

Contribution ID: 222

Type: Oral

LUXE: A new experiment to study non-perturbative QED in electron-laser and photon-laser collisions

Wednesday, 19 October 2022 12:40 (20 minutes)

The LUXE experiment (Laser Und XFEL Experiment) is an experiment in planning at DESY, Hamburg, using the electron beam of the European XFEL. LUXE is intended to study collisions between a high-intensity optical laser pulse and 16.5 GeV electrons from the XFEL electron beam, as well as collisions between the laser pulse and high-energy secondary photons. This will elucidate quantum electrodynamics (QED) at the strong-field frontier, where the electromagnetic field of the laser is above the Schwinger limit. In this regime, QED is non-perturbative. This manifests itself in the creation of physical electron-positron pairs from the QED vacuum, similar to Hawking radiation from black holes. LUXE intends to measure the positron production rate in an unprecedented laser intensity regime. The experiment has received a stage 0 critical approvement (CD0) from the DESY management and is in the process of preparing its technical design report (TDR). An overview of the LUXE experimental setup and its challenges and progress will be given, along with a discussion of the expected physics reach in the context of testing QED in the non-perturbative regime as well as with regards to searches for light exotic particles.

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