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FROM LHCb TO ENVIRONMENT MONITORING

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The Radiation Monitoring System for Run3 (RMS-R3), designed and manufactured at the Institute for Nuclear Research of the National Academy of Sciences of Ukraine, has been operating as part of the LHCb detector at CERN since late 2021 [1,2]. The system is based on metal foil detectors utilizing secondary electron emission [3]. It provides independent online luminosity monitoring critical for the experiment's feedback control scheme with the LHC control center.

During 2022-2025, RMS-R3 monitored diverse LHCb operational modes: pp collisions at $\sqrt{s} = 13.6$ TeV with luminosity up to $2 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$, PbPb collisions at $\sqrt{s_{\text{NN}}} = 5.36$ TeV (up to $9 \times 10^{26} \text{ cm}^{-2}\text{s}^{-1}$), and others AA collisions with fixed-target configurations with SMOG2 gas injection (pAr at $\sqrt{s_{\text{NN}}} = 133$ GeV, PbAr at $\sqrt{s_{\text{NN}}} = 70.9$ GeV, etc.). The system achieved $\pm 5\%$ luminosity measurement precision through calibration with PLUME [4], while RMS-R3 asymmetry analysis methods enabled tracking of interaction region positions and experimental conditions. Integration with LHCb's ECS (WinCC-based) and MONET web monitoring provided real-time operational tools for experiment control.

The extensive operational experience with RMS-R3 under harsh radiation conditions and diverse beam configurations initiated the development of mobile system for real-time observation (MSODR-E) and display of the radiation status in the environment as well as for radiation therapy. Three detector types integrated for complementary capabilities: Geiger-Müller counters (simple, reliable, high sensitivity without energy information), metal foil detectors/MFD (stable response via secondary electron emission, operate without external high voltage - critical for mobile systems), and Timepix3 silicon pixel detectors (highest spatial resolution and energy sensitivity for spectrometric analysis and radiation field visualization).

LiFePO4 batteries were used for the power supply system, which separately power the electronics and detectors using appropriate converters. This approach ensures long-term autonomous operation and charging via USB-C.

Integration of the BME280 environmental sensor for measuring temperature, humidity, and pressure, allowing readings to be adjusted based on external factors. Two-tier architecture consisting of STM32 microcontrollers for real-time data collection and Raspberry Pi 5 for high-level processing, visualization, storage, and remote access ensures fast analysis and minimal system latency. The MSODR-E development demonstrates successful technology transfer from high-energy physics instrumentation to field-deployable environmental monitoring applications.

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