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Improvement of β+/γ discrimination algorithm based on deep-learning

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In this study, we proposed a deep-learning based algorithm for discriminating positron/gamma-ray in a phoswich detector (two-layer scintillator). However, both Compton scattered gamma rays and positrons can deposit energy in both layers. Therefore, conventional pulse shape discrimination (PSD) algorithms incorrectly identified Compton scattered gamma-ray as positron. Compton scattered gamma-ray and positron may be discriminated should one acquired energy distribution of each scintillator because the distribution of energy deposited in each scintillator differs depending on the type of radiation. Therefore, we introduced an Autoencoder, an unsupervised deep learning architecture, to separate the coincidence signal into their original signals of each scintillator. The distribution of energy deposited on both scintillators was then obtained using the separated signal. False positrons can be rejected based on this energy distribution, which led to improvement of positron detection accuracy. The positron/gamma-ray discrimination algorithm using the autoencoder increased the sensitivity (true positive) by 14.4% and decreased the error rate (false positive) by 43.4% compared to conventional PSD algorithms.

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