Bunch Length Monitors - Overview

Updated February, 2004

1. S-band RF Transverse Deflecting Cavity
    a. Uses existing structures to be installed at 3 new locations:
       Injector, vertical deflection
       Linac 25-5, vertical deflection
       Linac 25-6, horizontal deflection
    b. semi-invasive pulse stealing mode of operation where 1 Hz is deflected onto profile monitor
    c. single bunch measurement, but requires 3 pulses to compensate for incoming tilt in the bunch length calculation
    d. invasive quad scan slice emittance in plane perpendicular to deflection
    e. invasive slice energy spread measurement for vertical deflection at horizontal dispersion location for profile monitor:
       injector-linac inflection point
       BC1 profile monitor
       dog-leg bend in the LTU

2. Electro Optic femtosecond laser measurement
    a. Non-invasive
    b. Single shot
    c. Longitudinal profile
    d. Timing with respect to laser pulse

3. OTR screens
    a. Coherent transition radiation
        i. Invasive to SASE process in undulator
        ii. E-beam increase in transverse emittance still transported to end.
    b. Coherent diffraction radiation
        i. Non-invasive, e-beam passes through hole in OTR foil
    c. Integrated bandwidth limited power of the coherent radiation gives single-shot measurement of rms relative bunch length
    d. Spectrally resolved power of the coherent radiation gives single shot measurement of rms absolute bunch length. This is necessary for tuning to a specific bunch length which is not the minimum bunch length for the compressor
    e. Single shot rms bunch length measurement available for feedback control of the linac RF phase for bunch length control.
    f. Autocorrelation measurements of the coherent radiation with an interferometer yield the average over many bunches of the 2nd moment of the bunch length distribution

4. Coherent synchrotron radiation, CSR
    a. Off-axis synchrotron radiation port on
        i. BC1 final dipole
        ii. BC2 final dipole
        iii. Chicane wiggler in the LTU dogleg
    b. Non-invasive measurement yielding same information as OTR screens in 3.c, d and f above and for feedback control as in 3.e.
    c. Spectral measurements also indicate level of microbunching instabilities initiated by CSR in the bunch compressor chicanes