

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

mercoledì 5 giugno 2013 18:25 (15 minuti)

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 mixture of gases (He, N, Ar). We demonstrate that it is possible to reconstruct tomographically electron trajectories inside the channel of the laser-wakefield accelerator from 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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Classifica Sessioni: WG5 - instrum - Plasma sources and instrumentation

Classificazione della track: WG5 instrum - Plasma sources and instrumentation