

# Longitudinally Resolved Measurements of Energy-Transfer Efficiency in a Plasma-Wakefield Accelerator

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Energy-transfer efficiency is an important quantity in plasma-wakefield acceleration, especially for applications that demand high average power. Normally, this efficiency is measured using an electron spectrometer; an invasive method that provides an energy-transfer efficiency averaged over the full length of the plasma accelerator. We present an experimental demonstration of a novel diagnostic that utilises the excess light emitted by the plasma after a beam-plasma interaction, yielding noninvasive, longitudinally resolved measurements of the local energy-transfer efficiency from the wake to the accelerated bunch. The applications of this diagnostic, such as experimental studies of the efficiency-stability relation and online optimisation of future multistage plasma accelerators, are then discussed.

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