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Design, prototyping and test of a Highly Compact and Granular Electromagnetic Calorimeter for the LUXE experiment.

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The LUXE experiment will investigate the strong-field QED regime by using the interactions of high-energy electrons from the European XFEL in a powerful laser field. It will measure the production of electron-positron pairs as a function of the laser field strength, up to the non-perturbative regime beyond the Schwinger limit. LUXE foresees a positron detection system consisting of a tracker and a granular and unprecedentedly highly compact silicon-tungsten electromagnetic sandwich calorimeter (ECALp). This ECALp has been designed to cope with the wide range of expected positron numbers and the need to measure them against a low-energy background. The ECALp is composed of tungsten absorber plates with thin sensor planes, including silicon pad sensors, flexible Kapton printed circuit planes, and carbon fibre support. The sensor planes are less than 1 mm thick and will be read using dedicated front-end ASICs in 130 nm technology (FLAXE) and FPGAs for data preprocessing.

GaAs with integrated readout strips are also being considered as an alternative to the silicon. Prototypes of individual sensor planes have been tested in a 5 GeV electron beam. A full compact calorimeter tower of up to $90 \times 90 \times 600 \text{ mm}^2$ ($15 X_0$) is about to be produced and tested in an electron beam. At VCI, we will discuss the design challenges, the sensor characterization, the prototyping, integration and commissioning, and the available beam test results from 2022 until this year.

Primary experiment

LUXE ECAL group

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