Contribution ID: **63** Type: **talk**

3D reconstruction of electron trajectories in a LWFA using spectrally and spatially resolved Betatron radiation

Wednesday, June 5, 2013 6:25 PM (15 minutes)

Experiments performed using the 200 TW Callisto laser system at LLNL to produce GeV-class electron beams and keV Betatron x-rays are reported. The laser was focused into various gas cells with sizes ranging from 3 to 10 mm that contained a mixure of gases (He, N, Ar). We demonstrate that it is possible to reconstruct tomographycally electron trajectories inside the channel of the laser-wakefield accelerator fom the angular dependence of the Betatron x-ray spectrum, using an image plate-based spectrometer with differential filtering. Experimental results are benchmarked against a code that solves the equation of motion of electrons oscillating in the plasma wake and by calculating the corresponding x-ray radiation spectrum and profile. This combined single-shot, simultaneous spectral and spatial x-ray analysis allows for a 3D reconstruction of electron trajectories in the plasma with micrometer resolution.

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Session Classification: WG5 - instrum - Plasma sources and instrumentation

Track Classification: WG5 instrum - Plasma sources and instrumentation