9815227-8-5 (2020), 116*

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- *Prof. Dr. Mihai Petrovici (physicist) - team leader*
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