



Update on the Triple GEM Detectors for Muon Tomography

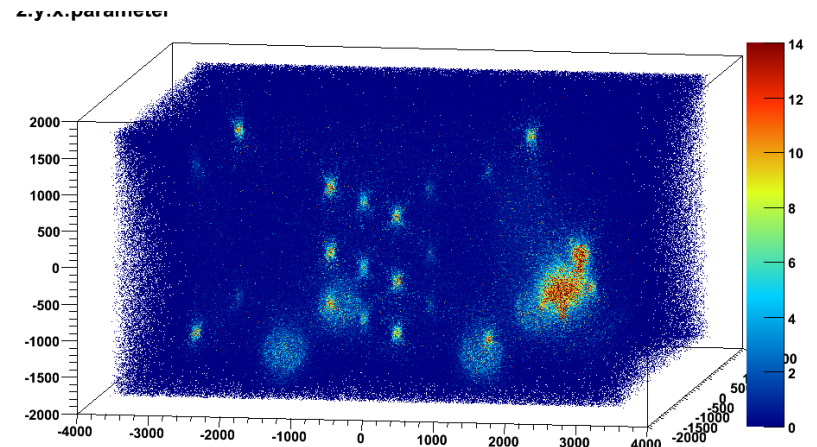
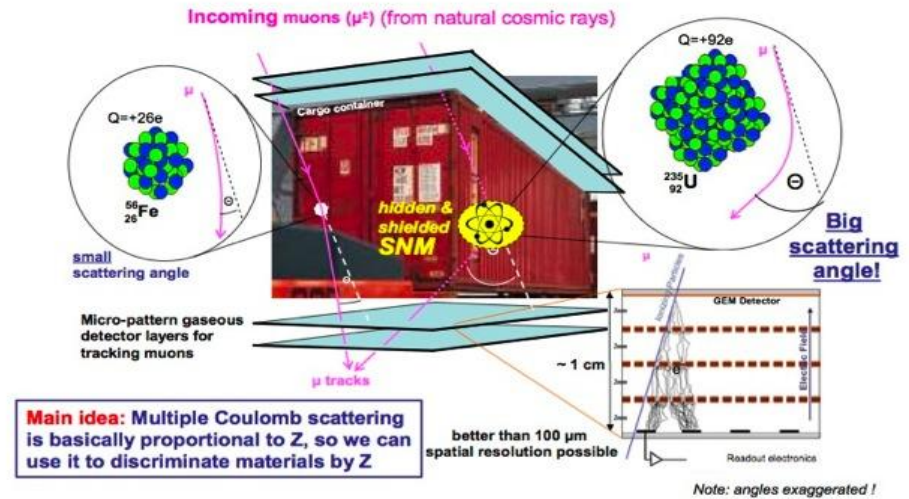
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- Motivation: Large area GEM for Muon Tomography
- Assembly & Commissioning of 10 triple GEMs
- Readout electronics & DAQ system
- Setup of the Muon Tomography prototype
- Plans for the near future

Motivation: Large area GEM for Muon Tomography

- Detection high-Z materials by the mean of Multiple Coulomb Scattering information of cosmic ray muons passing through the materials.
- The nearly Gaussian distribution has a width proportional to the Z-value of the material
- Need large area high precision position sensitive detectors for the tracking of the muons
 - GEM detectors is a promising candidate
- Extensive GEANT4 simulation work of the Muon Tomography
 - Simulation of a truck with different Z-values material after 10 min integration time



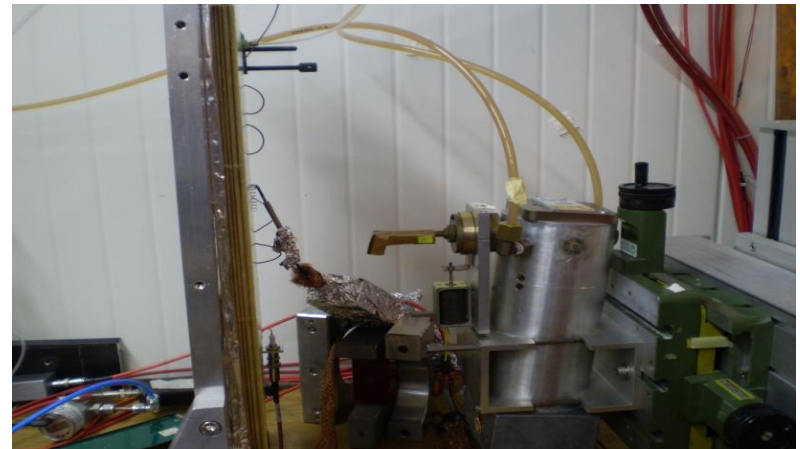
Assembly & Commissioning of 30cm x 30cm Triple GEMs

