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LUMINOSITY, BEAM AND BACKGROUND CONTROL SYSTEM RMS-R3 in the LHCb EXPERIMENT

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The modernized LHCb detector [1] provides a data set for luminosities in proton-proton collisions up to 2 × 1033 cm-2s-1 and at energies up to 13.6 TeV. Monitoring of the luminosity, beam and background control is necessary to ensure the safe operation of the experiment. To meet these needs, the Institute for Nuclear Research of the National Academy of Sciences of Ukraine created the RMS-R3 radiation monitoring system based on metal foil detectors [2] (an original development of the NAS) and the phenomenon of secondary electron emission.

The Radiation Monitoring System for Run3 (RMS-R3) has been operating as the part of the LHCb detector (CERN) since the end of 2021 [3]. The main tasks of RMS-R3 are to control the luminosity region and background, as well as conditions of the experiment. Intelligent design and geometric arrangement of the RMS-R3 modules in the LHCb experiment enable the precise measurement of proton beams collision region or fixed target nucleus positions with impact of the background. At present, only the monitoring of the relative luminosity at the experiment is carried out online by RMS-R3.

In the control structure of the experiment, the RMS-R3 system measures the frequency of collider beam interactions in a completely independent manner and displays this data on the monitoring screen in the LHCb control center. Using absolute calibration with the PLUME system [4], the RMS-R3 provides duplication of the online luminosity measurement, which is critical for continuous luminosity balancing within acceptable limits (±5%), which is implemented at LHCb by a feedback scheme with the LHC control center.

This work discusses the main results of RMS_R3 in the LHCb experiment: from luminosity measurements to the use of the asymmetry method, as well as comparisons with other beam and background systems (PLUME, VELO, etc.).

The work on the development of software for the RMS-R3 system in ECS, the WinCC-based LHCb control system, and in MONET, the LHCb web-based data quality monitoring system, is aimed at providing online monitoring of instantaneous luminosity, changing the position of the interaction region with precision accuracy and distinguishing between experimental conditions, etc. The advantage of these software solutions is the creation of new tools for LHCb operators and the full integration of the RMS-R3 system into the structure of monitoring the experimental conditions.

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[1] The LHCb Upgrades for Run3 and Run4. F. Alessio, CERN on behalf of the LHCb Collaboration. ICHEP. –2020. –Prague. 28 July 2020 to 06 August 2020. Mode of access: URL: https://indico.cern.ch/event/868940/contributions/3813743/attachmer

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Authors: RAMAZANOV, Dmytro ((Institute for Nuclear Research, National Academy of Sciences of Ukraine(KINR)); OKHRIMENKO, Oleksandr ((Institute for Nuclear Research, National Academy of Sciences of Ukraine(KINR)); CHERNYSHENKO, Serhii (INR NAS of Ukraine); PUGATCH, Valery (Institute for Nuclear Research, National Academy of Sciences of Ukraine(KINR)); KYVA, Volodymyr (Institute for Nuclear Research, National Academy of Sciences of Ukraine(KINR))

Presenter: CHERNYSHENKO, Serhii (INR NAS of Ukraine)

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