Test beam results of prototypes for the CBM-TRD at DESY and GIF++

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Outline

• The TRD at the CBM experiment
• Principle of operation
• DESY beam time
• GIF++ beam time
The Compressed Baryonic Matter Experiment

Main Tasks of the TRD:
- Electron identification
- Reconstruction of light nuclei
  → HK 31.3 (Wed 14:45)
  → HK 52.12 (Thu 16:30)
The Transition Radiation Detector

- 54 chambers per detector layer
- Two chamber sizes
- Four different pad granularities
- Signal collection time under 0.3 µs

hit rate / channel [kHz]
Multi Wire Proportional Chamber

**Entrance window:**
- 20µm Kapton foil
- Aluminized
- Potential: -150 V

**Pad plane:**
- PCB material (FR4)
- 35µm copper plated
- Segmented into pads
- Potential: 0V (ground)
Multi Wire Proportional Chamber

Cathode wire plane:
- Copper-Beryllium wires
- 79 µm diameter
- Potential: 0 V (ground)

Anode wire plane:
- Gold plated tungsten wires
- 20 µm diameter
- Potential: 1850 V
Multi Wire Proportional Chamber

drawings of the chamber and particle tracks

time

pion  electron
Multi Wire Proportional Chamber

pion  electron

![Diagram of Multi Wire Proportional Chamber](image)

![Image of pion and electron trajectories](image)

![Graph showing dE/dx + TR vs. Hits](image)
First Large Chamber Prototypes

Entrance window

Back panel

Wire ledges with anode- and cathode-wire planes
First Large Radiator Prototypes

Radiator material in between the supporting grid

Large radiator prototype
Front End Electronics

SPADIC (Self-triggered Pulse Amplification and Digitization ASIC)
- 32 channels
- 9-bit ADC
- Self-triggered
- Digital shaper
Test Beam At DESY II

Systematic analysis of detector response
• PID performance
• Electron efficiency
• Position resolution
• Tracking

→ Basis for the optimization of detector simulation software
Setup at DESY

→ HK 52.38 (Thu 16:30)
Setup at DESY

Large chamber and radiator prototypes

DAQ rack with AFCK boards

→ HK 12.5
First Results

Spectra of layer 1 (3GeV electron beam)

Entries

Charge / ADC Values

Without radiator

With radiator
Testbeam At The Gamma Irradiation Facility

- Dedicated facility for testing the long-term behavior of large particle detectors
- 13.7 TBq Cesium Source
- Main $\gamma$ emission at 662 keV
- $\mu$-Beam
Setup At GIF++

- Cesium source
- Detector prototype
- Attenuation filter and beam optics
- FEE
- Cesium source
First Results Of The GIF++ Test Beam Campaign

• Stable performance of detector and readout under high load

Still under investigation:
• Influence of the attenuation filters on the γ spectrum
• Simulation of the expected charge deposit in the detector
Summary

• First results of both test beam campaigns look promising

• A lot of work ahead of us

• DESY
  ▪ PID performance
  ▪ Position resolution and tracking
  ▪ Electron efficiency

• GIF++
  ▪ Influence of the filters
  ▪ Simulation of the charge deposit

• Improve the simulations