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High-granularity crystal calorimetry: conceptual designs and studies

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A new concept of high-granularity calorimetry based on crystals has been proposed for the Circular Electron Positron Collider (CEPC) with an aim to reach unprecedented energy resolution as well as 3D-positioning precision. In this conceptual design, crystals are finely segmented in both transverse and longitudinal directions. Each crystal is optically isolated and read out by a compact semiconductor photodetector (e.g. silicon photomultiplier, SiPM). Simulation models based on Geant4 are developed to study the expected performance of the whole calorimeter as well as essential optical properties of a single crystal. Cosmic-ray measurements have been made with single crystal bars including lead tungstate (PbWO4) and BGO. Performance of SiPMs from different vendors are also compared. A calibration scheme using optical fibres and a laser source is being considered and prototyped. The idea of adding precision timing information for a "5D-calorimeter" is also being investigated to quantify in simulation the improvements of the positioning precision and particle identification performance.

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