Muon System High Eta Upgrade

FP7, EEPN2, annual meeting

22-01-2014

Ahmed Abdelalim

Helwan Uni. and Zewail City, Cairo

For CMS-GEM Project

CMS GEM Collaboration

42 Institutions, ~ 75 authors

- **OVER FOUR YEARS OF R&D**
- **Working Groups**
  - Detector HW
  - Physics Studies
  - Trigger Simulations
  - DPG 1 and 2
  - Integration and Services
  - Electronics & DAQ
  - Online Operation

with weekly meetings; VII Workshops

https://indico.cern.ch/categoryDisplay.py?categId=1865

GE1/1 - TDR to be submitted in July CMS Week to CMS Management

GE2/1 and ME0 – for Phase 2

GE1/1 LS2 Project … Status and Goals

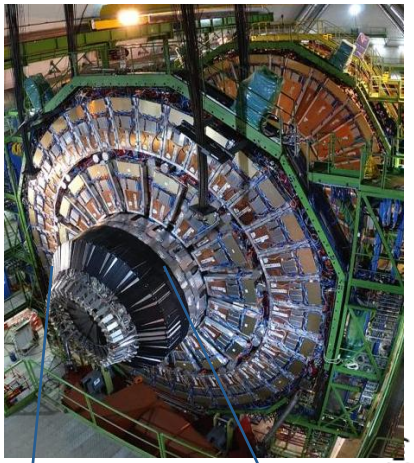
- Run 3 integrated luminosity will exceed 300 fb^{-1} and may approach 500 fb^{-1} by LS3
- HL-LHC with lumi-leveling at $5x10^{34}cm^{-2}s^{-1}$: 250 fb^{-1} per year

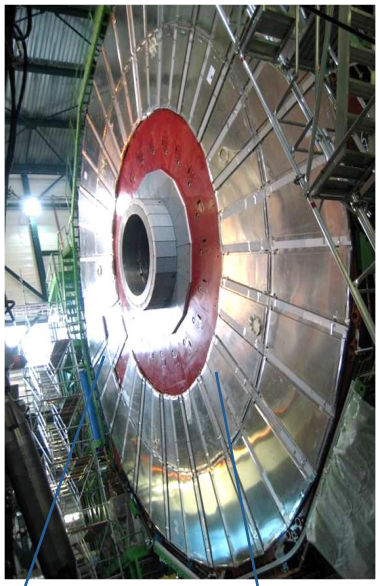
- GE1/1 LS2 Project:
  - Restore redundancy in high eta until 2.2 in first station
  - Install a detector in LS2 that serving as pilot for other Phase 2 GEM Projects (GE2/1 and ME0, see next slide)
  - Motivations for GE1/1 well established and approved
  - Cost effective high resolution participation into trigger
  - Begin with Slice test in 2015-2016
- Status in short:
  - 6 GE1/1 full size detectors produced
  - Interface with Muon POG
  - Sim Validation and Reconstruction
  - "Motivation" plots approved by CMS
  - GE1/1 TDR on track

The CMS GEM Project

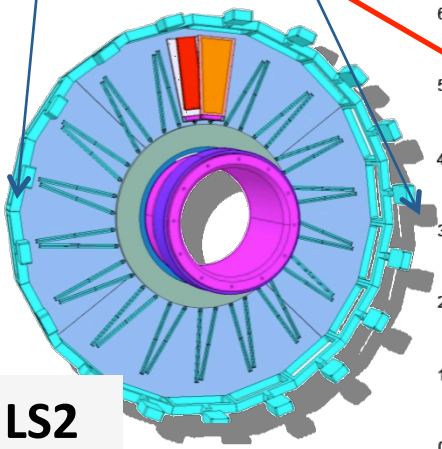
Install triple-GEM detectors (double stations) in 1.6<| η |<2.1-2.4 endcap region:

- Restore redundancy in muon system for robust tracking and triggering
- Improve L1 and HLT muon momentum resolution to reduce or maintain global muon trigger rate
- Ensure ~ 100% trigger efficiency in high PU environment

