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Spatial Control of Laser Wakefield Accelerated Electron Beams[1]

A. MAKSIMCHUK, K. BEHM, T. ZHAO, A. S. JOGLEKAR, A. HUSSEIN, J. NEES, A. G. R. THOMAS, K. KRUSHELNICK, University of Michigan, Ann Arbor, J. ELLE, A. LUCERO, Air Force Research Laboratory/Directed Energy Directorate, G. M. SAMARIN, G. SARRY, J. WARWICK, Queens University, Belfast, United Kingdom — The laser wakefield experiments to study and control spatial properties of electron beams were performed using HERCULES laser at the University of Michigan at power of 100 TW. In the first experiment multi-electron beam generation was demonstrated using co-propagating, parallel laser beams with a π-phase shift mirror and showing that interaction between the wakefields can cause injection to occur for plasma and laser parameters in which a single wakefield displays no significant injection. In the second experiment a magnetic triplet quadrupole system was used to refocus and stabilize electron beams at the distance of 60 cm from the interaction region. This produced a 10-fold increase in remote gamma-ray activation of ^{63}Cu using a lead converter. In the third experiment measurements of un-trapped electrons with high transverse momentum produce a 500 mrad (FWHM) ring. This ring is formed by electrons that receive a forward momentum boost by traversing behind the bubble and its size is inversely proportional to the plasma density. The characterization of divergence and charge of this electron ring may reveal information about the wakefield structure and trapping potential.

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