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Development and Commissioning of the Fast Beam Loss Monitor System at HIAF

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The Beam Loss Monitor (BLM) system for the High-Intensity heavy-ion Accelerator Facility (HIAF) has been constructed and deployed. This system features ultra-fast response ($\leq 20 \mu\text{s}$, measured down to $4.5 \mu\text{s}$) and employs 196 plastic scintillator detectors coupled to photomultiplier tubes (PMTs), strategically positioned in critical areas. It achieves a wide dynamic range of 6 orders of magnitude, enabling pulse counting mode for detecting very weak losses (down to $\mu\text{Sv/h}$ levels) and integration mode with threshold alarming for high loss rates. Commissioning of the BLM system with HIAF beam is scheduled for Q4 2025. Its performance, including fast response, sensitivity to weak losses, and reliability as a Machine Protection System (MPS) interlock device, has been successfully validated using high-power (100 kW) proton beams at the ADS-linac facility. Future work focuses on developing adaptive feedback algorithms utilizing real-time beam loss rate data from the BLM and Beam Charge Monitor (BCM) systems, aiming for closed-loop control to enhance beam loss suppression capabilities under complex operational scenarios.

Footnotes

Funding Agency

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Yes

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