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Characterization and Optimization of Cryogenic Pure CsI Detector for CLOVERS Experiment

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In this study, we conducted a comprehensive characterization and optimization of a cryogenic pure CsI (pCsI) detector. Achieving a notable light yield of 35.2PE/keVee and a world-leading energy resolution of 6.9% at 60keV, we utilized a 2cm cubic crystal coupled with a HAMAMATSU R11065 photomultiplier tube (PMT). Additionally, we measured the scintillation decay time of pCsI, which proved to be significantly faster than that of CsI(Na) at room temperature. Furthermore, we investigated the impact of temperature, surface treatment, and crystal shape on the light yield. Notably, the light yield peaked at approximately 20K and remained stable within the range of 70-100K. We observed that the light yield of polished crystals was approximately 1.5 times greater than that of ground crystals, while the crystal shape exhibited minimal influence on the light yield. These results are crucial for the design of the 10kg pCsI detector for the future CLOVERS (Coherent eLastic neutrinO(V)-nucleus scattERing at China Spallation Neutron Source (CSNS)) experiment.

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