Status of Simulation, Reconstruction and Physics Studies with GEM in CMS

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Introduction - 1

A working group was set to estimate the gain of an upgraded muon design at high η

Mandate:

- Definition of a single layer GEM Geometry ✔
- Determination of the Multiple Scattering ✔
- Study of the readout strips Vs point resolution ✔
- Reconstruction with/without GEM Vs point resolution ✔
- Simulation of signal for few Physics cases "✔"

Introduction - 2

A new working group needs starting a longer term work within CMS framework

Mandate:

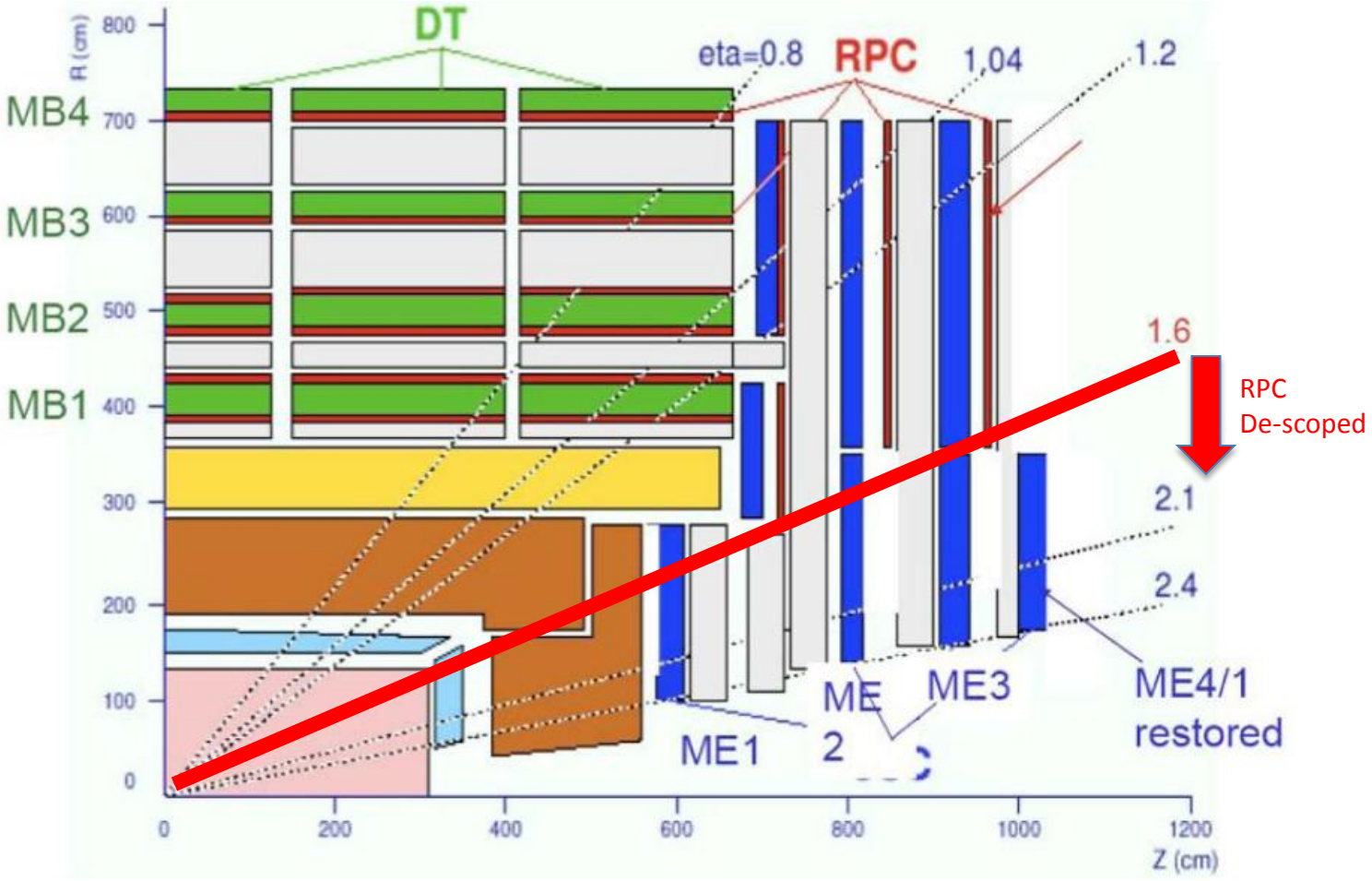
- Move from Single Gas volume (RPC-like) to Multi Gas Volume configuration (GEM-like)
- Design the new and improved Local Reconstruction (barycentre and local segments)
- Introduce in the Muon Reconstruction the new local segments and GEM seed based
- Study the physics impact (HLT and background studies)

