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Prospects for High-Repetition-Rate Multi-Pulse Laser Wakefield Accelerators

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In recent years laser wakefield accelerators –in which the plasma wave is driven by a single high-intensity laser pulse –have generated quasi-monoenergetic electron beams with energies up to the GeV range. However, the driving lasers used have low wall-plug efficiencies (<1%) and operate at pulse repetition rates of at most a few Hz. Scaling this approach to generate electron beams –or radiation sources driven by them –with high pulse repetition rates and high mean power would therefore be extremely challenging.

An alternative approach would be to deploy a train of properly spaced low-energy laser pulses to excite the wakefield synchronously. This concept was first studied theoretically in the 1990s, but there has been relatively little subsequent work. In this talk we discuss the prospects for multi-pulse laser wakefield acceleration (MP-LWFA) driven by pulse trains generated by ultrafast fibre lasers. This approach offers the prospect of efficient, GeV-scale plasma accelerators operating at pulse repetition rates in the kHz range. MP-LWFAs of this type would be an ideal driver for ultrafast, high-mean-flux plasma wiggler and undulator radiation sources.

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