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Exploring Wavelength Dependence in Laser Plasma Accelerators

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In laser wakefield acceleration (LWFA) experiments at major facilities, emphasis is typically placed on standard laser and gas parameters such as pulse duration, spot size, normalised vector potential, gas constituents and gas density in order to produce the most stable, high charge, high energy, narrow spread electron beams. While these parameters are certainly of unquestionable importance, the most fundamental laser parameter, its wavelength, remains relatively unexplored. A long wavelength driving laser may be advantageous to a laser wakefield accelerator; both theoretically from scaling laws deriving from the ponderomotive force, and from some early simulation results using particle-in-cell codes. Here we present simulation results and further discuss the experimental and theoretical implications of using long wavelength, short pulse drivers in LWFA experiments, with particular emphasis on the high intensity, short pulse, multi-beam mid-infrared (3.7μm central wavelength) Chimera laser system, currently under active development at Imperial College London.

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