Introduction - 3

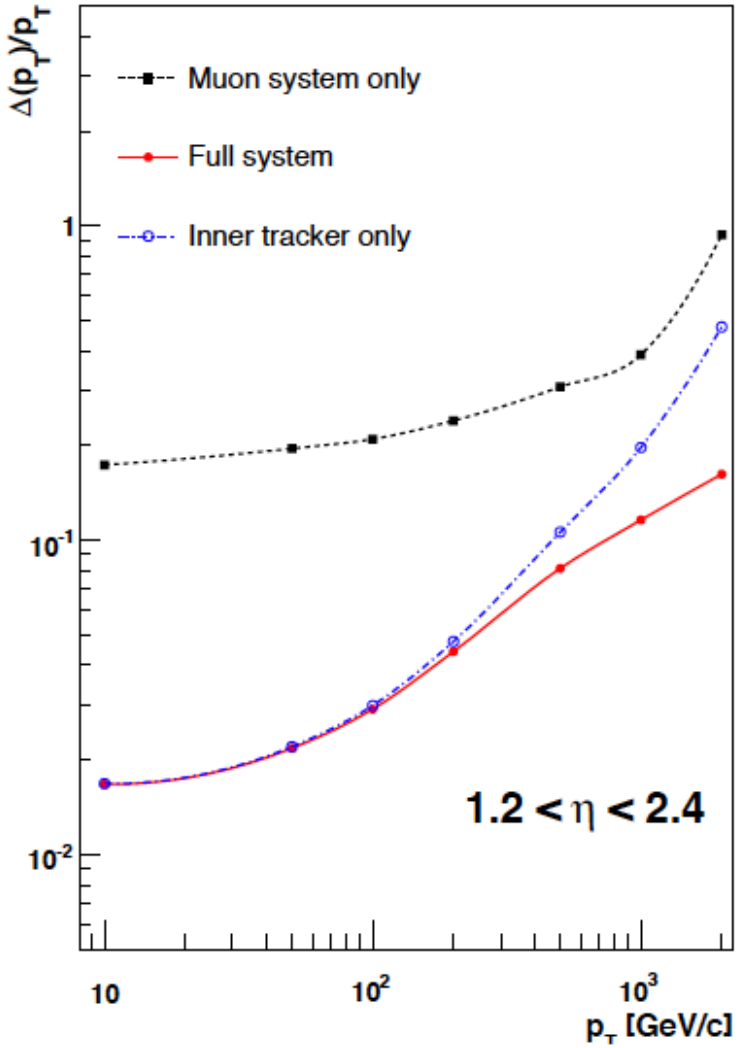
Tasks:

- GEM Geometry studies
- GEM Digitization
- Local Reconstruction
- Muon Reconstruction and Id
- GEM in L2 Muon
- Targeted Physics Analyses

