

Study of digital filters to 3D position-sensitive pixelated CdZnTe detector

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In this study, we designed the optimal digital filters to 3D position-sensitive pixelated CZT detector. There are two benefits to make anode pixelated: (1) the dependence of induced signal on interaction position is eliminated due to a small pixel effect (2) the energy resolution can be enhanced through electron trapping correction using interaction depth information. For single pixel events, the interaction depth can be obtained by the ratio of the cathode signal and the anode signal. The events related to different interaction depth is sorted and then the electron trapping calibration is done by aligning the photo peak to the same position. However, for multiple pixel events, the interaction depth can not be acquired by the method same as single pixel events. The electron drift time is used to determine the interaction depth. The movement of the electrons in faraway from the anode have no effect on the anode signal because of the small pixel effect. In other words, the anode signal only rises when the electrons reach anode vicinity which makes it possible to obtain drift time of the electrons from their origin to the anode adjacency. Using two triggers on the cathode signal generated when the electron clouds start to move and anode signal generated when the electron clouds reach the anode vicinity, respectively, the electron drift time can be determined. The advantage of using digital filters is many filters with various parameter can be tested. So, the performance of several digital filters for energy determination and timing determination, respectively, was evaluated. For energy, the optimal filter that can provide the best signal-to-noise ratio was chosen, while, for timing, the depth resolution is used to judge the performance of the timing filter.