Contribution ID: **2** Type: **Upgrades and Future Projects**

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

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 1 critical approval (CD1) from the DESY management and is finalising its technical design report (TDR). It is expected to start running in 2025/6. 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.

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Session Classification: Poster session

Track Classification: Upgrades and Future Projects