



Contribution ID: 350

Type: Poster

Towards large calorimeters based on Lanthanum Bromide or LYSO crystals coupled to silicon photomultipliers: A first direct comparison for future precision physics

Wednesday, 25 May 2022 08:47 (1 minute)

The challenge for new calorimetry for incoming experiments at intensity frontiers is to provide detectors with ultra-precise time resolution and supreme energy resolution.

Two very promising materials on the market are BrillanCe (Cerium doped Lanthanum Bromide, LaBr₃ (Ce)) and LYSO (Lutetium Yttrium Oxyorthosilicate, Lu₂(1-x) Y_{2x} SiO₅ (Ce)), supported by recent developments aiming at providing new relative large crystals.

The response of both LaBr₃ (Ce) and LYSO detectors having silicon photomultipliers as photosensors have been studied via detailed Monte Carlo (MC) simulations. The impinging gammas are in the range of 50-100 MeV. The MC simulations are based on GEANT4, including the full electronic chain up to the waveform digitization and finally the reconstruction algorithms.

For the (R = 4.45 cm, L = 20.3 cm) LaBr₃ (Ce) crystal an energy resolution of $\sigma_E/E \sim 2.3(1)\%$ and a timing resolution of $\sigma_t \sim 35(1)$ ps have been predicted. The energy resolution can be further improved by using larger crystals (either R = 6.35 cm or R = 7.6 cm, L = 20.3 cm) approaching respectively a $\sigma_E/E \sim 1.20(3)\%$ or a $\sigma_E/E \sim 0.91(1)\%$.

Due to the shorter radiation length and smaller Moliere radius the LYSO crystal of the available size (R = 3.5 cm, L = 16 cm) performs better in terms of energy deposit compared to the currently available larger crystal made of LaBr₃(Ce). An energy resolution of $\sigma_E/E \sim 1.48(4)\%$ can be obtained, and that can be further improved using bigger crystals (R = 6.5 cm, L = 25 cm, $\sigma_E/E \sim 0.74(1)\%$). A $\sigma_t \sim 40(1)$ ps can be also achieved.

The size of the crystals considered here is optimal for assembling segmented big detectors as will be shown. Such results put these future high-energy calorimeters at the detector forefront at intensity frontiers.

Collaboration

MEGII

Primary authors: BALDINI, Alessandro; PAPA, Angela (University of Pisa/INFN and Paul Scherrer Institute); VENTURINI, Antoine; VITALI, Bastiano; NICOLÒ, Donato; CEI, Fabrizio; CHIARELLO, Gianluigi; DAL MASO, Giovanni; SIGNORELLI, Giovanni; BENMANSOUR, Hicham; GALLI, Luca; CHIAPPINI, Marco; FRANCESCONI, Marco; GRASSI, Marco; SCHEWDIMANN, Patrick

Presenter: PAPA, Angela (University of Pisa/INFN and Paul Scherrer Institute)

Session Classification: Calorimetry - Poster Session