QED Cascades at
the Extreme Light Infrastructure - Nuclear Physics (ELI-NP)

Prof. Dietrich Habs, LMU Munich

At ELI-NP [1, 2] it is planned to use a brilliant intense electron beam of up to 600 MeV in combination with a dedicated laser as a linear Compton back-scattering source for intense brilliant γ-beams. At the same time, two powerful APOLLON lasers [3] will be installed, which allow to reach in a common laser focus intensities of up to 10^{24} W/cm^2 or normalized vector potentials of \( a_0 = 1000 \). Here we explore in Monte-Carlo simulations the possibility to produce QED cascades [4] of hard γ’s and e^+e^- pairs by focusing the 600 MeV electron bunch directly into the focus of the two APOLLON lasers, which will be circularly polarized, counter-propagating and produce in the focal plane an intense rotating E-field. The strong nonlinear radiation forces [5, 6, 7] on the seed electrons in the laser focus lead to typically 500 MeV γ’s, which in the laser focus, over a very short length, convert into e^+e^- pairs. The lepton pairs then are immediately accelerated by the laser E-field of typically 1 GV/µm to typically 500 MeV and an exponentially increasing QED cascade is predicted. In comparison to the experiment, the description of the new forces can be tested. At the same time, the 600 MeV electron bunch can be used to optimize the alignment of the two lasers in space and time. These studies were performed together with Nina Elkina and Hartmut Ruhl from LMU Munich.

References


