Plasma wedge diffraction and vacuum particle acceleration by high intensity laser pulses

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In the present work, we describe a new electron acceleration mechanism by considering a laser pulse irradiating a right-angled plasma wedge [1]. In such an arrangement, a diffracted electromagnetic wave with a significant longitudinal electric field component along the surface is induced [2]. This wave amplitude decays with the inverse square root from the plasma edge (its origin) and can be used to accelerate/produce collimated nano-Coulomb electrons beans with 100s MeV, when initiated by a laser beam at intensity $\sim 10^{19}$W/cm^2. We demonstrate that the electrons accelerated by this mechanism can phase lock with the wave over a long distances. Our findings are supported by 3D and 2D particle-in-cell simulations [3] and by a theoretical model which depicts the electron's energy gain scale. The proposed simple scheme is robust and can be reproduced in experiments on current (in particular table-top) laser facilities.

References

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