- **March 2009:**
 - Launch of the production of 10 the TERA foundation like (upgrade of COMPASS design) triple GEM detectors at CERN
 - Some modifications of TERA triple GEM w/r to the stretching and framing procedure
- **June 2009:**
 - First 3 triple GEMs assembled at CERN with the support of GDD group (L. Ropelewski) and PCB workshop (R. de Oliveira).
- **September 2009:**
 - 3 more chambers were assembled
 - Commissioning of the first 3 detectors (preliminary tests).
 - Electronics and DAQ system based on the CAST micromegas readout system
 - Ship material for 2 detectors back to Florida Tech to assemble them here
- **December 2009-January 2010: we plan to...**
 - Assembly of two more detectors (1 triple GEM and 1 double GEM)
 - Full commissioning of the 8 detectors
 - Set up the VME based DAQ to partially readout 4 detectors with Gassiplex FE cards
 - Set up the first MT prototype with 4 triple GEMs and to get first data



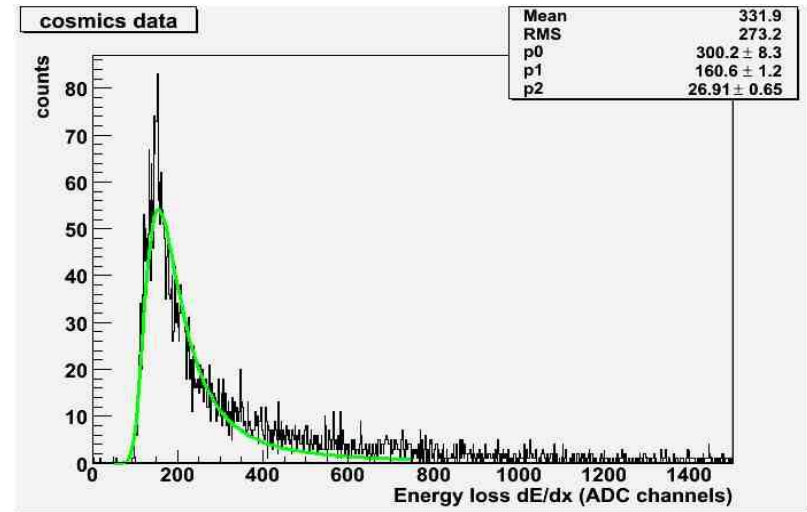
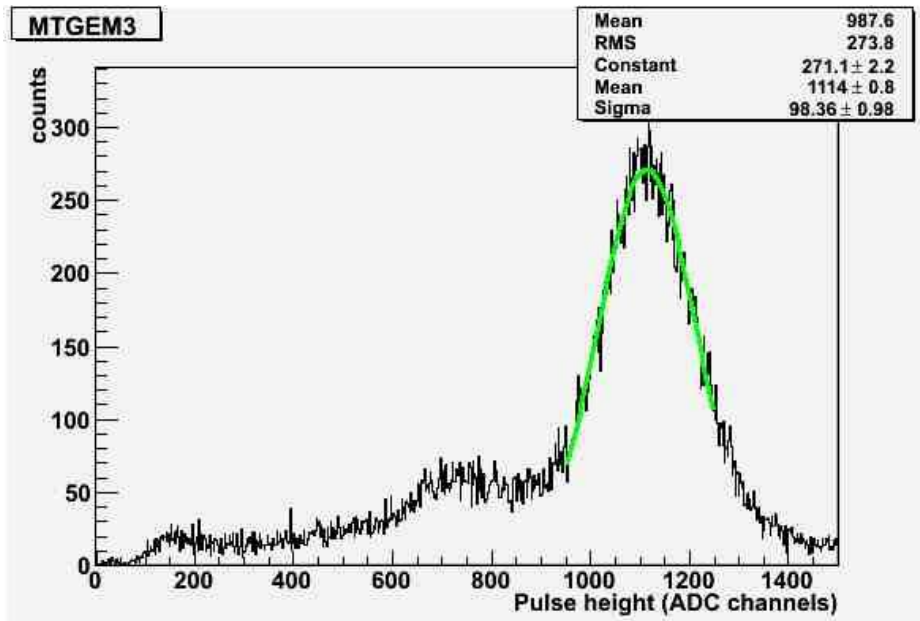
- 6 Triple GEMs assembled
 - Gas flow connections, good gas tightness and the 128 pins PK5S panasonic connectors
 - First 3 with The HV divider already board mounted

- Preliminary tests for 3 first chambers
 - Some early concerns about gas leak but all the 6 chambers show good gas tightness behavior
 - HV board before and after being mounted to the chamber
 - Signal test on X-ray test bench (GDD lab) from a strip 5 cm x 30 cm (one 128 pins connector)



