

# Precision Laser Diagnostics for LUXE

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Strong field QED is an active research frontier. The investigation of fundamental phenomena such as pair creation, photon-photon and photon-electron interactions in the non-linear QED regime are a formidable challenge – both experimentally and theoretically. Several experiments around the world are being planned or in preparation to probe this strong field regime.

LUXE (Laser Und XFEL Experiment) is an experimental platform that envisages the collision of the high quality 16.5 GeV electron beam from the European XFEL accelerator with a 100 TW class high power laser. One of the unique features of LUXE is to measure the key observables such as pair rates (e+e-) with unprecedented accuracy in the characterization of both beams together with ample statistics. The state-of-art detector technologies for high energy particle/ photon detection enable per cent level precision. The state-of-art high power lasers offer high-quality laser beams, however, the residual shot-to-shot fluctuations coupled with the large non-linearity of the processes under investigation form a particular challenge. An uncertainty of 5% on the absolute laser intensity already leads to a very large (about 40%) uncertainty in the pair rate. Hence it becomes essential to control the laser parameters precisely.

To mitigate this issue, a full suite of laser diagnostics is currently developed at the Jeti40 laser in Jena with the aim of tagging the shot intensity to <1%. In this presentation, details of the laser and the diagnostics suite for the single-shot tagging of all the laser parameters will be presented. Moreover, results from an ongoing campaign to properly relay image the beam without significant distortion of the laser beam parameters for post-diagnosis will be discussed. This talk is presented on behalf of the LUXE collaboration.