Contribution ID: **76** Type: **Poster**

Electron acceleration in dense plasmas heated by picosecond relativistic laser

Wednesday, October 24, 2018 2:00 PM (20 minutes)

Laser light with relativistic intensities and pulse length exceeding picosecond (ps) has been available recently. Fast electrons generated by over-ps laser-matter interactions are found to be enhanced beyond the scaling laws used in the sub-ps regime. Theories for sub-ps interactions cannot be scaled up simply to ps regime due to that meso-scale physics such as ion fluid dynamics and multiple scattering of electrons by intense fields set in.

We develop theoretical models for superthermal electron generation in ps relativistic laser-plasma interactions. Relativistic-intensity lasers are capable to push dense plasma and form a sharp interface by the laser hole boring (HB). We find that due to the continuous laser heating in ps time scale, the pressure balance between plasma and laser light is established being assisted by the sheath electric field, which acts as a surface tension, and then, the HB stops [1]. By solving the pressure balance equation, we derive the limit density for the HB, above which the laser light cannot push beyond. After the HB stops, the hot plasma starts to blowout back towards the laser at the interface where electrons interact with the intense laser multiple times stochastically and gain energy.
Electron acceleration through multiple scattering by laser is also found in a multi-ps laser interaction with thin foil where fast electrons recirculate around [2]. We here study the electron energy distribution based on the relativistic Fokker-Plank equation in momentum-p space. We introduce new diffusion and friction coefficients that represent the stochastic processes in the laser-foil interaction. The steady solution of the Fokker-Plank equation is found to be a power law when the diffusion coefficient is proportional to p. The particle-in-cell simulation shows that the high energy component of the electron distribution becomes a power law during the over-ps interaction. Our finding provides a further insight for complex multi-ps laser plasma interactions.

The new electron acceleration mechanisms we studied here are essential for various applications of ps intense lasers, and also important in terms of Laboratory astrophysics being related to the stochastic acceleration of cosmic rays in universe.
[1] N. Iwata et al., Nat. Commun. 9:623 doi: 10.1038/s41467-018-02829-5 (2018).
[2] N. Iwata et al, Phys. Plasmas 24, 073111 (2017).

Country or International Organization

Japan

Paper Number

IFE/P4-8

Primary author: Dr IWATA, Natsumi (Institute of Laser Engineering, Osaka University)

Co-authors: Prof. MIMA, Kunioki (The Graduate School for the Creation of New Photon Industries); Prof. SANO, Takayoshi (Institute of Laser Engineering, Osaka University); Prof. SENTOKU, Yasuhiko (Institute of Laser Engineering, Osaka University)

Presenter: Dr IWATA, Natsumi (Institute of Laser Engineering, Osaka University)

Session Classification: P4 Posters

Track Classification: IFE - Inertial Fusion Experiments and Theory