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Innovative transverse position measurement method based on precise signal phase detection and its experimental validation

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The accurate measurement of the transverse position of a beam is crucial in particle accelerators, as it plays a key role in determining the beam parameters. Existing methods for beam position measurement rely on the detection of image currents induced on electrodes or the narrow-band wake field excited by the beam passing through a cavity-type structure. These methods have some limitations. Indirectly measuring the multiple pa rameters is computationally complex and requires external calibration to determine the system parameters in advance, and the utilization of the beam signal information is incomplete. In this work, a novel method that measures the absolute electron beam transverse positionis proposed. By utilizing the geometric relationship between the center position of the measured electron beam and multiple detection electrodes, as well as analyzing the differences in the arrival times of the beam signals detected by these electrodes, the absolute transverse position of the electron beam crossing the electrode plane can be calculated. This method has features such as absolute position measurement, position sensitivity coefficient independent of the vacuum chamber aperture, and no requirement for symmetrical detector electrode layout. The feasibility of this method is validated through numerical simulation and beam experiments.

Footnotes

Funding Agency

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Yes

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