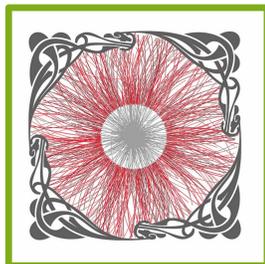




The CBM-RICH detector

J. Kopfer for the CBM-RICH collaboration
Justus-Liebig-Universität Gießen, Bergische Universität Wuppertal, jan.kopfer@uni-wuppertal.de

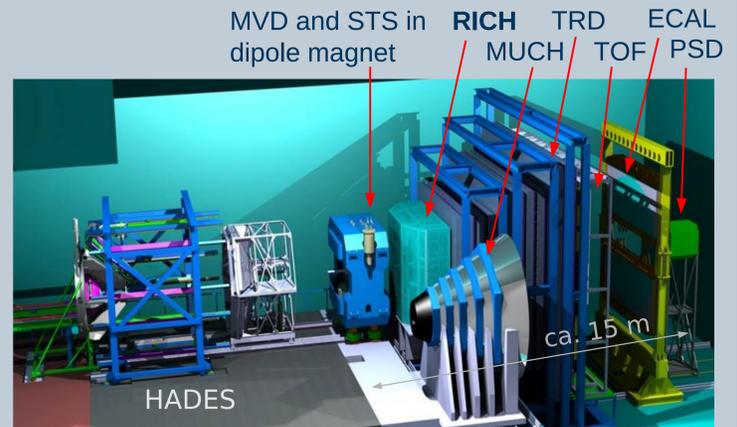


The CBM experiment

- Exploration of the phase diagram of nuclear matter at high net-baryon densities [1]
- Unprecedented statistical precision
- Important observables: light vector mesons and charmonia, accessible via decay in lepton pairs
→ ideal probes due to lack of strong interaction with the medium
- Measurement of such rare probes requires clean and efficient electron identification
→ RICH + TRD detectors

The CBM detector will consist of

- Silicon tracking system (STS) and micro vertex detector (MVD) in magnetic field
- Time-of-flight detector (TOF)
- Ring imaging Cherenkov (RICH) and transition radiation detector (TRD)
- Muon detection system (MUCH)
- Electromagnetic calorimeter (ECAL)
- Forward calorimeter (PSD)
- Ultra-fast data acquisition (DAQ) and online first level event selection (FLES)



The RICH detector

Requirements

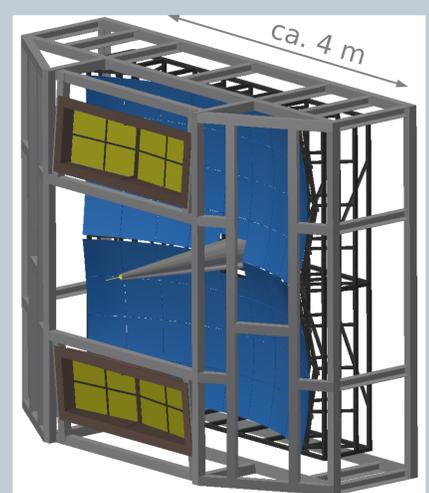
- Electron identification for $p < 10$ GeV/c in environment characterized by
 - Interaction rates up to 10 MHz
 - High track density from ≈ 1000 charged particles in central Au+Au collision
 - Large number of secondary electrons due to material budget in front of RICH
 - Magnetic stray field due to vicinity to CBM dipole magnet
- Pion suppression of 500-1000
- Wide acceptance

Design

- Focussing RICH detector geometry
- Camera: MAPMT or MCP-PMT (H8500, XP85012), 2.4 m², 55k channels
- Mirror: Simax glass with Al+MgF₂ coating, R = 3 m, d \leq 6 mm, 11.8 m², tiles of 40x40 cm²
- Radiator: CO₂ at 2 mbar overpressure, V \approx 30 m³, radiator length 1.7 m
- Free streaming self-triggered electronics, time-stamped data

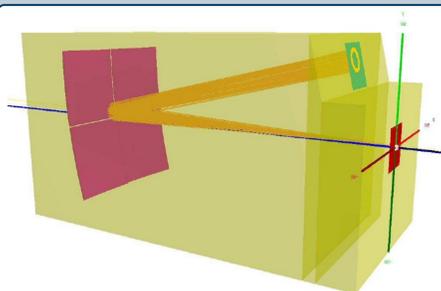
Reconstruction

- Local search of ring candidates based on Hough Transform
- Ring fitting using Chernov-Ososkov-Pratt algorithm
- Ring selection via determination of ring quality with artificial neural network
- Matching reconstructed rings with STS tracks using excellent tracking information

