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A high-intensity laser-based positron source

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Plasma based acceleration is considered a promising concept for the next generation of linear electron-positron colliders. Despite the great progress achieved over the last twenty years in laser technology, laser- and beam-driven particle acceleration, and special target availability, positron acceleration remains significantly underdeveloped if compared to electron acceleration. This is due to both the specifics of the plasma-based acceleration, and the lack of adequate positron sources tailored for the subsequent plasma based acceleration. Here a positron source based on the collision of a high energy electron beam with a high intensity laser pulse is proposed. The source relies on the subsequent multi-photon Compton and Breit-Wheeleer processes to generate an electron-positron pair out of a high energy photon emitted by an electron. Due to the strong dependence of the Breit-Wheeler process rate on photon energy and field strength, positrons are created with low divergence in a small volume around the peak of the laser pulse. It is shown that further reduction of the divergence can be achieved by employing frequency doubled and quadrupled laser pulses. The resulting low emittance in the submicron range potentially makes such positron source interesting for collider applications.

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Working group

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