ALICE MUON Project looking forward the QGP

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MFT



Quark Gluon Plasma & Heavy Quarks

Quark-Gluon Plasma (QGP):

State of nuclear matter where quarks and gluons are deconfined

 \Rightarrow Study of Strong Interaction / QCD in extreme conditions (T > I70MeV)

Heavy Quarks (c + b):

Created at the early stage of the collision: 0.1fm/c compared to 10fm/c of QGP lifetime ⇒ experience of the full history of collision

Quarkonia (J/ ψ and Υ families) sensitive to energy density/temperature \Rightarrow Quarkonia « melted » in the QGP \Rightarrow decrease of production rate (...?...)



Energy loss of Heavy Quarks depends on medium density ⇒ Measurement of Open Heavy Flavors (D & B)





Muon Spectrometer & MFT



Muon Spectrometer:

<u>Frontal absorber</u> + Tracking chambers + Iron wall + Trigger Chambers

Acceptance: $-4 < \eta < -2.5$

MFT:

Upgrade (Run III) ALPIDE sensors (ITS) Vertexer for MS

Collisions Run I (2009-2013): p-p : 900 GeV, 2.76 TeV 7 TeV and 8 TeV

Pb-Pb : 2.76 TeV $\mathcal{L}_{int} = 70 \mu b^{-1}$

p-Pb : 5.02 TeV

Run II (2015-2018): p-p : 13 TeV + 5.02 TeV

 $\begin{array}{l} \mbox{Pb-Pb}: \mbox{5.02 TeV} \\ \mbox{$\mathcal{L}_{int}=O(100)nb^{-1}$} \end{array}$

p-Pb : 5.02 - 8.16 TeV

Run III (2020-): High luminosity (x10) $\mathcal{L}_{int} = O(10)nb^{-1}$



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Overview

Publications of the Muon Spectrometer:

23 / 142 publications of ALICE (versus 18 / 98 one year ago)



Example: coherent J/Ψ photoproduction in Pb-Pb:



Muon Spectrometer Muon TRigger



MTR consolidation: new Regional boards

Muon Trigger:

72 RPCs in 4 layers
Trigger decision and read-out:
234 Local boards in 16 VME 9U crates
16 Regional boards (1 Regional per VME crate)
1 Global board (interface to CTP)
2 DARC boards for readout

Regional board limitations

Configuration speed slow (~2mn; daisy chained JTAG links) Readout of Regional registers not operational Limited number of spares (and FPGA not supported)

Upgrade of the Regional boards

Prototypes tested in Lab. and in cavern during 2015 TS
Installation/commissioning done during YETS 2015-16
Configuration of the Local by Regional via optical link from DARC ⇒ one to one link
Configuration time decreased down to ~40s
Readout of Regional registers OK





MID: FEERIC project

Run III:

high collision rate (50kHz in Pb-Pb) Muon TriggeR ⇒ Muon IDentifier

Goal: slow down RPC aging after LS2 20992 ch., 2384 FE cards (+spares) Present ASIC ADULT: no amplification Future ASIC FEERIC (0.35µm CMOS) with amplification

FEERIC card pre-series on I (/72) RPC in cavern since February 2015

very satisfactory performance and stability factor 4 less charge released in the RPC gas with FEERIC (right plot) \Rightarrow reduced aging

Planning and Milestones

EDR defended in March 2015 \Rightarrow successful PRR on April 5th 2016 ⇒ successful Production 2016-2017 Installation during LS2









MID: Readout Electronics

Readout Electronics for continuous mode

Replacement of the 234 Local boards and of the 16 Regional ones presently in operation

Readout card prototype ready

Emulate, on the same board, 7 local boards connected by e-links@320Mb/s to one regional board implementing I GBT@3.2Gb/s (GBTx, GBT-SCA,VTRx)

Start tests since early 2016 FPGAs firmware loaded successfully

Planning & Milestones

EDR defended in June 2015 \Rightarrow successful No change (with respect of UCG/MoU) Pre-series + PRR end of 2016 Production 2017-2018 Installation during LS2



Muon Forward Tracker





Principle of the MFT





Principle of the MFT



FJPPL/FKPPL May '16

MFT: Overview/Reminder



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MFT: Tests of Alpide in Korea

Production of probe cards for prototypes of Alpide chips. Strong contribution to the characterization of the sensor (beam tests) Development of a series tests set-up in order to qualify final Alpide chips for ITS & MFT



FJPPL/FKPPL May '16

MFT Milestones

Momerandum Of Understanding of the MFT: Submitted in January 2016 Under signature process

Annex 1: List of Institutes and Contact Persons

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Country	City	Institute	Team leader (1)
China	Wuhan	Central China Normal University (CCNU)	D. Zhou
France	Clermont- Ferrand	Laboratoire de Physique Corpusculaire (LPC), Clermont Université, Université Blaise Pascal, CNRS/IN2P3	P. Crochet
France	Nantes	SUBATECH, Ecole des Mines de Nantes, Université de Nantes, CNRS/IN2P3	G. Batigne G. Martinez-Garcia
France	Saclay	Commissariat à l'Energie Atomique, IRFU	A. Baldisseri
France	Villeurbanne	Université de Lyon, Université Lyon 1, CNRS/IN2P3, IPN-Lyon	B. Cheynis
India	Aligarh Kolkata	Aligarh Muslim University Saha Institute of Nuclear Physics	M. Irfan S. Chattopadhyay
Japan	Hiroshima Nagasaki	Hiroshima University Nagasaki Institute of Applied Science	K. Shigaki K. Oyama
Peru	Lima	Pontificia Universidad Católica del Perú	A. M. Gago Medina
Republic of Korea	Incheon Pusan Seoul	Inha University Pusan National University Yonsei University	M. J. Kweon IK. Yoo Y. Kwon
Russia	Gatchina	Petersburg Nuclear Physics Institute	V. Nikulin V. Samsonov
Thailand Thailand	Nakhon Ratchasima Chachoengsao	Suranaree University of Technology Thai Microelectronics Center (TMEC)	C. Kobdaj W. Jeamsaksiri

Roadmap until installation:

Alpide chip production: start Q4 2016

Ladders:

Engineering Design Report: Q4 2016 Production Readiness Report: Q1 2017

Disks:

EDR: Q1 2017 PRR: Q2 2017

Cone:

EDR: Q2 2017 PRR: Q3 2017 integration in the barrels: Q4 2019

MFT down in the cavern: Q1 2020 $\,$

MFT ready for beam: Q3 2020 (7 months of contingency)



Contributions of FKPPL to ALICE MUON



Korean Post-doc (Y.-W. Baek) based at CERN very valuable for the Muon-Trigger operations on-site Run coordination & detector expertise



Participation of French researchers to bi-annual ITS-MFT-O² Asia workshops

- Wuhan, China June '15 (<u>https://indico.cern.ch/event/381564</u>)
- Seoul, South Korea Dec. 15 (<u>https://indico.cern.ch/event/452733/</u>) Very fruitful meetings

South Korea in charge of series tests of the sensors for the MFT





고맙습니다

どうもありがとうございます

Merci beaucoup



Available at Anguk metro station between exits 4 and 6



 Official source of lumi/statistics plots: <u>https://aliceinfo.cern.ch/Figure/node/8930</u>





