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Longitudinal Beam Profile Diagnostics Using Coherent Cherenkov Diffraction Radiation at CLARA Facility

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Producing and diagnostic of short bunches in modern particle accelerators are forefront issues. For example in modern high-gain free-electron lasers the electron bunches are longitudinally compressed down to 100 fs to achieve high peak currents which is crucial to drive FEL process. Such a short bunch duration opens the possibility to use effect of coherent radiation for longitudinal beam profile diagnostics.

In compartments with other mechanisms the use of coherent Cherenkov diffraction radiation (ChDR) has a several significant advantages. First of all, it is non-destructive unlike a deflection cavity and less expensive than electro-optical methods. Moreover, in compartment with other polarisation radiation methods ChDR is highly directional, enabling us to separate useful signal from any background such as diffraction radiation generated from an input surface and synchrotron radiation generated upstream our target.

In current work we shall describe the methodology we propose for longitudinal diagnostics using Cherenkov diffraction radiation at CLARA (beam area 1) facility. ChDR induced by charged particle beam (~50 MeV beam energy at up to 10 Hz pulse repetition rate with sub-ps bunch length) will be detected by Martin-Pupplet interferometer with use of pyroelectric detectors with 0.1-30 THz spectral range. We shall also investigate the possibility of using mathematical approach [1] for single electron spectrum prediction and further longitudinal charge distribution reconstruction by Kramers-Kronig analysis. Preliminary results will be demonstrated and analysed.

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