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Online beam phase and energy gain measurement through beam-cavity interaction

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Online beam monitoring is crucial for enhancing the efficiency and availability of high-power accelerator operations. While real-time monitoring of transverse beam parameters is commonly employed in modern accelerators, there is a scarcity of online measurement techniques for longitudinal beam characteristics. We are currently developing an online tool for measuring fundamental longitudinal beam parameters: synchronous phase and energy gain. This endeavor is founded upon a comprehensive understanding of beam-RF cavity interactions, facilitated by advanced hardware platforms, flexible software applications, and computationally intensive algorithms.

Validation of our measurement methods has been conducted using beam and RF data acquired during the latest beam commissioning at the European Spallation Source (ESS). This validation encompassed both single-cell and multi-cell cavities, affirming the reliability and feasibility of our techniques. Furthermore, comprehensive comparative analyses were performed, aligning results from various measurement methodologies with theoretical calculations, enhancing our understanding of measurement accuracy.

Our ongoing research aims to provide accelerators with robust and real-time monitoring tools for longitudinal dynamics aspects based on beam and RF cavity interaction, thereby ensuring optimal efficiency and performance in high power accelerator operation.

Footnotes

Funding Agency

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Yes

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