

to

Hadron Physics Department

Mihai Petrovici, Summer Student Program, Bucharest, July 5, 2019

"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













## Past, Present & Future



FAIR



www.ifin.ro







*"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* 

# Nuclear Structure and Dynamics

# Comprehensive understanding of exotic nuclear structure and dynamics



**Proc** 

Shapes, isospin mixing, pairing correlations and simultaneous description of T=1 ( $J=0^+$ ) and T=0 ( $J=9^+$ )  $\beta$  decays of <sup>70</sup>Br to <sup>70</sup>Se

- > A.Petrovici, Phys. Rev. C 97, 024313 (2018)
- > A.Petrovici, O.Andrei, A. Chilug, Phys. Scr. 93, 114001 (2018)

> A. Petrovici, O. Andrei, A. Mare, will appear in AIP Conf.

# Abundances of waiting point nuclei, H and He in postprocessing approach to rp process on accreting neutron stars



H. Schatz, MSU, East Lancing

Strongly Interacting Matter

**Strongly interacting matter @ LHC energies with ALICE** HPD contribution from R&D to Physics

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#### Detector assembling & tests 24% of ALICE-TRD chambers

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remojtam +107 - 807 μAC + Relativas Capitar - Cabrai + Cabrai + Cabrai + Corr - Colong + Centert + Cult O.4. Col. - CONST 6 = Cytoret - CCCU, O - Constain - 607 μPO - Cell (201 - 0.6.) 2 + 187 - Leadona + 186 - 187, LG - 187 79 = N20 - Schala CRAM - Koles - LB - Legours - LUAMC - MITH = Healt - HMTE - OHea - Andro - Andro - PALACTO Franzo - Franza - Marie - HK, LT - Schala - SHC - Statu - Status - SHC - Collect - Salarto - Collect - Torre



Shifts for running the experiment

VTHIAS is = 7 TeV (without Color Reco

## **HPD Physics within ALICE**

*p*+*p* 7 *TeV* 

**Present status** 









#### HPD – Physics – within ALICE or related to ALICE



ALICE TPC Upgrade

## ALICE-upgrade A. TPC-upgrade - 50% OROCs will be assembled & tested by HPD





4×10<sup>-</sup>









	interaction rate in kHz	Accepted rate in kHz	Accepted frac- tion in %	$ \frac{\text{deadtime}}{\text{in }\%} $	data volume in Gb/s/sector
tracklet readout only					
avg. deadtime 6 $\mu$ s	50	38.5	76.9	23.1	4.73
	100	62.5	62.5	37.5	7.68
	200	90.9	45.5	54.5	11.17
avg. deadtime 8 $\mu$ s	50	35.7	71.4	28.6	8.78
	100	55.6	55.6	44.4	13.65
reduced raw data readout	50	23.3	46.5	53.5	7.8
full zero-suppressed ADC data	50	16.6	33.2	66.7	27.9

TRD readout rates and data volume for different TRD data formats and event scenarios.



## HPD contribution to the ALICE-TPC Upgrade

## **ALICE-TPC - Upgrade - HPD activities**



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![](_page_16_Picture_3.jpeg)

![](_page_16_Picture_4.jpeg)

![](_page_16_Picture_5.jpeg)

![](_page_16_Picture_6.jpeg)

![](_page_16_Picture_7.jpeg)

![](_page_16_Picture_8.jpeg)

![](_page_16_Picture_9.jpeg)

![](_page_16_Picture_10.jpeg)

![](_page_16_Picture_11.jpeg)

![](_page_16_Picture_12.jpeg)

![](_page_16_Picture_13.jpeg)

![](_page_16_Picture_14.jpeg)

#### ALICE-TPC - Upgrade - HPD activities

![](_page_17_Figure_1.jpeg)

#### https://youtu.be/ZHBgGKamUc8

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8

![](_page_17_Picture_3.jpeg)

![](_page_17_Picture_4.jpeg)

![](_page_17_Picture_5.jpeg)

![](_page_17_Picture_6.jpeg)

#### **HPD** contribution to the ALICE Experiment

![](_page_18_Picture_1.jpeg)

## ALICE-TPC - Upgrade

![](_page_19_Picture_1.jpeg)

R&D Activities X Steps towards construction & tests of CBM ToF & TRD subdetectors CBM Experiment @ FAIR

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

![](_page_21_Figure_1.jpeg)

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

# Phase Diagram of strongly interacting matter @ FAIR energies CBM Experiment

![](_page_22_Figure_1.jpeg)

![](_page_23_Figure_0.jpeg)

# FAIR construction status

![](_page_24_Picture_1.jpeg)

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

![](_page_25_Picture_1.jpeg)

High counting rate RPCs
High counting rate TRD
TRD - FEE

![](_page_25_Picture_3.jpeg)

![](_page_26_Picture_0.jpeg)

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

![](_page_26_Figure_2.jpeg)

 $\delta t \sim 50-60 \ psec$  *Cluster size* ~ 1.8-2 *strips*  $\varepsilon \geq 90\%$ 

![](_page_26_Figure_4.jpeg)

CBM-TOF

**CBM-TRD** 

![](_page_27_Picture_2.jpeg)

# Technical Design Report for the CBM

Time – of – Flight System (TOF)

The CBM Collaboration

![](_page_27_Figure_6.jpeg)

**Compressed Baryonic Matter Experiment** 

# Transition Radiation Detector (TRD)

**Technical Design Report** 

The CBM Collaboration

for the CBM

![](_page_27_Figure_10.jpeg)

*Input for \_\_\_\_\_ Applied research \_\_\_\_\_ Technological transfer* 

Application: high sensitivity whole-body PET imaging.

