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Staging Laser Wake-field Acceleration

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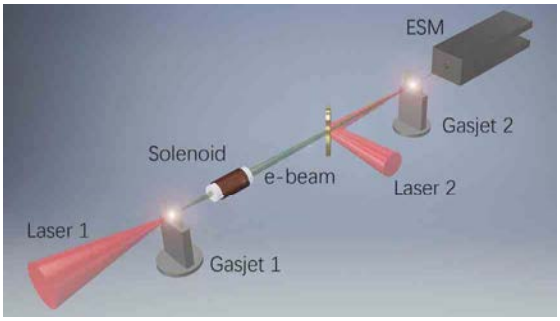
概要

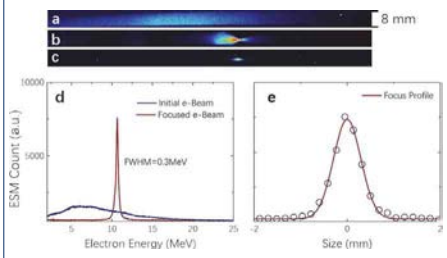
Staging laser wake-field acceleration is considered as a necessary technique for developing full-optical jitter-free electron accelerators. Here we demonstrate the strong coupling of electrons accelerated with the laser pulse from a gas-jet, with wave breaking electron self-injection, and the booster produced in the second gas jet by another laser pulse temporally and spatially synchronized with the first laser beam. Measured characteristics of electron beams modified by the booster wake field agree well with those obtained by multidimensional particle-in-cell simulations.

方法



The experiment was carried out with the P-cube 80-TW Ti:Sapphire laser system at Osaka University, which can deliver 2 synchronized CPA laser beams from the same oscillator. The laser beam 1 was focused a He gas jet producing injector electrons. A solenoid collected and focus the electrons with desired energy to the booster plasma wake-field at 1 meter away. An electron spectrometer was installed just after the second gas jet.

結果



Injector electron beam:
(a) Initial spectrum.
(b) Spectrum focusing solenoid.
(c) Spectrum with 500 μm aperture.
Energy spread ~3%. Focus spot <0.7 mm. Charge of ~1.6 pC.

Clear deceleration and/or acceleration of the beam electrons were observed depending on the time delay exhibiting the coupling of the injection electron beams with the laser wake field in the booster.

Also, strong coupling with an injection efficiency up to 90% was observed, due to the self- focusing effect (Bennet–Budker effect).

The results were verified with multidimensional particle-in-cell simulations.

Please check the poster for more details.