Theoretical research of high-intensity laser interactions

Abstract: The topic of the thesis is to study quantum electrodynamics (QED) phenomena in the interaction of ultra-strong laser pulses with plasma targets. The better understanding of strong field QED processes and QED plasmas in laser-plasma interactions is crucial for planning and interpreting the results of experiments on the new generation of high power laser facilities, such as ELI Beamlines. When an electron moves in a strong electromagnetic field, it radiates. An emitted hard photon interacting with a strong field can in turn create an electron-positron pair. Besides, the radiation back reaction influences the trajectory of charged particles. At very high field intensities, virtual particles and antiparticles, the fluctuations of which form the vacuum, can be polarized due to very strong electric fields leading to the polarization of the vacuum. A polarized vacuum then behaves as a non-linear medium in which the classical Maxwell equations do not apply. The thesis will in particular focus on theoretical and numerical investigation of the processes, when not only QED phenomena, but also collective effects play an important role.

Type of thesis: dissertation thesis

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