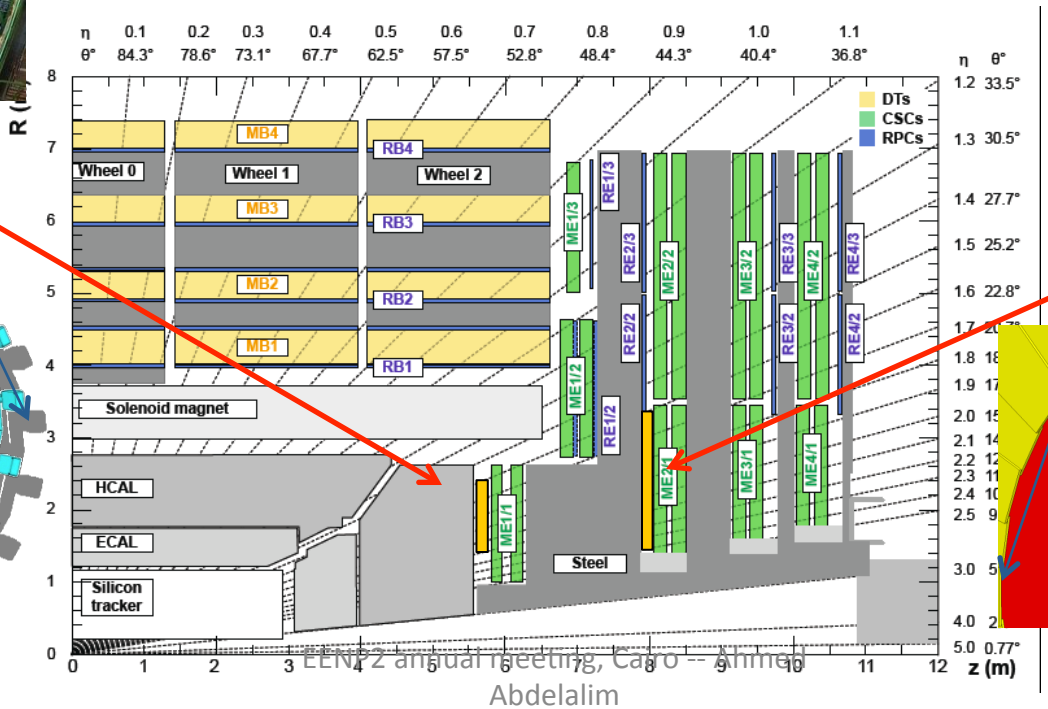




GE1/1

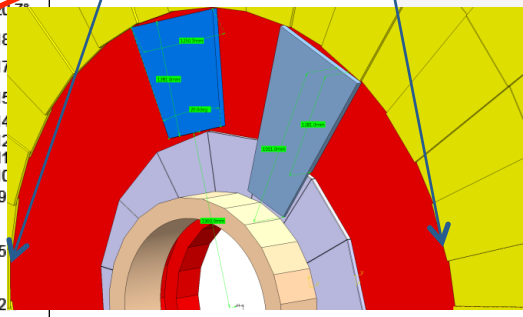


LS2

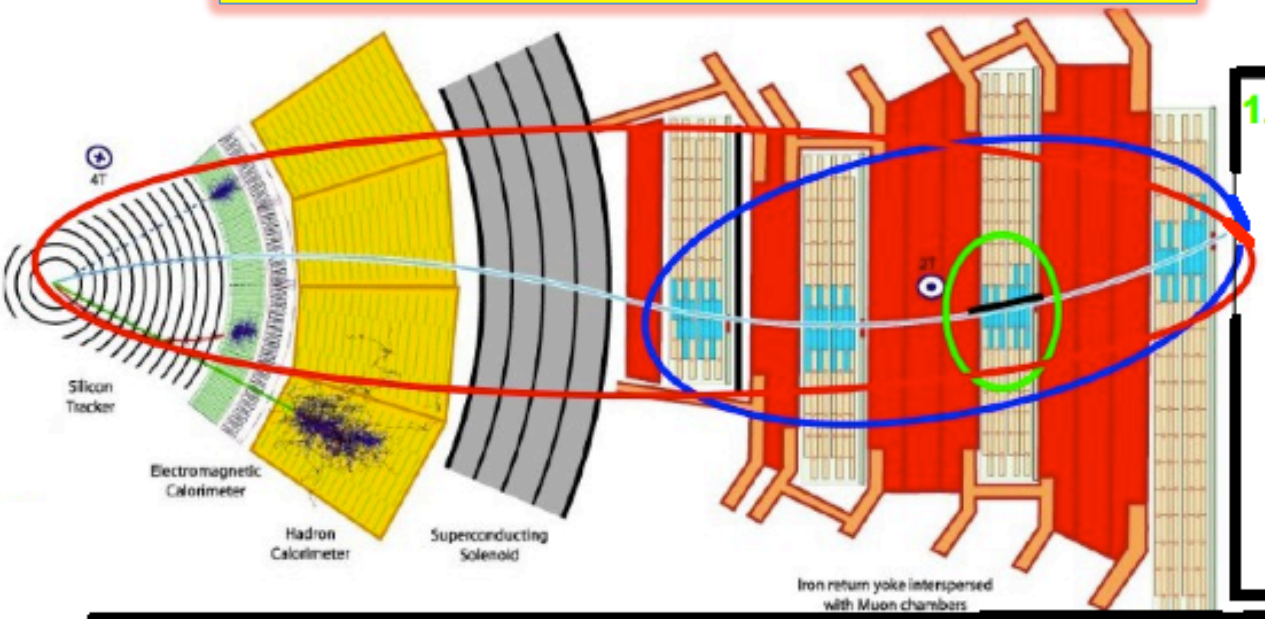


GE2/1

LS3



Muon Reconstruction Status



1. Local Reconstruction
Reconstruction of **hits** and **track segments** inside a **chamber**

DONE: GEM RecHit implemented for Digital R/O
DONE: Correct RecHit uncertainty implemented
TO BE DONE: Seeding with GEMs