The High η region



The Basic Observation



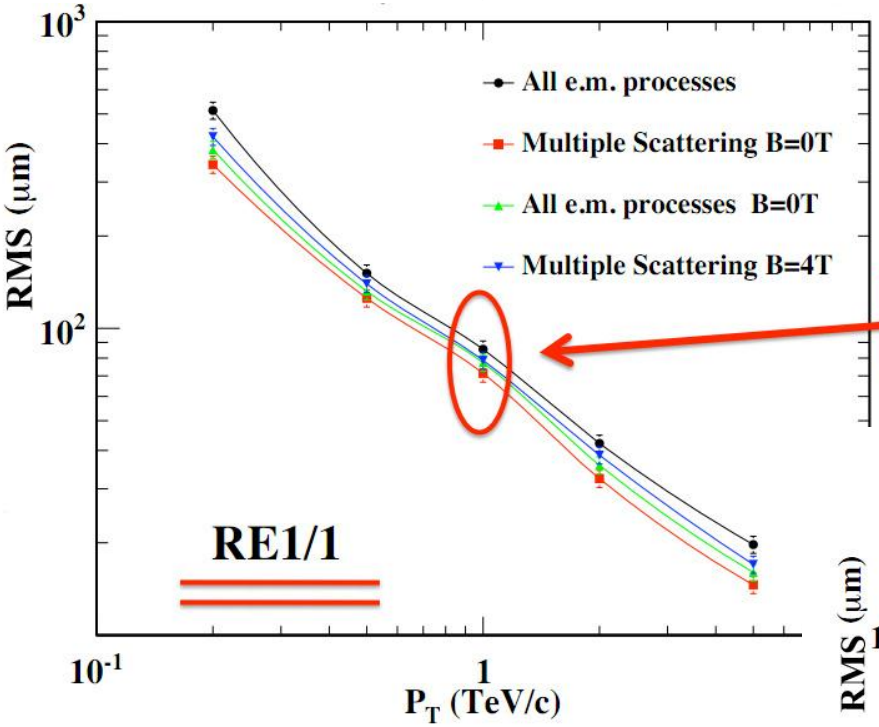
Tracker Level arm reduction for $|\eta|>1.7$

Improved Tracking capability in Muon system is interesting for $p_T > 200$ GeV

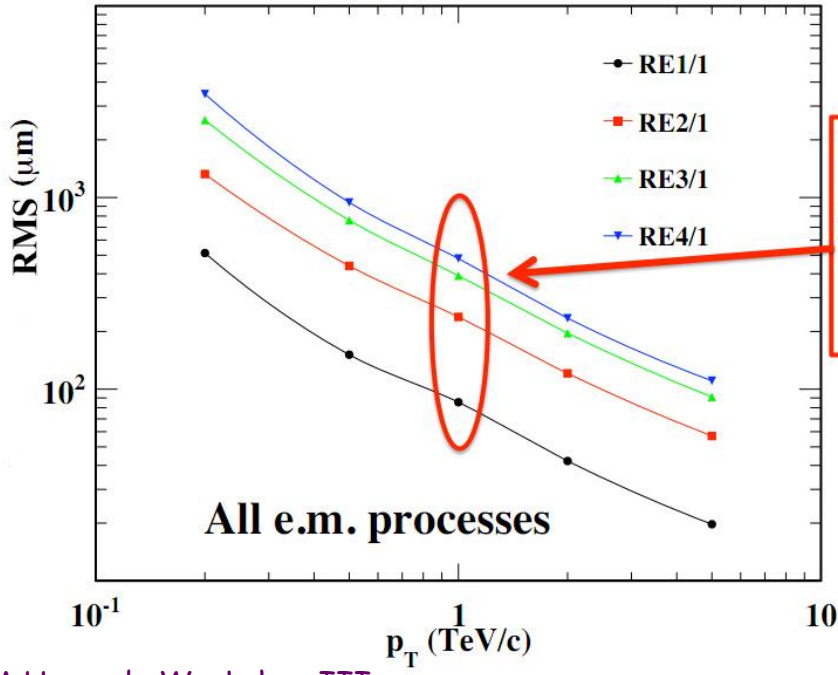
Point resolution still dominant w.r.t. multiple scattering

