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Novel method for transverse narrow-band impedance calculation by coupled-bunch instability measurements in circular accelerators

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In the research and development phase of accelerators, impedance and instability analysis of the storage ring are typically conducted in advance for performance evaluation. However, the pre-calculated impedance often deviates from the actual measurement results. For built accelerators, the impedance of individual components can be measured with various methods such as the coaxial wire method. However, modern accelerators are typically composed of a large number of complex components, such as cavities, magnets, and solenoids, each with unique geometric shapes and structures. Measuring the impedance of each component individually is therefore a challenging and time-consuming task. This paper proposes a novel method to estimate the overall impedance parameters of the storage ring by analyzing the change in the growth rate of beam instability modes with beam current. This method provides an effective impedance measurement solution for built accelerators, furthering our understanding and optimization of accelerator performance. This novel method is also applied in BEPCII.

Footnotes

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