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Measurement of slice energy spread of a high brightness electron beam using a passive dielectric-lined waveguide structure

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In this study, we investigated the possibility of using a passive dielectric-lined waveguide structure on slice energy spread measurement of femtosecond electron beam. Such diagnostic setup for a 25 MeV electron beam with a duration of a few hundred femtoseconds is simulated using IMPACT-T. The DLW acts as a passive streaker by generating traverse wakefields that deflect the electron bunch. Simultaneously, a dipole magnet serves as a spectrometer, separating the slice energy distribution, which is then visualized on YAG screen. The DLW's wakefields significantly broaden the transverse beam profile on the screen, with the beam tail experiencing a stronger transverse kick than the head. This effect results in a beam separation on the vertical axis. To analyze the wakefields, CST simulations are used to compute wake potential excited by a Guassian beam. By proper deconvolution, the corresponding transverse wake function is obtained. This wake function is combined with IMPACT-T simulations and a 6D phase space distribution to deduce the slice energy spread. The results demonstrate a promising approach for diagnostics that helps to optimize free-electron laser (FEL) drive beams.

Footnotes

Paper preparation format

Region represented

Asia

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