

Plasma-based Prticle Acceleration Using Synchronized Mid-IR and Near-IR Laser Pulses

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Different Lasers for Different Tasks



Combining and synchronizing near-IR and mid-IR pulses would be a unique aspect of ATF-II \rightarrow "surgical" injection, direct laser acceleration \rightarrow novel hard X-ray optical and attosecond particle probes of matter



Unique properties of the DLA beam

The angular spread of the DLA electrons is higher than that of non-DLA electrons \rightarrow the beam is not well suited for FEL or collider apps without extra processing

Transverse

But it has other great features that make it immediately attractive for incoherent radiation generation!

attosecond probes of atomic physics



The case for beam-laser synchronization

External injection into the <u>decelerating</u> phase of a plasma bubble



The wake decelerates the electrons, but the DLA pulse accelerates them at more than twice the deceleration rate! \rightarrow X-ray sources based on synchronized lasers and electron beams (ATF-II)

Change of the LPA paradigm by Direct Laser Acceleration Inside a Plasma Bubble

•The main role of the bubble is not to accelerate but to provide focusing field to undulating electrons \rightarrow mid-IR driving pulse!

•Attosecond electron bunches produced by laser slicing inside the plasma bubble \rightarrow near-IR pulse

•Excellent source of X-ray and Gamma-ray radiation because of the large undulator parameter $K = p_{\perp}/mc$

