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Energy Resolution Optimization of the Yale "PIXeY" Two-Phase Xenon Detector NICHOLAS DESTEFANO, MOSHE GAI, University of Connecticut, DANIEL MCKINSEY, ETHAN BERNARD, CHRISTOPHER WAHL, BLAIR EDWARDS, MARKUS HORN, NICOLE LARSEN, BRIAN TENNYSON, Yale University — PIXeY (Particle Identification in Xenon at Yale) is a two-phase (liquid/gas) xenon prototype detector with 3-kg active mass. The two-phase xenon technology has many applications that include gamma-ray imaging, neutrinoless double beta decay searches, dark matter searches, and 4π gamma-ray detectors for studies in Nuclear Astrophysics. PIXeY was built to optimize energy resolution, position resolution, and gamma/neutron discrimination. A number of fiducial cuts and correction factors were used to optimize energy resolution. The light and charge signals were corrected by the spatial location of the event within the detector, taking into account effects such as the electron lifetime, geometric light collection, and any other position and field-dependent variations. The energy spectrum of various sources was studied by varying the cathode, anode, and PMT voltages. Optimal configurations for the drift and scintillation fields were found for energies ranging from 41.5 keV (^{83m}Kr) to 2.61 MeV (^{228}Th), resolving the light signal and keeping the charge signal unsaturated. In addition, after optimizing for the energy resolution of Cs-137 (662 keV) the value obtained was 1.4% σ/E. Once the energy resolution studies have concluded, PIXeY will serve as a platform for future improvements, including multiple optical volumes and single-wire readout for R&D on gamma-ray imaging.

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