

## In-beam performance studies of the first full-size CBM-TRD prototypes developed in Frankfurt\*

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### Introduction

For the Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) a Transition-Radiation Detector (TRD) is being developed. Its goal is to provide a good particle identification and tracking performance in the high particle-density environment of the experiment. The aim is to achieve 90 % electron efficiency with a pion miss-identification below 1%. For the test beam at the CERN-PS in October 2012 [1] full-size prototypes were build and used. Detailed information about the prototypes and their manufacturing can also be found in this report [2].

To match the challenge of the high-flux environment in the CBM experiment, we employ thin symmetric Multi-Wire Proportional Chambers (MWPC), with a single wire plane, 8 or 10 mm gas volume region, and a 20  $\mu\text{m}$  thick aluminized mylar-foil as cathode plane and at the same time entrance window. In order to maximize electron-identification power, the optimization of the radiator performance is essential. During the test-runs in October 2012 several different types of radiators have been tested, including regular and irregular foil radiators, several foam radiators and fibre radiators. In addition to the radiator scan, the dependence of the gas-gain on the gas-pressure inside the chambers was measured, to investigate the deformation of the mylar-foil and its influence on the gas-gain.

### Measurements

Two prototypes with dimensions of  $60 \times 60 \text{ cm}^2$ , one with a 4+4 mm and the other one with a 5+5 mm gas gap [2], were used with a SPADIC rev 0.3 [3] readout-chain for the measurements at the CERN-PS. The radiator scan included 15 different radiators and was performed with a 3 GeV/c mixed electron-pion beam.

### Results

Figure 1 displays the signal of electrons and pions averaged over one run. The dashed curve are electrons with FFM R002 (shown in Figure 2) as radiator, the signal below the dashed curve are electrons without a radiator and the filled area is the average pion signal. The used radiator is made out of polyethylene foam with a bubble-diameter of about 1 mm, which corresponds to approximately 260 surface boundaries for a total radiator thickness of 26 cm.

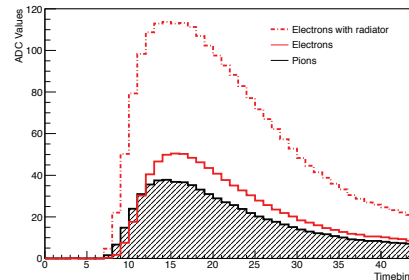


Figure 1: Average electron and pion signal of the 5 + 5 mm prototype without a radiator and with the FFM R002 radiator.

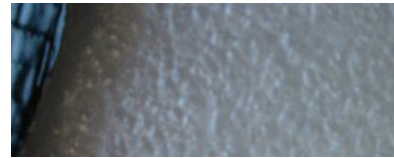


Figure 2: The radiator FFM R002. It consists of polyethylene foam with a bubble-diameter of about 1mm.

The measurement shows a difference of more than a factor two between the electron signal with and without the FFM R002 radiator. At the same time the FFM R002 is cost efficient and mechanically stable, which makes it an attractive choice for a radiator material.

### Outlook

The next steps of the CBM-TRD development will be to investigate combinations of the thin entrance window and the stiff radiator, in order to minimize the deformation of the entrance window.

### References

- [1] D. Emschermann et. al., "Common CBM beam test of the RICH, TRD and TOF subsystems at the CERN PS T9 beam line in 2012", this report.
- [2] E. Hellbär, et al., "Construction and simulations of full-size CBM-TRD prototypes without drift region", this report.
- [3] T. Armbruster, et. al., "CBM-TRD readout with the SPADIC amplifier / digitizer chip", CBM Progress Report 2010, Darmstadt 2011, p. 44.

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