Sub-FS Resolution with the Enhanced Operation of the X-band Transverse Deflecting Cavity using an RF pulse Compression SLED Cavity


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Abstract
The successful operation of the e-band transverse deflecting cavity (XTDC) installed downstream of the LCLS undulator has been further enhanced by the recent addition of an RF pulse compression “SLED” cavity that doubles the temporal resolving power of this powerful diagnostic system for measurement of the longitudinal profile of both the electron bunch and the inner FEL pulse. RF pulse compression has allowed us to use the existing SLAC S-band X-polar Klystron with nominal output power of 50 kW and extend the RF pulse length by a factor of 4 to give us 4 times the peak power after compression. A new, innovative SLED cavity was designed and built at SLAC to operate efficiently at X-band (10.65 GHz). The elegant design uses a small spherical cavity combined with a polarizing mode coupler hybrid. We report on the installation, commissioning and beam measurements demonstrating the sub-femtosecond resolution of the XTDC system.

System Layout for Deflector Diagnostic at LCLS

Beam Streaking Results

low resolution non-SLED mode

Data and error bars: # = 11, 52 = 2, 53 = 5, 54 = 4
Measurement range:
- Time resolution: 10 psec
- Temporal response: 10 psec
- Spatial resolution: 100 microns
- Spatial overlap: 100 microns
- Temporal overlap: 100 microns
- Spatial and temporal overlap: 100 microns

Beam Streaking Results high resolution SLED mode

Data and error bars: # = 11, 52 = 2, 53 = 5, 54 = 4
Measurement range:
- Time resolution: 10 psec
- Temporal response: 10 psec
- Spatial resolution: 100 microns
- Spatial overlap: 100 microns
- Temporal overlap: 100 microns
- Spatial and temporal overlap: 100 microns

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