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Optimization of light collection from crystal scintillators

Valentyna Mokina

INFN Sezione di Roma

Institute for Nuclear Research, Kyiv, Ukraine

Cryogenic scintillation bolometers are promising detectors to search for dark matter and neutrinoless double beta decay, and to investigate rare alpha decays thanks to very high energy resolution, low energy threshold and excellent particle discrimination ability. Increase of light collection and improvement of energy resolution in the light channel of scintillating bolometers are important tasks in such experiments. The purpose of our work was to study dependence of energy resolution and relative pulse amplitude of scintillation detector on crystal shape, shape and material of reflector, conditions of crystal surface, presence of optical contact between scintillator and photo detector. Four CaWO_4 crystal scintillators (cut from one crystal boule) with similar optical properties were used. The light collection for the different conditions was simulated with a Monte Carlo method, using ZEMAX, GEANT4 and LITRANI.

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