Testing of Real-Size Prototype GEM detectors for CBM-MUCH with Pb+Pb Collisions at SPS CERN

(For CBM Collaboation)

Advanced Detectors for Nuclear, High Energy and Astroparticle Physics
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Plan of the talk

- Motivation for the Pb+Pb test at SPS
- Schematic of Experimental Setup
- Data taking at different run
- Results
Motivation for the Pb+Pb test at SPS

- Almost whole area of the detector is populated with particle beams.

- For this we need many FEBs --> which requires cooling of chips (one real size prototype GEM chamber require 15 FEBs).

- Two water based cooling plates are built:
  1. At Bose Institute (6 mm Al pipe winding inside 10 mm Al plate)
  2. At VECC (Grooved channels inside 10 mm Al plate)

- New CBM DAQ
  1. Old readout chain

- New readout chain

Diagram:

1. Old readout chain:
   - Detector → FEB → ROC → ABB Board / Ethernet → DABC (DAQ)

2. New readout chain:
   - Detector → FEB → AFCK (AMC FPGA Carrier - Kintex) → FLIB (FLES Interface Board) → FLES (First Level Event Selector) → CPU
   - Copper link → Optical link → Time synchronization
Schematic of experimental setup

Beam energies: 13 AGeV/c, 30 AGeV/c, 150 AGeV/c
Target: Lead (1 mm thickness)
Lateral view of the experimental setup
Experimental setup

Target (Pb)
AFCK board with nDPB configuration for MUCH

mTCA crate
Data were taken in 4 phases

1. Phase 1: Preliminary test without beam

2. Phase 2: 13 AGeV/c (only GEM1 was used for testing)

3. Phase 3: 30 AGeV/c (GEM1 and GEM2 was used for testing)

4. Phase 4: 150 AGeV/c (GEM1, GEM2 and GEM3 was used for testing)
(We have also used 20 cm thick Fe absorber in front of GEM2 and GEM3 in phase 4 data to study the absorber effect.)

**GEM1:** Real size prototype GEM (Trapezoidal shaped) built at VECC

**GEM2:** Real size prototype (Trapezoidal shaped) built at RD51 Lab CERN

**GEM3:** Small size prototype 3 built at GSI (10 cm x 10 cm dimension)
Baseline ADC histogram

ADC vs channel number

ADC histogram for one channel
ADC histogram

Raw ADC histogram of GEM2

Baseline corrected adc histogram for one FEB and 10 channels combined
Spill structure for GEM1

![Graph of Spill Structure for GEM1](image)

Spill structure for GEM2

![Graph of Spill Structure for GEM2](image)
Time Correlation

Time Correlation between f0-f1 of 6161

Time Correlation between f0-f2 of 6161

Time Correlation between f1-f2 of 6161

Time Correlation between f0-f3 of 4ef6
Time Correlation

Noise correlation

Time Correlation between gem1-gem2

TimecorrelationG2G1
Entries 1.845467e+07
Mean 127.9
Std Dev 739

TimecorrelationG1G2
Entries 2830455
Mean −8.109
Std Dev 24.64
χ² / ndf 152.9 / 22
Constant 708.4 ± 9.3
Mean −7.934 ± 0.249
Sigma 22.24 ± 0.22
Thank You for your kind attention
Experimental Setup
Pb+Pb Collisions

1. At 13 AGeV/c

Only prototype 1 was tested

2. At 30 AGeV/c

2 prototype was tested

3. At 150 AGeV/c

3 prototype was tested