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e-e+ plasma generation and dynamics in laser interaction with solid-state target

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New laser facilities will reach intensities of 1023 Wcm−2. In these setups with extreme fields, quantum electrodynamic (QED) effects become important. We study high-intensity lasers grazing the surface of a solid-state target by two-dimensional particle-in-cell simulations with QED effects included. The two laser beams collide at the target surface at a grazing angle. Due to the fields near the target surface, electrons are extracted and accelerated. Finally, the extracted electrons collide with the counter-propagating laser, which triggers many QED effects and leads to a QED cascade under a sufficient laser intensity. Here, the processes are studied for various laser intensities and angle of incidence and finally compared with a seeded vacuum cascade. Our results show that the proposed target can yield many orders of magnitude more secondary particles and develop a QED cascade at lower laser intensities than the seeded vacuum alone [1].
At even higher laser intensities, 1024 Wcm−2, the created e-e+ plasma may reach solid densities and exhibit collective behavior [2].

[1] M. Filipovic and A. Pukhov Eur. Phys. J. D (2022) 76:187 (2022)
[2] A. Samsonov and A. Pukhov, https://arxiv.org/pdf/2409.09131 (2024)

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