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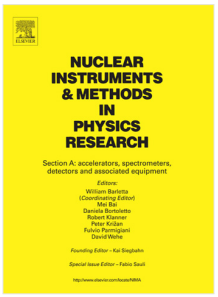

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Methodology and Performance Comparison of Statistical Learning Pulse Shape Classifiers as Demonstrated with Organic Liquid Scintillator

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Abstract

In this paper, we present novel methods for automated pulse shape discrimination. The classifiers are trained using simple radionuclide sources and do not require ground truth labeling. We test their performance using labels derived from time of flight experiments and present the results in terms of energy-dependent Receiver Operating Characteristic (ROC) curves. In addition, we also train and test standard pulse shape discrimination methods on the same data for comparison. We find multiple methods that can yield similar false neutron and true neutron rates at 24 keVee as tail-to-total or Gatti's optimal linear filter yield at 54 keVee.

Key words: pulse shape discrimination, Bayes classifier, density estimation, neutron detection

1. Introduction

Many scintillation material detectors have distinctive time-evolving light output resulting in pulse shapes that depend on the particle that interacts and deposits energy in the active material. Great interest has been concentrated on maximizing the amount of information that can be extracted from those pulses.

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