

Short Bunch Beam Diagnostics

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Abstract

With the emergence of 4th generation FEL based light sources there is now considerable interest in both producing and characterizing ultra-short (<100 fs) electron bunches. Knowledge of the extremely high peak current in a short bunch is required to diagnose the SASE (self amplified stimulated emission) process. Measuring the femtosecond duration of the pulse is inherently interesting, particularly for experimenters using the beam to measure fast phenomena (e.g. femto-chemistry). Diagnostic techniques that have the necessary femtosecond resolution will be reviewed: These include high-power RF transverse deflecting structures that “streak” the beam in the accelerator allowing the bunch length to be recorded on a profile monitor. Electro optic crystal diagnostics use the electric field of the electron bunch to modulate light thereby exploiting the femtosecond technology of high bandwidth visible lasers. Coherent synchrotron radiation (CSR) from dipole magnets and optical diffraction radiation (ODR) both result in radiation with wavelengths of the order of the bunch length and hence in the terahertz band which can be detected by a variety of techniques. The role of each of these techniques is discussed in terms of its application at the Linac Coherent Light Source (LCLS) and the Short Pulse Photon Source (SPPS) currently under construction at SLAC.