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Electron-Positron Plasma Generation in Foam Targets

Electron-positron plasmas are fundamental to understanding some of the most energetic astrophysical phenomena and represent a unique state of matter. While they have been theoretically studied extensively, experimental studies remain limited due to the challenge of generating and confining such plasmas.
Numerous setups have been proposed to maximize pair yield [1]. With the advent of ultra-intense lasers, such as the 10 PW L4 laser at the ELI facility [2], the experimental realization of e^-e^+ plasmas is coming within reach. In recent years, foam targets have attracted significant interest in high-energy laser-plasma interactions [3] and are suitable for studying QED effects.
In our study, we consider a pre-ionized foam target with a Gaussian channel to guide a high-intensity laser pulse, generating high-energy electrons, using 2D PIC simulations A reflector placed behind the target reflects and intensifies the laser fields, enhancing pair production. We find that the production rate is highly sensitive to the reflector geometry and initial plasma profile. Additionally, we compare the resulting energy spectra with theoretical predictions, highlighting conditions for optimal pair production.

[1] A. Samsonov and A. Pukhov, *arXiv:2409.09131* (2024)
[2] F.P. Condamine et al., *PPCF* **65**, 015004 (2023)
[3] O.N. Rosmej et al., *HPLSE* **13**, e3 (2025)

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