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Type: **Poster Presentation**

Background discrimination for DSNB detection using high-resolution convolutional neural networks

Wednesday, 1 June 2022 17:35 (3 minutes)

The Diffuse Supernova Neutrino Background (DSNB) is the faint signal of all core-collapse supernovae explosions on cosmic scales. A prime method for detecting the DSNB is finding its inverse beta decay (IBD) signatures in Gadolinium-loaded large water Cherenkov detectors like Super-Kamiokande (SK-GD). Here, we report on a novel machine learning method based on Convolutional Neural Networks (CNNs) that offer the possibility for a direct classification of the PMT hit patterns of the prompt events.

While the enhanced neutron tagging capability of Gadolinium greatly reduces single-event backgrounds, correlated events mimicking the IBD coincidence signature remain a potentially harmful background. Especially in the low-energy range of the observation window, Neutral-Current (NC) interactions of atmospheric neutrinos dominate the DSNB signal, which leads to an initial signal-to-background (S:B) ratio inside the observation window of about 1:10.

Based on the events generated in a simplified SK-GD-like detector setup, we find that a trained CNN can maintain a signal efficiency of 96 % while reducing the residual NC background to 2 % of the original rate, corresponding to a final signal-to-background ratio of about 4:1. This provides excellent conditions for a DSNB discovery.

Main Topic

Deep learning

Secondary Topic

Image segmentation, object detection and classification

Participation mode

In person

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