2. Stand-alone Reconstruction (or Level-2 in HLT)
Reconstruction of the **track** inside the **muon system**

3. Global Reconstruction (or Level-3 in HLT)
Reconstruction of the **track** combining the information from **tracker** and **muon system**

DONE: GEM RecHits included in the track fittting

DONE: GEMs included in the STA muon, GLB muon comes consequently

TO BE DONE: Tracker muon

Special reconstructions:
- Cosmin muon
- TeV muon

TO BE DONE

Muon ID with GEMs — TO BE DONE

ONGOING: DIGItization step is in place but still not realistic: no noise implemented and CLS always 1

GEM Physics (Phase1 and Phase 2)… (1)

- **$gg \rightarrow H \rightarrow \tau\tau$, $WH \rightarrow l\,\nu_l + \tau\tau$**
  - ***++***: adding GE1/1 shows a lower trigger threshold ⟶ increasing eff.
  - ***manpower***: Claudio, Cesare, Rosamaria Vendiitti* (Bari), Raffaella Radogna*(Bari) Ankit Mohapatra (Florida).
- **$WH \rightarrow WWW \rightarrow 3\mu\,3\nu_\mu$**
  - ***++***: a lower trigger threshold ⟶ help in adding the 2nd muon to single muon trig. From W.
  - ***manpower***: Nishu Naib, Archie Sharma.
- **$H \rightarrow ZZ \rightarrow 4\mu$**
  - ***++***: PU handling, lowering trigger threshold, one of the four muons is very soft.
  - ***manpower***: Francesca Cavallo, Sylvie Braibant, Paolo Giacomelli, Luigi Guiducci.

++: motivation and/or interests.

GEM Physics (Phase1 and Phase 2)… (2)

- **H → μμ, ZH → *ll* μμ, WH → *l* ν_l μμ**
  - ***++***: for post-LS2 and LHC-phase-2. muon pT ≈ 50 GeV. Profit from GE1/1?
  - ***manpower***: Jangbae Lee, Cesare, Raffaella Radogna (Bari).
- **EXO channels**
  - ***channels***: **μμ* → μ μZ → 4μ, W' → μ ν_μ, and Z' → μμ**
  - ***++***: TeV muons may shower leading to inaccurate momentum measurement, adding gem can help a lot here.
    μ* has a boosted signature, adding GE1/1 can help for better isolation in High PU env. Moreover increased acceptance, increases eff. ≈15% (low masses) and ≈ 8% (high masses).
  - ***manpower***: Kerstin Hoepfner* (Aachen), Ahmed Abdelalim* (Helwan-Zewail)
- **Z → μ μ**
  - ***++***: for detector calibration and used as a candle for TnP.
  - ***manpower***: Ashfaq Ahmed, Imran.
- **MiniBias**

++: motivation and/or interests.

Physics samples page

Color Code	Priority / Availability
	High.
	Medium.
	Low.

H to ZZ to 4 l

- Group(s) - contacts: Universita e INFN - Paolo Giacomelli <paolo.giacomelli@cern.ch>

LO xsec@ 14 TeV [fb]	CMSSW	Global tag	PU	#events	Event type	evt size [kB]	total size [GB]	GEN fragment (DAS)	DataSet (DAS)	availability	priority	Comments
0.1269	6_2_0_SLHC5	auto:upgrade2019	0	199500	AODSIM	70.49	13.41	here	here			H mass 125 GeV, Geo: v5
0.1269	6_2_0_SLHC5	auto:upgrade2019	0	200000	AODSIM	70.51	13.45	here	here			H mass 125 GeV, Geo: v4
0.1269	6_2_0_SLHC5	auto:upgrade2019	50	20000	AODSIM	--	--	--	--			H mass 125 GeV
0.1269	6_2_0_SLHC5	auto:upgrade2019	140	20000	AODSIM	--	--	--	--			H mass 125 GeV

H to tau tau

- Group(s) - contacts H2Tau: Bari - **Rosamaria Venditti**, channel H to tau tau to mu + taujet
- Group(s) - contacts WH with H2Tau: Bari - **Anna Colaleo** <anna.colaleo@cern.ch>
- Interested manpower: Florida - **Ankit Mohapatra**, cl

channel	LO xsec@14 TeV [fb]	CMSSW	Global tag

Plots needed for validation:

For validation here are the distributions needed (Gen. and Reco. level when possible):

- Vertex: z0 and d0.
- Tracks: Chi2 for track fitting, and number of rechits associated to the tracks.
- Muons: number of muons per event, pT, eta.
- composite particle(s), mass, pT and eta.
- MET sum_met, phi (if present).