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Efficiency measurement of a GeV Laser Wakefield Accelerator
MATTHEW STREETER[1], Queen's University Belfast — We report on the transfer efficiency of laser energy to the accelerated electron bunch in a laser wakefield accelerator. This was explored experimentally through simultaneous measurement of the deceleration of laser photons and the acceleration of the trapped electrons as a function of the accelerator length. The efficiency, expressed as the ratio of total electron energy gain to total laser loss, was maximised at $> 20\%$ by tuning of the plasma density and pulse compression. Using ionisation injection allowed for 160 pC bunches to be accelerated to a maximum energy of 1.5 GeV over 25 mm of plasma at a density of 1.25×10^{18} cm^{-3}. At higher densities, the laser was observed to redshift over a full octave, from 800 nm to 1600 nm. Simulations show that at the optimal conditions, the evolution of the driving laser pulse enables the electrons to maintain phase with the peak accelerating field, and so the accelerator becomes effectively dephasingless.

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