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A SiPM-based readout system for the CBM's RICH

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Comprehension of the QCD phase diagram opens a window for a better understating of matter dynamics inside massive objects like neutron stars. The Compressed Baryonic Matter experiment (CBM) at FAIR shall measure products coming out from ion collisions to study the equation-of-state of matter at high densities, to search phase transitions, chiral symmetry restoration, and exotic QCD matter. Tracking and particle identification detectors assembled along the collision axis of the CBM, record information of the particles popping up from the primary ion interaction to elucidate their predecessors and decaying channels. One of these novelty detectors is a Ring Imaging Cherenkov (RICH) counter. The CBM's RICH encloses two concave photon cameras pointing towards two spherical glass mirrors focusing Cherenkov photons produced by the interaction of charged particles with a CO2 radiator volume. The photon cameras use H12700 Multi-Anode Photomultipliers (MAPMTs). Low dark counts and radiation hardness characterize MAPMTs, but sensitivity to external magnetic fields, poor granularity, low photo-detection efficiency, and high operation voltages circumscribe their main drawbacks. Those MAPMT disadvantages have encouraged to explore new photo-detection technologies for improving timing, spatial, and amplitude resolutions. Silicon photomultipliers (SiPMs) fulfill those requirements, but the implementation of a SiPM-based RICH carries challenges due to SiPM's temperature dependency and high dark count rate. We present the design and test of a SiPM frontend electronics adapted to the CBM's RICH readout system. We implemented an 8×8 SiPM (AFBR-S4N66P024M) array, coupled to a 64-channel amplification board made of highly linear and low power-consumption amplifiers (12 mW/channel). We analyze the inter-channel signal variance, as well as, the noise levels and triggering methodologies.

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