- **First test results**

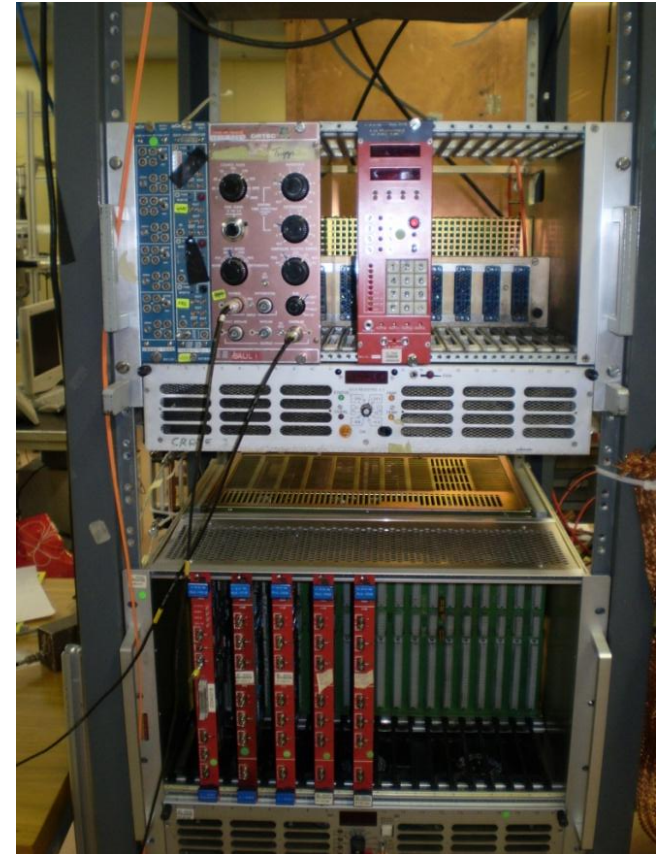
- Good energy spectrum for the 3 first chambers at nominal HV
- No discharge observed
- ~20% energy resolution (FWHM) at 8 keV X-ray



- **First cosmic data**
 - We took 5 hours cosmic data (100 K events recorded) with one of the detectors
 - Pulse height distribution with Landau distribution fit (green curve)
- **More tests (December 09)**
 - Tests for the 5 other detectors
 - Gain curve and uniformity tests of the chambers

- No solution yet to read out the full 10 detectors
 - We would need to readout more than 15 K channels
 - Exploring different options
- For now: Gassiplex FE cards + CAST DAQ system
 - Expect 8 to 16 FE cards (From both Saclay and Democritos)
 - At best, we will be to cover 10 cm x 10 cm area of 4 of our detectors
 - Using CAST/MAMMA telescope VME based DAQ system
- Labview based DAQ software
 - Labview DAQ software developed by Th. Gerialis (Democritos)
 - Made some modifications and need to be tested

- Current state of the readout and DAQ
 - Setup currently sitting at GDD lab at CERN
 - From the CERN Electronic Pool: VME Crate, 4 CRAMs V550, 1 Sequencer V551 ...
 - Wil add 4 more CRAMs (from the MAMMA group) if needed to handle 16 Gassiplex FE
- Adapters card from detectors to FE cards
 - GEM: 128 strips/connector, Gassiplex FE cards: 96 channels
 - Production 12 adapters cards (6 left side cards, 6 right side cards)
 - different from the ones developed at CERN
 - Connection of all 128 strips (paired strips on the edge)
- Labview DAQ software
 - Modifications => Ability to handle up to 8 V550 modules
 - Simplification => remove part specific to CAST experiment (calibration, trigger system ...)
- To do in early December 09 (next week...)
 - Complete the setup of the DAQ hardware
 - Get the system work using the modified labview software
 - Put all things together with the detectors and FE cards



GEM based Muon Tomography prototype

- We want to take cosmic data with GEM Muon Tomography
 - Even with limited electronics to readout the detectors
 - Start with 4 detectors (2 on top and 2 on the bottom)
 - Partial readout of the detectors area
- Stand for the Muon Tomography prototype
 - Simple design for only top and bottom only MT setup
 - We are shipping the stand to CERN for the cosmic data taking
- External trigger of the system
- Setup of the GEM MT prototype



- Large area GEM detectors for Muon Tomography
 - Ultimately, we want to build a 1m x 1m size triple GEM (2010)
 - Many groups has similar in large GEM detectors (see Acharna's talk)
 - We want to look at mechanical design issues with GEM foils
 - Stretch free GEM for large area detector
 - We would like to start study with 10 cm x 10 cm triple GEM with honeycomb spacer
 - Testing different pitch for honeycomb spacer
 - We would like to get GEM foil samples to start the studies
- Readout electronics & DAQ system
 - Fully readout of our 10 current detectors
 - Same system for the large area 1m x 1m GEM prototype
 - We are mainly interested in APV chip for the front end electronics
 - RD51 WG Scalable Readout System
 - Developing FE to use CAST like DAQ system