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Indications on the ion acceleration with a magnetic reconnection induced by dual ps high-intensity laser pulse incidence on a foam target

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The reconnection of magnetic field lines plays an important role in acceleration of charged particles in space and laboratory plasmas [1]. During this process, topology of magnetic lines is rearranged and magnetic energy is transferred to the kinetic energy of charged particles. High power pulse laser interaction with plasma targets provides an approach for modelling astrophysical phenomena under the conditions of terrestrial laboratories including relativistic magnetic reconnection and charged particle acceleration [2]. Extensive computer simulations [3, 4] of dual laser pulse interaction with plasma targets demonstrate charged particle acceleration within the region in between of two laser pulses, where self-induced opposite polarity magnetic field merges and annihilates. In our experiment, two co-propagating in parallel laser beams from LFEX (240 J, 1.5 ps) separated by a distance of 50 μm are incident obliquely on a low-density foam foil target. The lasers generate two toroidal-shaped magnetic field structures on the target rear side, which encounter with each other. We observe 14 MeV protons accelerated toward the laser propagation direction, not in the target normal direction. This fact implies that the growth of electric field induced by magnetic reconnection is enough faster than the electric field compensation by the return electric current. It results in the proton acceleration observed in our experiment.

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