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Detector challenges of the strong-field QED experiment LUXE at the European XFEL

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The LUXE experiment aims at studying high-field QED in electron-laser and photon-laser interactions, with the 16.5 GeV electron beam of the European XFEL and a laser beam with power of up to 350 TW. The experiment will measure the spectra of electrons, positrons and photons in expected ranges of 10^{-3} to 10^{9} per 1 Hz bunch crossing, depending on the laser power and focus. These measurements have to be performed in the presence of low-energy high radiation-background. To meet these challenges, for high-rate electron and photon fluxes, the experiment will use Cherenkov radiation detectors, scintillator screens, sapphire sensors, as well as lead-glass monitors for backscattering off the beam-dump. A four-layer silicon-pixel tracker and a compact electromagnetic tungsten calorimeter will be used to measure the positron spectra. The layout of the experiment and the expected performance under the harsh radiation conditions will be presented. Particular attention will be devoted to the sapphire sensors gamma beam profiler (GBP) which should provide a 5 um precise Compton-scattered gammas beam profile width, which in turn, will allow a 5% determination of the absolute laser field intensity experienced by the electron beam. This performances is quite challenging, given the high irradiation dose experienced by the GBP (about 1 MGy/year). The use of sapphire sensors in high energy physics experiments is quite novel, and details will be given on the R&D performed until now to assess their performances in the harsh environment of the LUXE experiment.
The experiment has received stage 1 critical approval (CD1) from the DESY management and is about to publish its technical design report (TDR). It is expected to start running in 2025/26.

Primary author: LIST, Jenny (DESY)

Presenter: Dr MARCO, Bruschi (CERN)

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