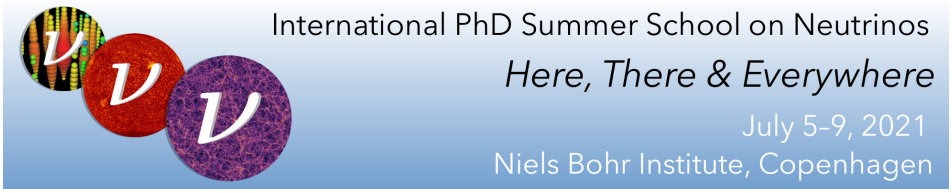

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Detection of Tau Neutrinos at the Super-Kamiokande Experiment

Wednesday, 7 July 2021 16:00 (15 minutes)

The Super-Kamiokande experiment (SK) is the famed water Cherenkov detector which discovered the oscillation of atmospheric neutrinos. As a result of the oscillation of atmospheric muon neutrinos, tau neutrinos are expected to appear. Therefore, direct detection of tau neutrinos in the atmosphere provides unambiguous confirmation of the phenomenon of neutrino oscillation. Moreover, identifying and reducing tau neutrino background in the atmospheric oscillation analysis would increase the mass hierarchy sensitivity of SK.

In 2018, SK excluded the hypothesis of no tau appearance with a significance level of 4.6σ. SK used machine learning techniques of neural networks (NNs) to classify the tau charged-current interactions from the interactions of the atmospheric muon and electron neutrinos. The present NN of SK is a multilayer perceptron, with a single hidden layer. My research involves upgrading the NN for better classification, such as with the implementation of the more sophisticated algorithms of convoluted NNs.

In particular, the signatures to classify these interactions are expected to be seen in neutrons, which are copiously produced in the particle showers arising from the tau and atmospheric neutrino interactions. So far, information related to neutrons has never been used at SK for discerning tau neutrinos. The prospect of expanding the NN with new inputs about neutron captures is under consideration, owing to the enhanced detection of neutrons with the addition of gadolinium in SK. Preliminary results show that this additional information shall improve the NN classification, and hence, the detection of tau neutrinos.

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