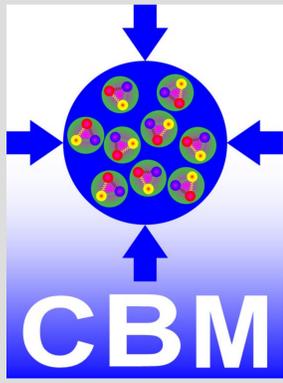


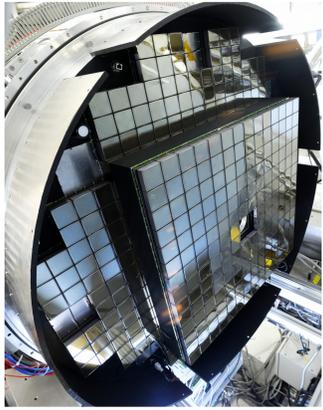
The HADES RICH upgrade within the FAIR Phase-0 program

HADES

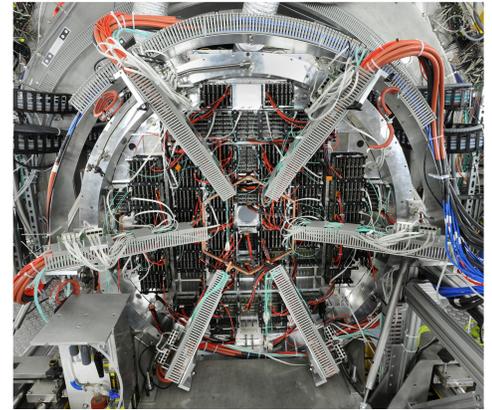
Adrian Amatus Weber for the HADES and CBM collaborations
 Justus-Liebig Universität Gießen, Germany
 contact: adrian.a.weber@exp2.physik.uni-giessen.de



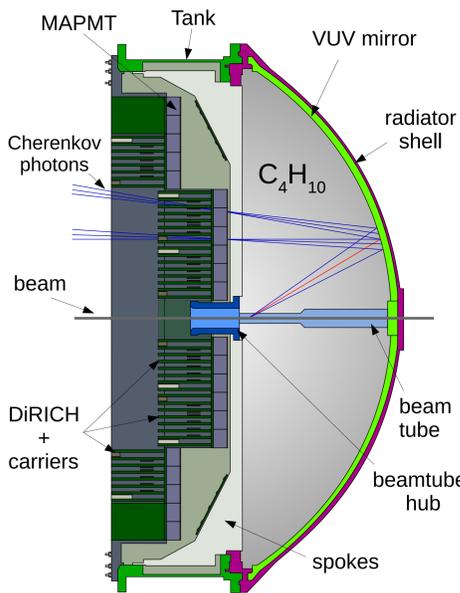
Motivation



- The High Acceptance DiElectron Spectrometer (HADES) is installed at the SIS18 accelerator of GSI
- HADES is designed to study baryonic matter in light and heavy systems
- The HADES RICH detector is a key part for the electron identification especially in low momentum regions
- The upgrade ensures stable RICH operation for the future FAIR program
- Improvement in close-pair DiElectron reconstruction
- HADES RICH also serves as a large scale prototype for the CBM RICH detector
- The upgrade profits from synergys between the CBM and HADES experiment (e.g. sharing of photon sensors)



Hardware Upgrade



- The old CsI based photocathode of the detector was replaced by 428 modern Hamamatsu H12700 MAPMTs
- The mirror and the radiator volume were kept the same (No aging visible)
- CaF_4 window between detector and radiator volume was removed to reduce scintillation background (originally needed to separate radiator- from detector gas)
- New beamtube hub installed to reduce Delta-Electrons in HADES

- The whole detector volume is from now on filled with C_4H_{10} as radiator gas
 - suppression of scintillation light by orders of magnitude
 - same index of refraction as C_4F_{10}

Readout Electronics Upgrade

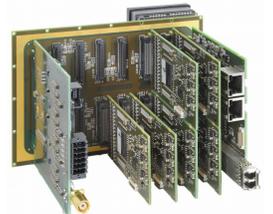
- The MAPMTs are read out using 856 newly developed DiRICH front-end boards
 - FPGA based TDC readout
 - high precision signal Time- and Time-over-Threshold measurement (*MAPMT transit-time-Spread TTS is limiting factor*)
 - 32 channels per DiRICH module
 - prepacked dataflow from backplane modules with 12 DiRICHs each
- All 6 MAPMTs per backplane share same HV channel
 - MAPMTs are gain matched
- Individual threshold determination for all 27392 channels
- Temperature and gas mixture monitoring for excellent performance and safety