![](_page_28_Picture_2.jpeg)

#### MC simulations based on the measured performance

![](_page_28_Figure_4.jpeg)

$$\epsilon_{MIP} > 95\%$$
  
 $\epsilon_{\gamma} \sim 2-3\%$ 

# Inner zone CBM ToF

![](_page_29_Picture_1.jpeg)

## HCR-2D position sensitive TRD

![](_page_30_Picture_2.jpeg)

#### HCR-2D position sensitive TRD – FEE & DAQ FASP\_03

![](_page_31_Figure_1.jpeg)

#### FASPRO - FASP Read Out

![](_page_31_Picture_3.jpeg)

![](_page_31_Picture_4.jpeg)

# 

#### **GETS - General Event Time Serializer**

![](_page_31_Figure_7.jpeg)

![](_page_31_Figure_8.jpeg)

## FASP-FEE & free running mode DAQ

## **CADENCE** design

![](_page_32_Picture_2.jpeg)

FASP\_02

10 000 0 - N PARA

![](_page_32_Picture_4.jpeg)

FASP\_03

![](_page_32_Picture_6.jpeg)

![](_page_32_Picture_8.jpeg)

![](_page_32_Picture_9.jpeg)

![](_page_32_Picture_10.jpeg)

# mCBM setup

![](_page_33_Figure_1.jpeg)

**CBM-TRD** 

![](_page_34_Figure_1.jpeg)

# **Technical Design Report for the CBM**

# Transition Radiation Detec (TRD)

The CBM Collaboration

![](_page_34_Picture_6.jpeg)

![](_page_34_Picture_7.jpeg)

![](_page_35_Picture_0.jpeg)

Applied Research & Technologícal Transfer

# Applied research &

# Technological transfer

![](_page_37_Picture_2.jpeg)

![](_page_38_Picture_0.jpeg)

Vacuum Thin Film Deposition System by magnetron sputtering for deposition of the metallic and nonmetallic thin films with lubricant, photo-catalytic, anticorrosion, wearresistant, etc. properties.

![](_page_38_Figure_2.jpeg)

Variation of coefficient of friction with sliding distance – 600 m Variation of coefficient of friction with sliding distance – 1 m

*Electrostatic spraying of nano/ micro - powder colloidal dispersions* 

![](_page_38_Picture_6.jpeg)

![](_page_38_Picture_7.jpeg)

![](_page_38_Picture_8.jpeg)

SEM images of aromatic microcapsules deposited on textile surfaces by electrostatic spraying

# ALICE-related international events

Organized by us in Romania

![](_page_39_Picture_2.jpeg)

![](_page_39_Picture_3.jpeg)

#### **CBM-related international events** Organized by us in Romania

#### **16<sup>th</sup> CBM Collaboration Meeting**

27 September – 1 October 2010 Mamaia, Romania

#### Topic

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

#### Front-End Electronics

**Data Aquisition, Fast Online Event Selection** 

**Online and Offline Software,** Computing Model

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

#### **Organizing Committee:**

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

#### Sponsors:

![](_page_40_Picture_12.jpeg)

![](_page_40_Picture_13.jpeg)

://niham.nipne.ro/cbm2010

![](_page_40_Picture_15.jpeg)

![](_page_40_Picture_16.jpeg)

## **Training & teaching**

![](_page_41_Picture_1.jpeg)

![](_page_41_Picture_2.jpeg)

![](_page_41_Picture_3.jpeg)

#### 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:

## **Training & teaching**

![](_page_42_Picture_1.jpeg)

#### **Outreach**

#### Ursula Bassler, Deputy Director IN2P3 President of the CERN Council | CERN

Paolo Giubellino, Managing Scientific Director GSI/FAIR

![](_page_42_Picture_5.jpeg)

Romanian Radio broadcast - Live

![](_page_42_Picture_7.jpeg)

![](_page_42_Picture_8.jpeg)

### **Outreach**

Magic cubes

### **Booklet**

![](_page_43_Picture_2.jpeg)

![](_page_43_Picture_3.jpeg)

#### MINISTERUL EDUCAȚIEI NAȚIONALE

#### 2014

- ➢ The 65<sup>th</sup> anniversary of IFA-IFIN-HH
- ➢ The 60<sup>th</sup> anniversary of CERN
- > The 15<sup>th</sup> anniversary of ALICE membership
- > The 10<sup>th</sup> anniversary of CBM membership

сви

CERN

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The 10<sup>th</sup> anniversary of DetLab of HPD

![](_page_43_Picture_11.jpeg)

![](_page_43_Picture_12.jpeg)

![](_page_43_Picture_13.jpeg)

HADRON PHYSICS DEPARTMENT Horia Hulubei National Institute of Physics and Nuclear Engineering Bucharest, ROMANIA http://dihom.ninne.ro

![](_page_43_Picture_15.jpeg)

#### **Posters**

![](_page_43_Picture_17.jpeg)

![](_page_43_Picture_18.jpeg)

## They are the main actors !

![](_page_44_Picture_1.jpeg)