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GeV-scale accelerators driven by plasma-modulated pulses from kilohertz lasers.

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The energy required to drive a large-amplitude plasma wave can be delivered over many plasma periods, rather than in a single period, if the driving pulse is modulated. This approach opens up plasma accelerators to novel laser technologies which can provide the required energy at high pulse repetition rates, and with high wall-plug efficiency. The required modulation can be achieved in a two-step process: (i) spectral modulation of the long drive pulse by co-propagation with a low-amplitude plasma wave driven by a short, low-energy seed pulse; (ii) conversion of the spectral modulation to temporal modulation via a dispersive optic to generate a train of short pulses suitable for resonantly driving a plasma accelerator. Existing, efficient thin-disk lasers can be used to accelerate electrons to GeV level energies at kHz-repetition-rate.

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