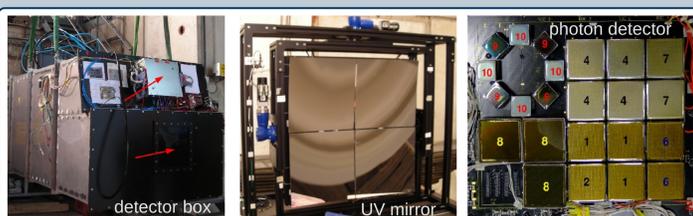


Prototype tests

experimental setup



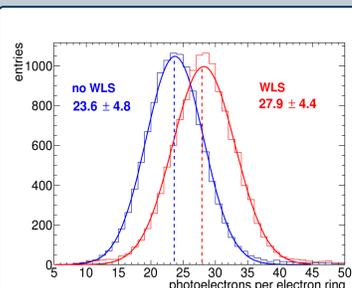
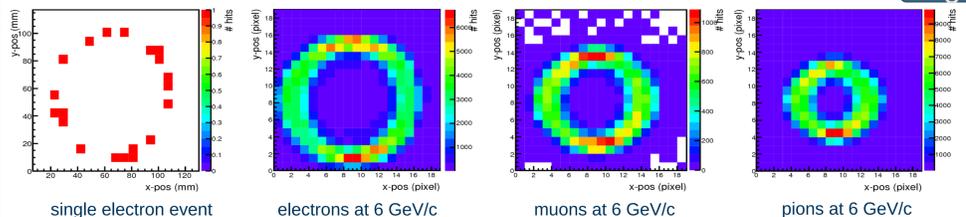
Prototype real-size in radiator and focal length, tested in-beam (e^- , π^-) at CERN PS/T9 [2]
- CO₂ radiator
- MAPMT array as photon detector
- remote tilting of mirror allows to focus rings on different parts of photon detector



components

equal to those foreseen for the full CBM RICH detector

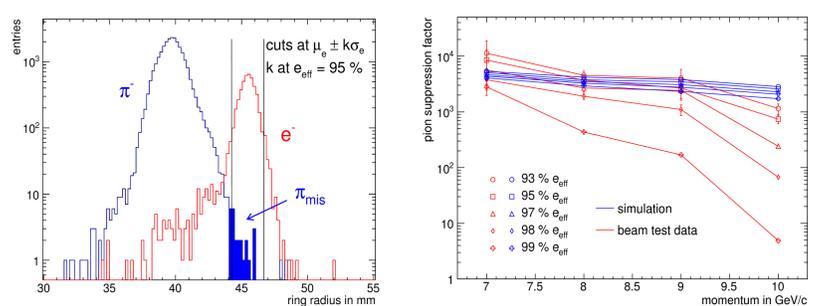
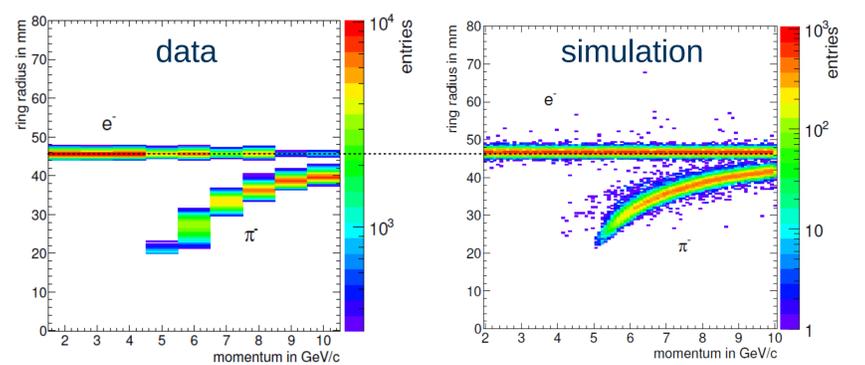
rings



- Number of photoelectrons per electron Cherenkov ring on H8500D-03 in agreement with MC
→ $N_0 = 154$ cm⁻¹
- Hit multiplicity can be increased by ≈ 20 % using wavelength shifting films without decrease in ring resolution [3]

hit multiplicity

pion suppression



pion suppression factor: π/π_{mis}

- ➔ CBM-RICH concept verified with real-size prototype
- ➔ Performance of detector components (radiator, mirror, photon detector) understood
- ➔ Ring reconstruction routines tested with real data
- ➔ Beam test results in terms of hit multiplicity and pion suppression in agreement with expectation from MC

[1] The CBM Physics Book, Eds. B. Friman et al., Lecture Notes in Physics (2011)
[2] J. Adamczewski-Musch et al, "The CBM RICH project", NIMA (2014)
[3] J. Adamczewski-Musch et al, "Wavelength shifting films on multianode PMTs with UV-extended window for the CBM-RICH detector", NIMA (2014)

