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Coherent OTR as a tool for transverse bunch size measurements

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Optical Transition Radiation (OTR) is widely used for transverse beam profile diagnostics at electron linear accelerators. But this technique may not be implemented for FEL's [1] or LWPA accelerators [2], the reason is that such machines have ultrashort bunches causing coherent effects in the OTR emission process [3]. An approach to calculate the coherent OTR (COTR) propagation through a standard optical system with a focusing lens has been developed. COTR image of the bunch profile is obtained by the summation of the OTR fields coherently emitted by all electrons from a bunch and then focused in the detector plane. Assuming the bunch transverse profile is a Gaussian type it was shown that the final image has a typical "ring"shape. The characteristics of such image depend on the bunch transverse size and can be determined from the COTR image measurement for known optical system parameters.
[1] E. Saldin, E. Schneidmiller, M. Yurkov, The Physics of Free Electron Lasers // Springer-Verlag, 2010.
[2] N. Bourgeois, et al., Transverse Beam Profile Measurements of Laser Accelerated Electrons using Coherent Optical Radiation // AIP Conf. Proc., 1507, (2012) 258.
[3] H. Loos, R. Akre, et al., Observation of Coherent Optical Transition Radiation in the LCLS Linac // SLAC-PUB-13395 (2008).

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