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Longitudinal phase space mapping of low energy electron beams using an rf deflector and a bend

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Longitudinal phase space (LPS), referring as the current profile and the energy spread, is among the most important parameters to be known in many accelerators that require high quality electron beams, such as an Ultrafast Electron Diffraction (UED) or a Free Electron Laser (FEL). For a UED or a long wavelength FEL, the beam energy is usually on the level of several MeV or a few tens MeV. In this situation, the beam measurement has to be done at a short distance to avoid space charge induced quality deterioration. This paper will present a systematical design of an LPS measurement system consisting mainly of a rectangular type RF deflector and a magnetic bend. The system is particularly developed for low energy electron beams, so the deflector structure and the optical lattice are carefully optimized. Particle tracking of the LPS measurement system is performed with the PARMELA code. It is shown that the time resolution and energy spread resolution of the designed system are 500 fs and 0.05%, respectively. Enhancing the time resolution to less than 100 fs is also discussed.

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Footnotes

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