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Quantitative single shot and spatially resolved plasma wakefield diagnostics MUHAMMAD KASIM, JAMES HOLLOWAY, LUKE CEURVORST, MATTHEW LEVY, NAREN RATAN, JAMES SADLER, University of Oxford, Oxford, ROBERT BINGHAM, STFC Rutherford Appleton Laboratory, Didcot, PHILIP BURROWS, University of Oxford, Oxford, RAOUL TRINES, STFC Rutherford Appleton Laboratory, Didcot, MATTHEW WING, University College London, London, PETER NORREYS, University of Oxford, Oxford — Plasma wakefield detections and diagnostics can give valuable information for optimizing plasma accelerator experiments. However, there are only a few techniques to do the plasma wakefield diagnostics. Here we introduce a method to diagnose the plasma wakefield's parameters using photon acceleration. In this technique, a laser pulse that could cover several plasma wavelengths is fired into the wakefield. Inverting the measured frequency modulation profile of the pulse yields the density profile of the wakefield at the interaction point. By introducing a crossing angle, the interaction point can be chosen and thus make it possible to diagnose the wakefield at the chosen point in the plasma. We performed simulations to check the accuracy between the measured wakefield amplitude and the actual amplitude. These results agree qualitatively and quantitatively with a relative error less than 10% for various wakefield amplitudes, probe's wavelengths, and crossing angles. Theoretical model with its computational method are presented as well as several limitations that could spoil the measurements. This technique opens up new possibilities of qualitative and quantitative diagnose of plasma wakefield density at known positions.

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