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Simulation of sapphire micro-strip detectors with Allpix Squared for the LUXE's Gamma Beam Profiler detector

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LUXE (Laser Und Xfel Experiment) is a new experiment proposed at DESY to investigate the strong-field regime of QED, with the main aims (a) to measure the interactions of real photons with e^-/e^+ at field strengths where the coupling to charges becomes non-perturbative; (b) to make precision measurements of the $e^-\gamma$ and $\gamma\gamma$ interactions in a transition from perturbative to non-perturbative QED; and (c) to exploit strong-field QED processes to search for new particles beyond the SM coupling to photons. This is achieved by using the European XFEL electron beam and an high-power 40TW laser. Two modes of operation are envisaged: e-laser mode, where electrons scatter photons in the focused laser beam at the interaction point (IP); and a gamma-laser mode, where the electron is first converted to high-energy gamma and then collided with the laser field. For the e-laser interactions, important information is contained in the energy spectrum and angular distribution of photons produced at the IP. Also, the ellipticity of the photon beam is a direct measure of the laser intensity experienced by the electrons.
The Gamma Beam Profiler (GBP) detector is part of LUXE's photon detection system. Its purpose is to measure the transverse profile of such an high-energy photon beam at about 11m downstream the IP. Such a detector operates in presence of a very intense high-energy gamma ray flux, calling for a radiation-hard material, and it has target 5um profile reconstruction accuracy goal. A micro-strip detector made of artificial optical-grade sapphire is envisaged for this task. This material has an extremely low leakage current at room temperature, remaining stable under high irradiation, therefore representing a promising low-cost alternative to the well known diamond detectors often used in such beam monitor applications.

This talk focuses on the efforts to parametrically simulate a sapphire micro-strip detector using the Allpix Squared framework and only open-source software - e.g. Salome (CAD), ELMER (finite-element field solver) and Paraview (visualization). First, the key steps of simulation development are briefly summarized. Also, a first validation of the tool with data in the literature is presented. Second, recent experimental data from test beams is used to fine-tune the simulation to the GBP case. Last, the tools is used to evaluate the expected detector performance in profile reconstruction when the front-end response is taken into account.

Will the talk be given in person or remotely?

In person

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