A combiner module for trigger and data handling



One single DiRICH board (v1)



Backplane with DiRICH boards, combiner and power module

Performance of the detector in Ag+Ag collisions @ 1.58AGeV

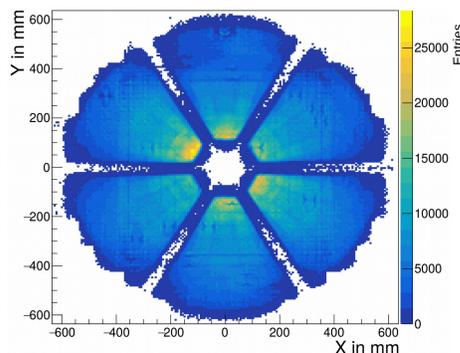


Fig. 1 : Ring center distribution from real data

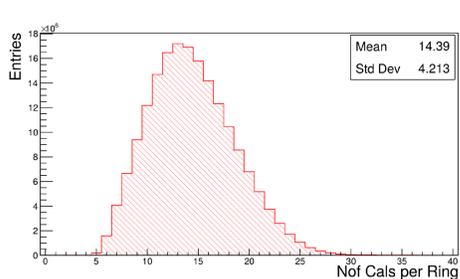


Fig. 2 : Number of Hits in ring from real data

- RICH identified electrons are homogeneously distributed over full detector (Fig. 1)
- Found rings have in average 14 hits at a radius of 23 mm (Fig. 2, 3)
 - comparable with simulations (Fig. 4)
- Single photon timing precision for full detector better than 250ps sigma
- ToT cuts suppress (capacitive) cross talk (Fig. 7)
- Additional cuts on hit arrival time increase electron reconstruction purity (Fig. 5, 6)
- Low level of non-coincident background (dark noise) and coincident background (scintillation light) per event thanks to timing precision (Fig. 7)

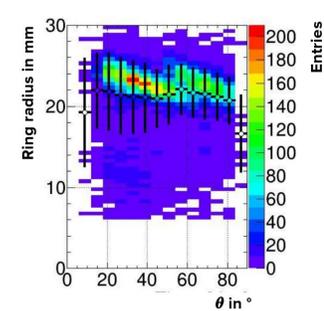


Fig. 3 : Ring radius from real data

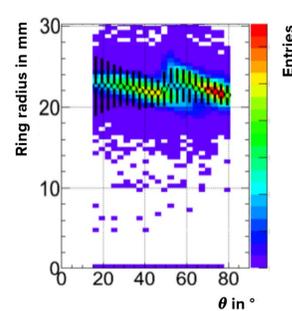


Fig. 4 : Ring radius from simulation

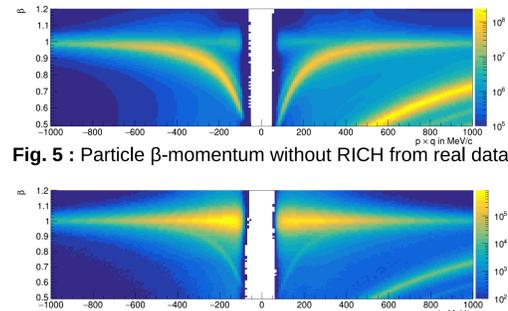


Fig. 5 : Particle β -momentum without RICH from real data

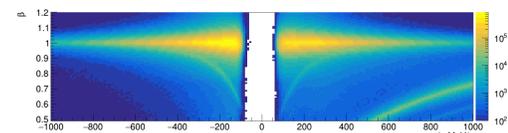


Fig. 6 : Particle β -momentum with RICH from real data

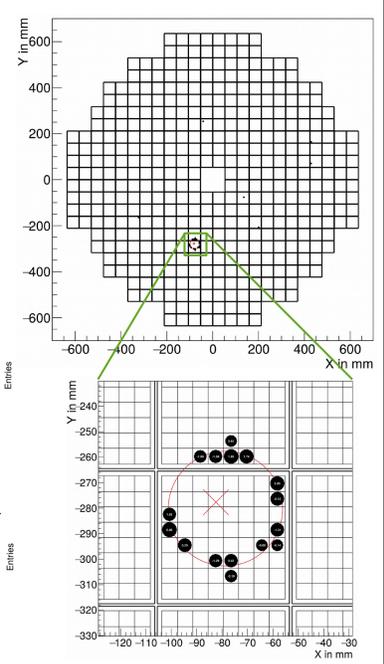


Fig. 7 : Single event display from real data with tight cuts