$P_T < 200$ GeV still relevant for HLT and Muon Id

Multiple Scattering Studies



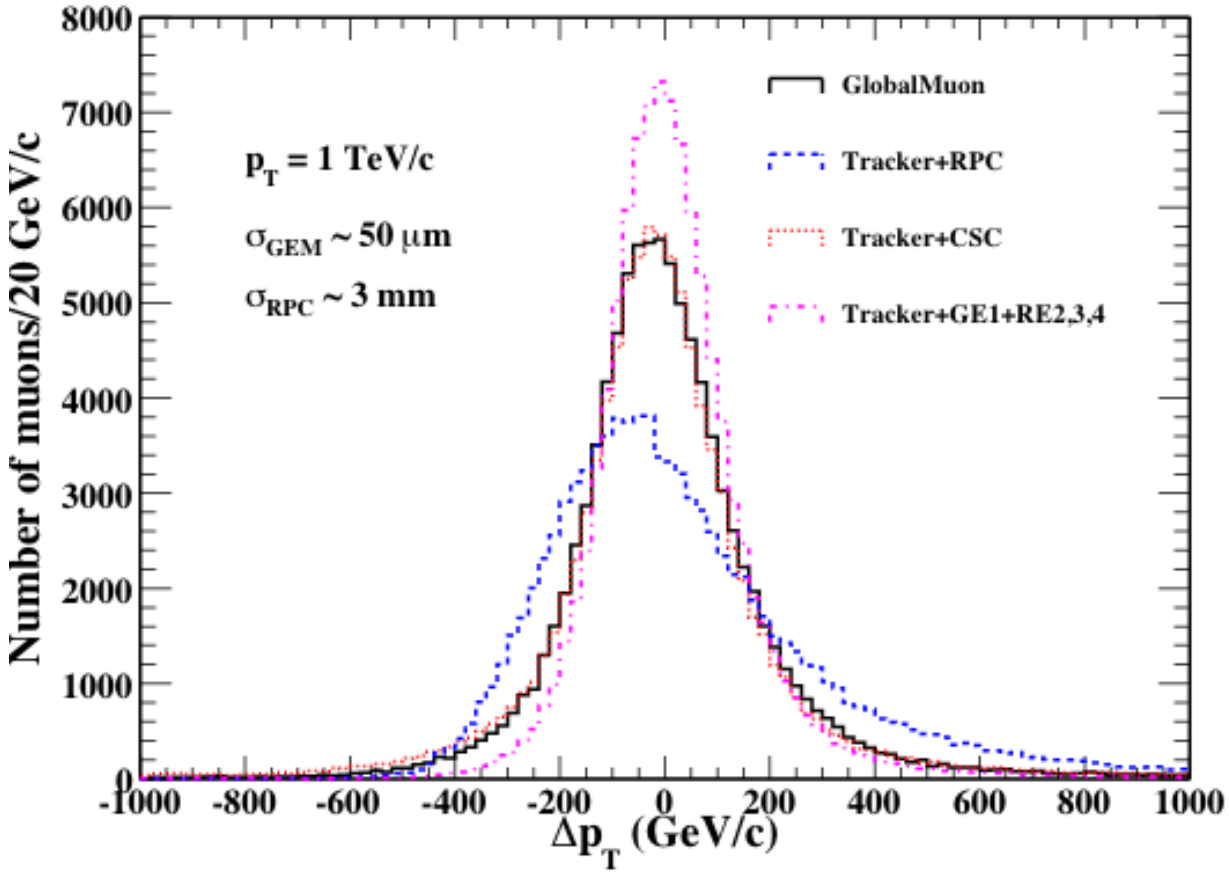
~ 90 μm for 1 TeV Muon



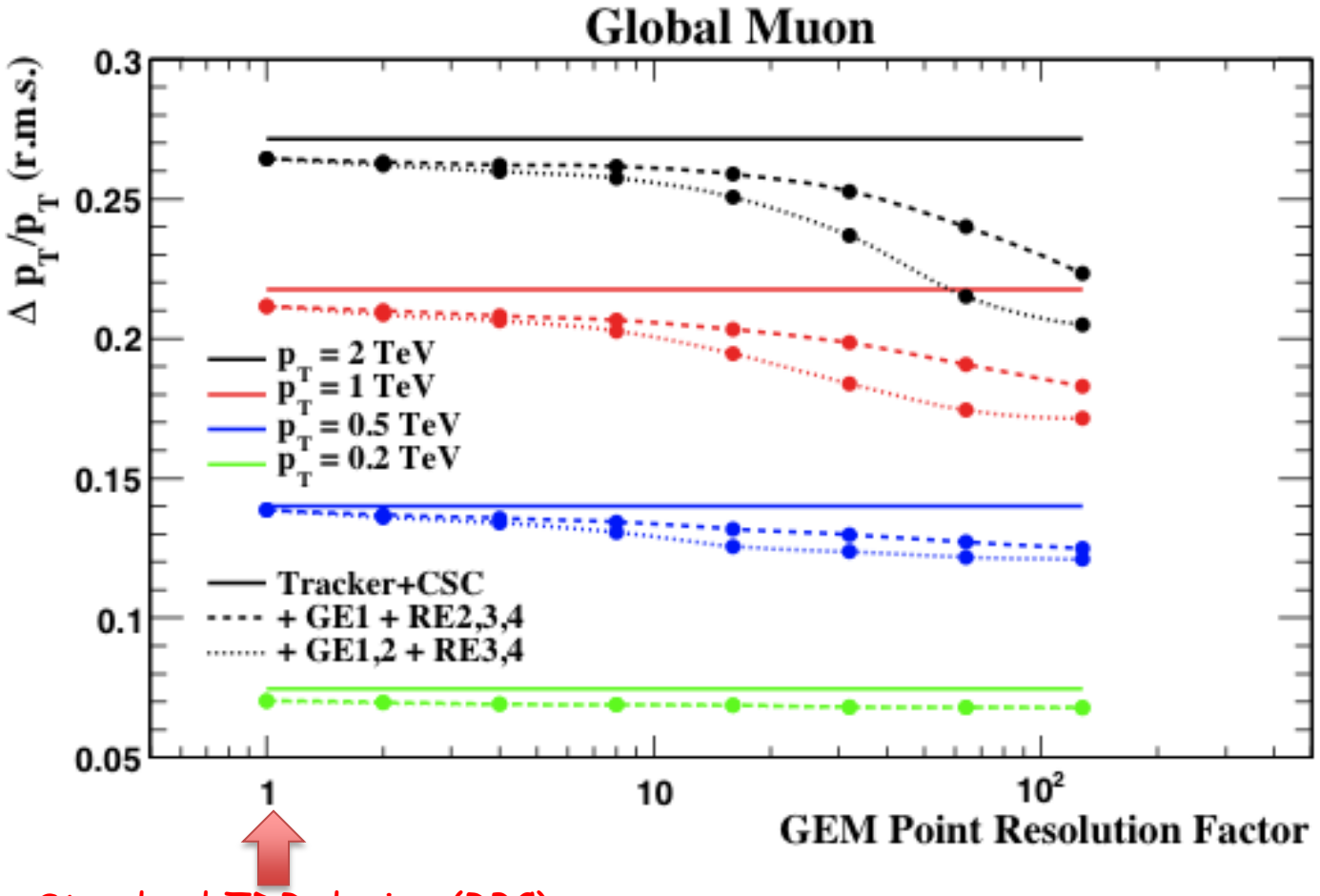
RE1/1 ~ 90 μm
RE2/1 ~ 240 μm
RE3/1 ~ 390 μm
RE4/1 ~ 480 μm

For 1 TeV Muon

Result obtained for an ideal layer of GEM in the first station



Reconstruction Studies



Standard TDR design (RPC)

