Creation and Acceleration of Breit-Wheeler Positrons in a Plasma Channel

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Sources of relativistic positrons are relevant for a wide range of applied and fundamental research domains. However, the energy achieved by current accelerator facilities is limited by their size of several kilometers, and potential alternatives are rarely discussed. Here, we show that positrons can be created, injected, and accelerated during the propagation of an ultra-intense laser in a plasma channel over a distance of 400 micrometers. Positrons are generated when the laser interacts with a relativistic electron beam propagating at 90 degrees of incidence via Quantum Electrodynamics processes [1]. We derive a semi-analytical estimate to determine the number of positrons created within the plasma channel. We also demonstrate that a few per cent of them are deflected by the laser along its propagation direction. A direct acceleration of the positrons in the laser field is maintained over hundreds of microns in the plasma channel. We prove that positrons are guided along the channel main axis thanks to a high-charge self-loaded electron beam driven by the high laser intensity. Our proposal opens a path toward a new kind of compact and relativistic positron source based on future-generation laser systems.

References

[1] M Vranic, O Klimo, G Korn and S Weber, Sci. Rep. **8**, 4702 (2018)