

Title:

Plasma-photonic diagnostics of relativistic electron and laser beams

Author:

Andrew Sutherland, University of Strathclyde

Abstract:

The interaction between either or both high-power lasers and relativistic electron beams has become commonplace in state-of-the-art particle accelerators and, as such, requires scrupulous coordination. Specifically, temporal synchronization with femtosecond accuracy and spatial coincidence at the micrometer scale are essential features. Presented is a new, minimally-invasive, plasma-based technique capable of exceptional combined spatiotemporal accuracy; discussion is supported by both experimental and analytical investigations as well as 3D PIC simulation. The dynamics of the scheme center on the atomic process of impact ionisation contained by localised plasma oscillations and result in detectable recombination radiation sensitive to both the temporal synchronisation and spatial alignment of the interacting beams. The establishment of this observation encourages even further investigations into quantifying other key interaction characteristics, such as beam profile and emittance, and their particular application in particle beam-driven plasma wakefield acceleration.