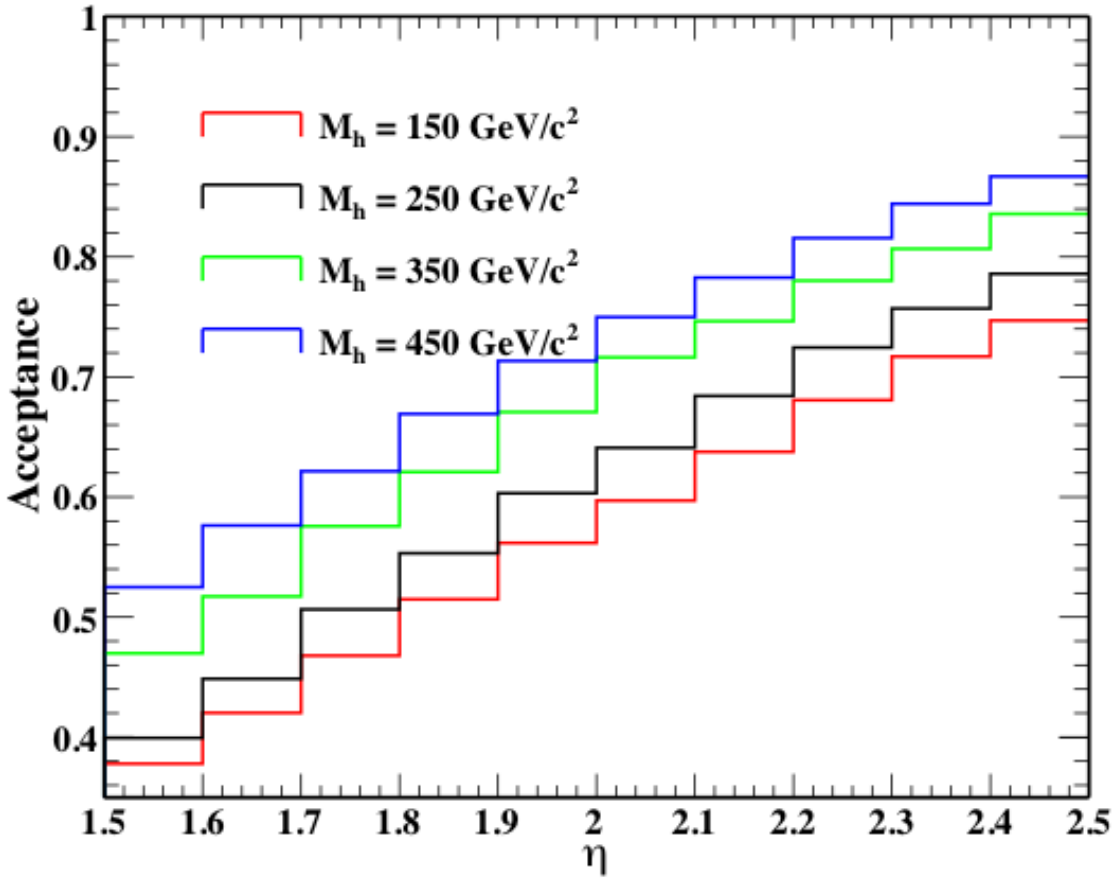
The Physics

1μ	W, t, W', HSCP, etc
2μ	Z, t, Z', HSCP, HWW, etc
3μ	WZ, SUSY, etc
4μ	ZZ, HZZ, etc

The Acceptance

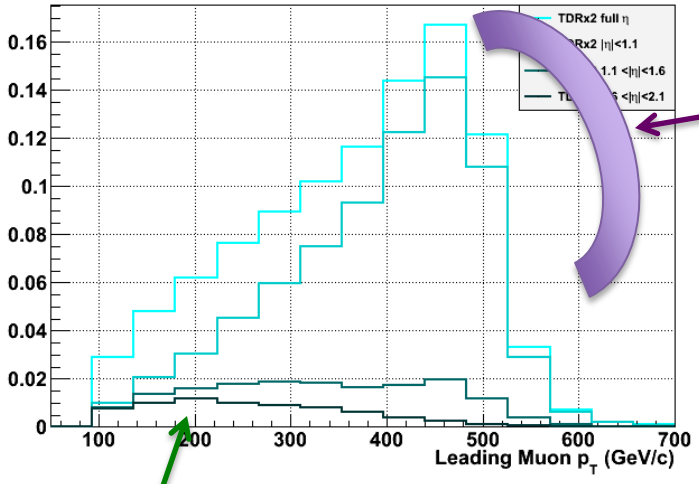
Acceptance Gain
nearly linear
at "low" mass

