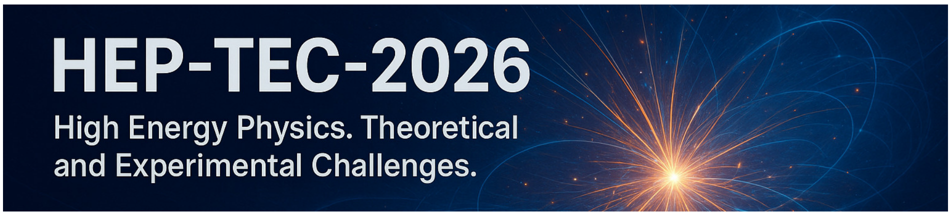

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SIMULATION OF THE RADIATION MONITORING SYSTEN PROTOTYPE FOR THE CBM EXPERIMENT

Thursday, January 15, 2026 12:40 PM (20 minutes)

The Compressed Baryonic Matter (CBM) experiment at FAIR is designed to explore the QCD phase diagram in the region of high baryon density and low temperature using high-intensity proton and heavy-ion beams. The unprecedented interaction rate, reaching up to 10 MHz, results in a severe radiation load on detector components, making continuous radiation monitoring a critical requirement for stable and safe operation.

To address this challenge, the Institute for Nuclear Research of the National Academy of Sciences of Ukraine proposes the RMS-CBM radiation monitoring system, based on the proven RMS-R3 technology developed for the LHCb experiment. Owing to its compact design, radiation tolerance, and operational reliability, this technology is well suited for forward fixed-target experiments such as CBM.

As part of the RMS-CBM prototype development, an electronic simulation of the detector module was carried out using the LTspice environment. A simplified electronic equivalent was implemented to achieve realistic behavior with moderate computational complexity. The model includes resistive representations of metallic sensor and accelerating foils, parasitic capacitances between layers, a current source modeling the radiation-induced charge signal, and a simplified two-stage charge-sensitive integrator. Time-domain simulations demonstrate stable amplification of short charge pulses with the expected signal shape, confirming the conceptual validity of the detector and integrator architecture. Noise spectral density analysis shows that the equivalent noise charge is of the order of 1 ke-, which satisfies CBM performance requirements and ensures reliable signal detection under high-rate conditions.

The simulation results confirm the technical feasibility of the RMS-CBM concept and its suitability for operation in the harsh radiation environment of the CBM experiment. Future work will focus on refining the electronic model by implementing a complete integrator circuit and detailed signal transmission elements, allowing precise evaluation of dynamic range, linearity, and long-term stability.

Author: KSHYVANSKYI, Oleksandr

Presenter: KSHYVANSKYI, Oleksandr

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