Scaling relativistic laser-solid interaction using 30fs laser pulses

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BACKGROUND & THEORY

- Incident and reflected laser pulses form a standing wave region to accelerate electrons [1, 2]. Direct laser acceleration further boost their energy [3].
- Relativistic electrons from solid targets have superior properties in beam charge and divergence than those from underdense plasmas.
- Relativistic electron bunches of attosecond duration can be generated [4].
- Potential applications: Warm dense matter creation, Electron radiography, Seed of wakefield accelerators, Fast ignition researches.
- In this work, we present:
  - Angular dependence
  - Prepulse and target material effect
  - Attosecond electron bunches

EXPERIMENTAL

- Focused the laser beam onto a thick glass target at normal and grazing incidence.
- Recorded the spatial profile of the emitted electron beam on a stack of image plates at grazing exit and along the beam path.
- Tuned the prepulse delay [5] and angle of incidence.
- Performed two-dimensional Particle-In-Cell (PIC) simulation using OSIRIS framework [6].

RESULTS

- Angular distribution of electron energy spectra is observed in grazing incidence (76°) but not normal incidence in simulations and is observed in grazing incidence without prepulse, and the spectra were also taken at grazing incidence.
- Attosecond electron bunch generation favors larger angle of incidence.
- Prepulse delay is included to find higher energy bump at 20ps from experiments.

CONCLUSIONS

- Short-pulse laser solid interaction produces attosecond electron bunches, It’s angle of exit is close to the specular reflection direction. It is observed in 76° and 45° incidence but not normal incidence in simulations and is observed in grazing incidence but not normal incidence in experiments.
- Attosecond electron bunch generation favors larger angle of incidence.
- Angle of incidence is tuned for the angular distribution of electron energy spectra.
- Prepulse delay is included to find higher energy bump at 20ps from experiments. Simulations need to be done.

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REFERENCE