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Status of the development of the RICH detector for CBM including a mRICH prototype in mCBM

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The Compressed Baryonic Matter (CBM) experiment is being built at the future Facility for Antiproton and Ion Research (FAIR) next to GSI, Darmstadt, Germany. The fixed-target CBM experiment will explore dense baryonic matter at moderate temperatures produced in A+A collisions at beam energies from 2-11 AGeV. In the matter being created in this collision process, conditions are achieved as they are present in mergers of neutron stars. A key diagnostic probe in order to characterize this matter created in the laboratory is electromagnetic radiation from the fireball, e.g. giving access to its temperature or its lifetime. In CBM, virtual photons will be measured through the reconstruction of di-electrons, the electrons being identified with a gaseous RICH detector and several layers of TRD detectors.

The CBM RICH detector is under development since long, and recently passed the threshold to construction with first mass production of part of the electronics. A full-size prototype of one of the two photodetector planes is under construction in order to test the mechanical stability, handling and the air-cooling concept. Approximately half of the H12700 MAPMTs are temporarily in operation in the upgraded HADES RICH detector. The DiRICH based readout chain now running in HADES has been commonly developed and will also be integrated in CBM. However, in contrast to the triggered HADES readout, CBM will be operated with a free-streaming readout where all detectors send their data with precise time stamps to a central GPU farm for event building and trigger decision. This way, interaction rates of up to 10 MHz will be recorded. In order to test this novel readout concept, a “mini-CBM” (mCBM) experiment has been set up with prototypes of all CBM subdetectors implementing the full functionality of the future free-streaming readout already here. For this purpose a “mini-RICH” (mRICH) detector has been constructed in a proximity focussing geometry using aerogel tiles as radiator. The DiRICH readout has successfully been adopted to the free-streaming CBM readout making use of microtimeslices readout by regular triggers. Recorded data are used to develop AI based noise reduction and ring finding algorithms which will be compared to the so far used Hough Transform.

In this report, a brief update on the development and status of the CBM RICH detector will be given. Main focus of the talk will however lie on the successful construction, operation and characterization of the mRICH detector with free streaming readout. The performance will be evaluated with data recorded in several beamtimes at GSI FAIR phase 0.

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