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Beam and Background Monitoring System for the CBM Experiment at FAIR/GSI

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The CBM (Compressed Baryonic Matter) experiment at GSI/FAIR (Darmstadt) is scheduled to start data taking in 2028. The main goal is to study the phase diagram of QCD in the region of high baryon densities. Extreme conditions will be realized at the accelerator complex SIS100 (FAIR) in the energy domain of 2 -10 GeV/nucleon. Statistically important data require high frequencies of nuclear interactions: 0.1 - 1 MHz (2028), 10 MHz (2030 - 2032), 100 MHz. (after MAPS modernization 2035-2040). High radiation loads need to be permanently monitored to provide safe and effective conditions of the experiment.

We shall present two options of building relevant radiation monitoring system. The general approach for the proposed options is based on the metal foil detectors technology, proved to be radiation hard and reliable. Straight-forward solution foresees to exploit the detectors assembly RMS-R3 operating in the LHCb experiment till the end of RUN-3 data taking in 2026. Some results will be presented demonstrating is excellent performance. In particular, the impressive results obtained by applying asymmetry method show the RMS-R3 capability to monitor the evolution of instantaneous luminosity as well as reproducibility of the safe and effective beam and background conditions.

Given the fact of a limited space and desire to minimize the radiation length we have worked out the second option of th monitoring system, named MS-SL-CBM-R1 (Monitoring System-Super Light for the CBM RUN-1). While the construction layout remains the same as in the RMS-R3 case, the building elements are different Targeting the minimization of the overall thickness. This is possible by the fact that operational; principle of the Metal Foil Detectors I based on the Secondary Electron Emission taking place in about 50 nm surface layer of a sensor foil under the hit by charged particles. Th whole detector assembly is built in a plane perpendicular to the beam axis symmetrically in the vertical and horizontal directions allowing to apply an asymmetry method for monitoring of the interaction region and background contribution.

Authors: CHAUS, Andrii (INR NAS of Ukraine); Пан CHERNYSHENKO, Serhii (INR NAS of Ukraine); PUGATCH, Valery (Institute for Nuclear Research, National Academy of Sciences of Ukraine(KINR)); КИВА, Володимир (ІЯД НАН України); РАМАЗАНОВ, Дмитро (ІЯД НАН України); ПУГАЧ, Михайло; КШИВАНСЬКИЙ, Олександр (ІЯД НАН України); КОВАЛЬЧУК, Олексій (ІЯД НАН України)

Доповідач: PUGATCH, Valery (Institute for Nuclear Research, National Academy of Sciences of Ukraine(KINR))

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