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A 1D CNN Algorithm for Low Background β Detection with Time Projection Chamber

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TPC System
• Consists of a main TPC detector (240 channels) and an anti-coincidence detector (16 channels) for a total 256 signal channels
• The detector casing is crafted from aluminum and includes a radiation entrance window for samples, measuring 70mm×70mm on its surface
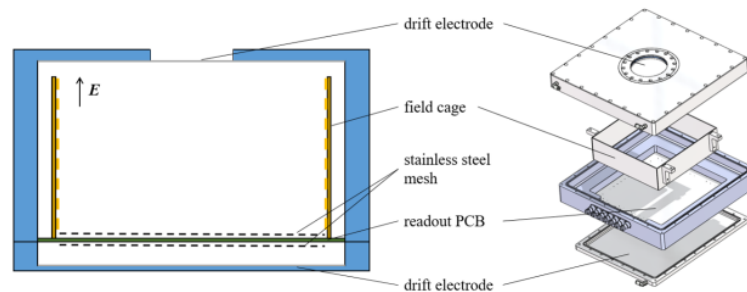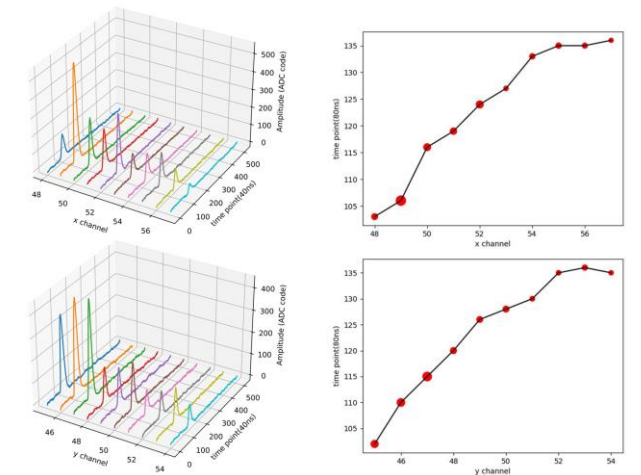
Readout Electronics
• Comprise two components: the Front-End Card (FEC) and the Data Collection Module (DCM)
• Involving pre-amplification and shaping of the detector's charge signals.
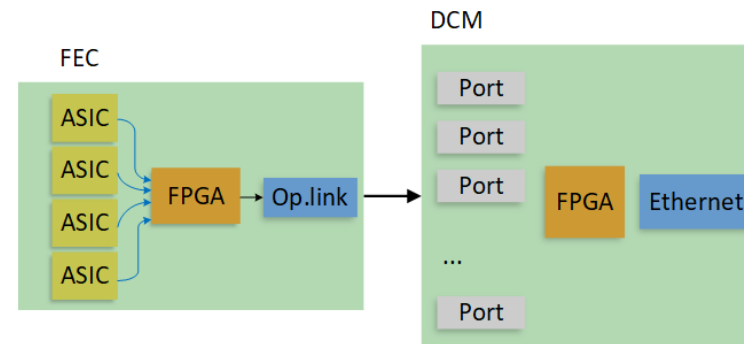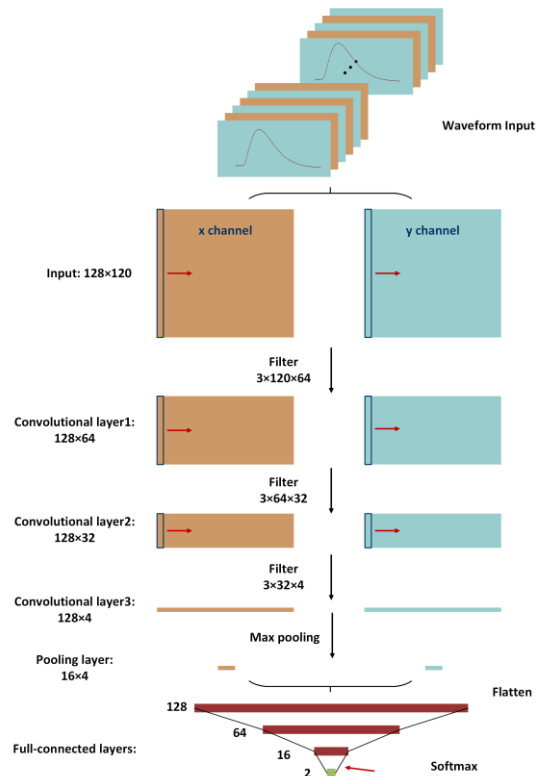
Feature Reconstruction
• Reconstruct the three-dimensional trajectory and energy deposition of particles
• Allowing for the reconstruction of additional features.
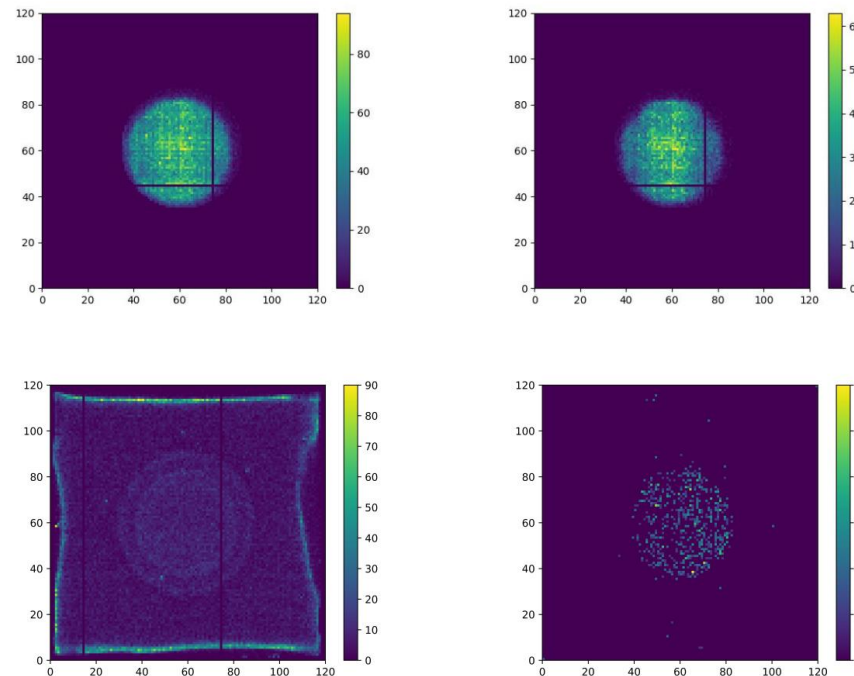

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Network Architecture

• Comprises convolutional layers and fully connected layers.
• The last layer of the fully connected layers is a softmax function.

Test Result

• The rejection rates are 44.53% for β events and 99.15% for background events.
• Reveal a significant disparity in the algorithm's filtering performance between the β and background datasets.

Algorithm Evaluation

• A statistical analysis of the distributions of energy loss, drift time and trajectory lengths (before an after filtering)
• Providing evidence for the algorithm's superiority over manual selection.