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**Photon acceleration and modulational instability during wakefield excitation using long laser pulses** RAOUL TRINES, CHRISTOPHER MURPHY, ROBERT BINGHAM, KATHRYN LANCASTER, OLEG CHEKHLOV, PETER NORREYS, STFC Rutherford Appleton Laboratory, JOSE TITO MENDONCA, LUIS SILVA, Instituto Superior Tecnico, Lisbon, Portugal, STUART MANGLES, CHRISTOS KAMPERIDIS, ALEXANDER THOMAS, KARL KRUSHELNICK, ZULFIKAR NAJMUDIN, Blackett Laboratory, Imperial College, London, UK — Recent laser-wakefield experiments on the Astra laser at RAL using laser pulses that are several times longer than the wakefield period have yielded transmission spectra that exhibit a series of secondary peaks flanking the main laser peak. It has been found that these peaks are too closely spaced to be the result of Raman instabilities; instead, photon acceleration of the laser's photons in the wakefield has been proposed as the likely origin of the secondary peaks. In this paper, we present the results of recent Astra experiments in which a laser pulse of 50-200 fs containing 300-600 mJ was focused on a helium gas jet on a 25 micron focal spot. The observed transmission spectra have been modelled using a dedicated photon-kinetic numerical code. The origin of various spectral characteristics will be explained in terms of photon acceleration, and the feasibility of using this effect as a wakefield diagnostic will be discussed.

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