Monte Carlo Simulation of Pair Creation Using Petawatt Lasers

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Irradiating high-Z targets such as gold with ultra-intense lasers creates electron-positron pairs. In particular, the positron density in the plasma created by this procedure is higher than that obtained via other laboratory-based methods. In this set-up, first the laser creates a plasma on the surface of the target, then the electro-magnetic fields of the laser accelerate electrons out of the plasma and through the target. The pair generation then occurs via the Bethe-Heitler and Trident processes, while other processes such as Compton scattering affect the outgoing spectra. All of the significantly contributing processes are well-known and hence we can study this phenomenon using Monte Carlo simulation. We focus on the latter part of this procedure, the passage of high-energy electrons through the target creating pairs. In particular, we discuss the usefulness of CERN's Geant4 Monte Carlo code in simulating this process. Once this code is successfully calibrated, we will use it to perform parameter studies, and design future targets to optimize the positron yield.