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The Next Generation of Crystal Detectors in High Energy Physics Experiments

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Crystal detectors have been used widely for decades in high energy and nuclear physics experiments, medical instruments and homeland security applications. Novel crystal detectors are continuously being found. Future HEP experiments require bright and fast crystal detectors with excellent radiation hardness. Cost-effectiveness is also a crucial issue for crystal detectors to be used in a large volume. To face these new challenges a thorough R&D program is required to investigate and develop crystal detectors for future HEP experiments in all frontiers.

Summary

Crystal detectors have been used widely in high energy and nuclear physics experiments, medical instruments and homeland security applications. Novel crystal detectors are continuously being discovered and developed in academia and in industry. In high energy and nuclear physics experiments, total absorption electromagnetic calorimeters (ECAL) made of inorganic crystals are known for their superb energy resolution and detection efficiency for photon and electron measurements. A crystal ECAL is thus the choice for those experiments where precision measurements of photons and electrons are crucial for their physics missions. For future HEP experiments at the energy and intensity frontiers, however, the crystal detectors used in current ECALs are either not bright and fast enough, or not radiation hard enough. Crystal detectors have also been proposed to build a Homogeneous Hadron Calorimeter (HHCAL) to achieve unprecedented jet mass resolution by duel readout of both Cherenkov and scintillation light, where development of cost-effective crystal detectors is a crucial issue because of the huge crystal volume required. This paper discusses several R&D directions for the next generation of crystal detectors for future HEP experiments at all frontiers.

Primary author: Dr ZHU, Ren-yuan (Caltech)

Presenter: Dr ZHU, Ren-yuan (Caltech)

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