

# Upgrade of the CMS Resistive Plate Chambers for the High Luminosity LHC

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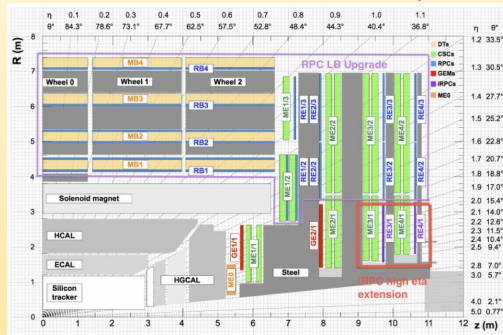


- During the upcoming High Luminosity phase of the CERN Large Hadron Collider (HL-LHC) the integrated pp beam luminosity will be increased to **3000 fb<sup>-1</sup>**
- To ensure a highly performing muon system, several upgrades of the Resistive Plate Chamber (RPC) system of the CMS experiment are currently being implemented
- The upgrade includes the replacement of the readout system of the present system, and the installation of two new RPC stations with an improved chamber and front-end electronics design

The installation of improved RPCs (iRPCs: RE3/1 and 4/1) in the forward region of the 3rd and 4th endcap disks will lead to the extension of the RPC coverage from  $\eta = 1.9$  up to **2.4**.

## Major motivations:

- Enhanced local muon measurement by adding track hits
- Improved intrinsic time resolution by about a factor just over two
- Better spatial resolution of the order of a few cm along the strip direction
- Elimination of reduction in trigger efficiency by including the RPC hits into the trigger primitive stub finding algorithm

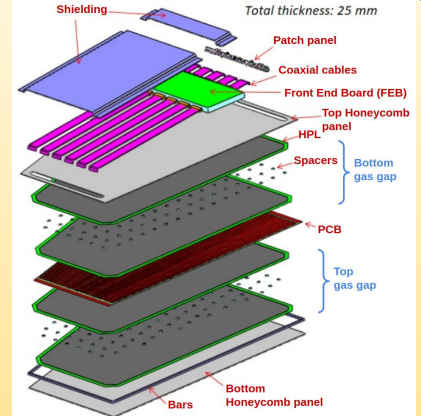


A quadrant of the CMS experiment. The iRPCs will be installed in the region indicated by the red box.

- The RPC chambers are readout, controlled and monitored through the Link System. The data **transmission rate** between the new, upgraded Link system and RPC back-end electronics will **increase to 10.24 Gbps** and **resolution** of the Muon hit time **improves to 1.5 ns**.
- The new Front-End Board (FEB) for iRPCs aims at keeping the iRPC efficiency as high as the current CMS RPC. It uses **sensitive, low-noise electronics** and can sustain a much higher rate (up to 2 kHz/cm<sup>2</sup>)

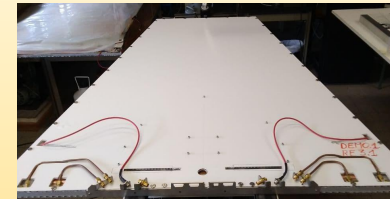
The iRPCs will achieve **higher rate capability** with respect to the current RPC detectors by shortening the recovery time of the electrodes and the **aging effect will decrease** due to the reduction in the integrated deposited charge.

## Schematic layout of the iRPC chamber



As part of the iRPC demonstrator project, **six iRPC chambers** (three RE3/1 and three RE4/1) are developed at Ghent University

- to study the detector behaviour under real LHC conditions: background, noise, B field
- to validate the iRPC FEB and back-end electronics
- to acquire installation expertise on CMS-RE3/1 and RE4/1 regions
- to integrate the new RPC stations into the CMS DCS and DAQ system



The first iRPC chamber built at Ghent University