HEDLA 2022
13th International Conference on High Energy Density Laboratory Astrophysics
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Plasma Injector and Electron Acceleration in a Wedge Diffracted High Intensity Laser Pulse

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A new electron acceleration mechanism is proposed that exploits the interaction of a grazing laser pulse on a right-angled plasma wedge [1]. In such an arrangement, a diffracted electromagnetic wave is induced with a significant longitudinal electric field component along the surface [2]. This field amplitude decays with the inverse square root from the plasma edge (its origin) and electrons can phase lock with it. The acceleration can be maintained over very long ($\sim$ mm) scales, resulting in collimated nano-Coulomb electrons beans ~ 100 MeV, when initiated by a laser beam at intensity $I\lambda_0^2 \sim 10^{19}\mathrm{W}\mu\mathrm{m}^2/\mathrm{cm}^2$. 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 as $\gamma(t) \propto \sqrt{I\lambda_0^2\omega_0 t}$ with $\omega_0 t \gg 1$. The proposed simple scheme is robust and can be reproduced in experiments on current laser facilities.

References

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