Ermeticity: ~4π
essential
to avoid fake E_T



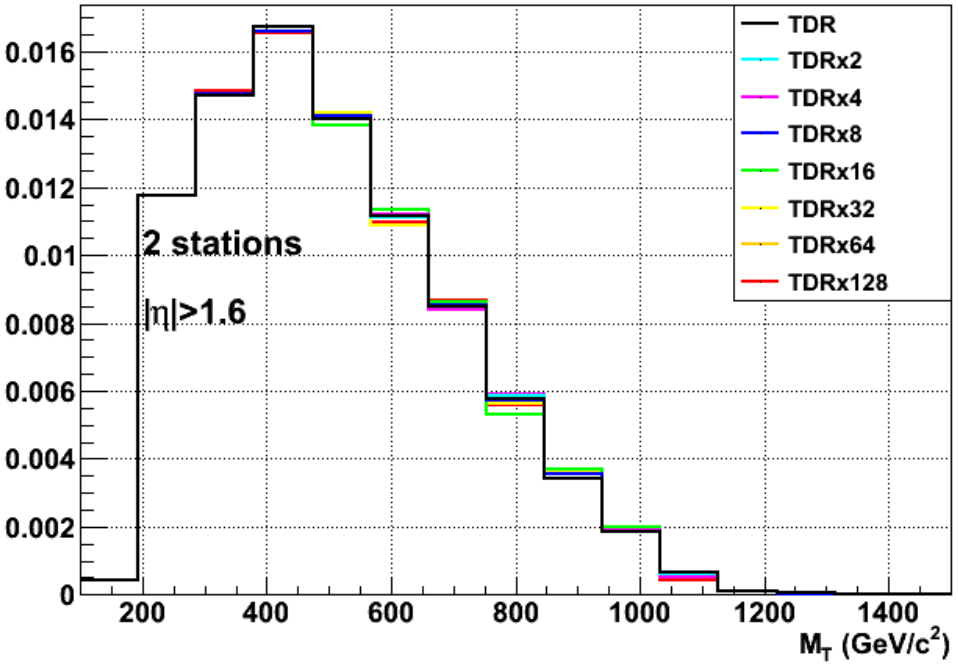
W'

$M_{W'}$= 1 TeV/c2



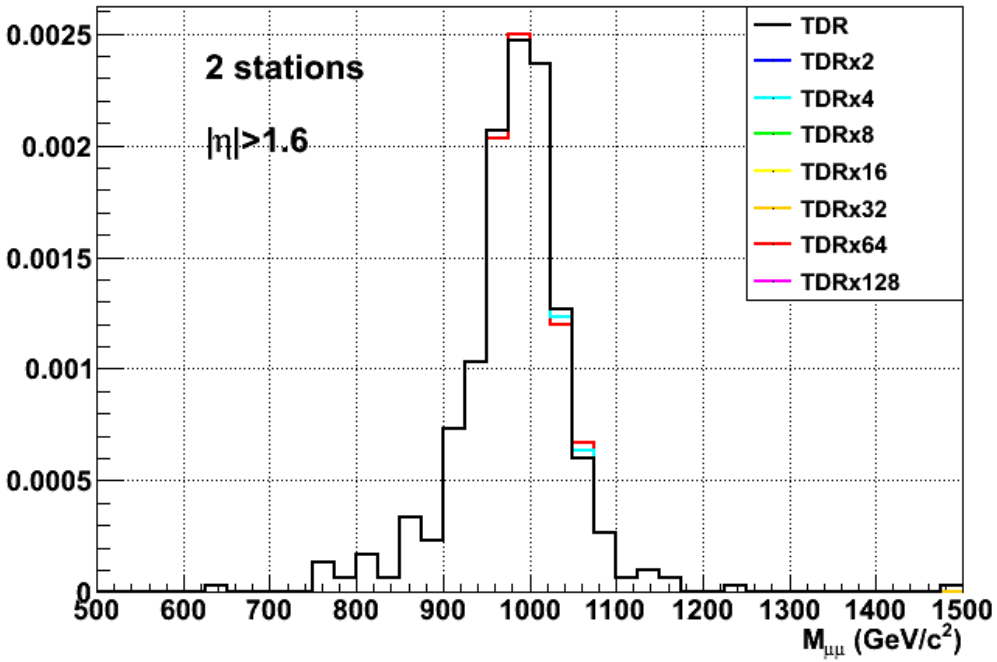
The most sensitive distribution region to W' mass measurement

The GEM region



Z'

$M_{Z'}$= 1 TeV/c2



Precision on Mz' is not determined by the pt resolution

Background rate might benefit from high Pt tail reduction

Outlook

Simulation & Reconstruction

GEM Geometry and Simulation and reconstruction and identification has been studied by using RPC baseline CMSSW SW

We need to start GEM SW development

Physics

Some physics case studied in the ideal CMS conditions

While signals are rather fast to simulate the entire background is basically a huge work the CMS Computing framework is necessary

Conclusion

Devices with high point resolution offers the opportunity to obtain a redundant tracking capability in the region where Muon system contributes significantly

The impact to Muon Id and Physics can be studied only within the official CMS framework