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Simulation of Errors in Multi-Pulse Laser Wakefield Acceleration

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Laser wakefield acceleration (LWFA) has achieved many notable successes in recent years. However, the lasers used today have low wall-plug efficiency and pulse repetition rates typically limited to a few pulses per second. With these limitations LWFA would not meet the requirements of many applications such as next generation light sources with high average brightness and short pulses. In multi-pulse laser wakefield acceleration (MP-LWFA) the plasma wakefield is instead driven by a train of low-energy laser pulses separated by the plasma period. This opens plasma accelerators to laser technologies, such as fibre and thin-disk lasers, which cannot provide high pulse energies, but can produce low-energy pulses at kHz repetition rates with high efficiency.

For this approach the response of the plasma to a train of laser pulses must be well understood. We present the results of a study of the effects of errors in the pulse train and/or plasma density, including tuning errors and random fluctuations around the ideal pulse spacing. An analytic theory is found to be in good agreement with simulations using the Particle In Cell code EPOCH.

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