

Photoelectric event discrimination with neural networks in metascintillators, beyond energy resolution concepts

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Abstract

Energy resolution is a handy, dimensionless metric presenting the quality of energy conversions in a radiation detector. In novel systems such as the metascintillator-based ones, with variable light yield per event, this concept is inapplicable.

In this work, we present the theoretical concept and simulation-based neural network application on the reconstruction of event interaction. We show the ability of neural networks to significantly improve the classification of event interaction as photoelectric or scattered, when more than two independent information channels (e.g. multiple SiPMs) are used. In this pilot work, we show the application of this concept for a 3x25.1x24 mm³ semi-monolithic design using BGO-EJ232 and LYSO:Ce-EJ232Q as meta-scintillators. Regardless of the difference in light yield between the constituting components, ranging from the same to one order of magnitude, the neural network achieves above 95% precision in identifying photoelectric interactions. This is a significant improvement to the standard, energy spectrum based approach.