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Correlating Light Emission and Wakefield Dissipation

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In plasma wakefield acceleration, energy is tranferred from a driver to a witness bunch through the wakefields. Energy lost by the driver is stored in wakefields as kinetic energy of the oscillating electrons, and as potential energy of the electric and magnetic field. A witness bunch can be accelerated by the longitudinal electric field. Wakefield energy is eventually dissipated in the plasma. A part of this energy is emitted as light. We discuss the proportionality between the emitted light and wakefield amplitude. We correlate the measured light to energy deposited in the plasma by laser pulses and electron bunches with the amplitude of wakefields expected at the plasma entrance. We use these results to investigate the evolution of wakefields driven by a long relativistic proton bunch at AWAKE.

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