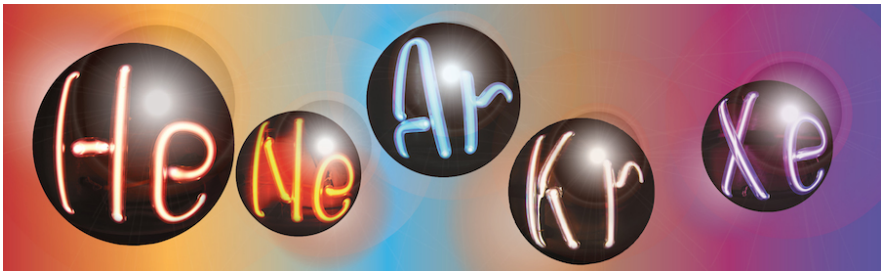

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The light detection system of the ICARUS detector in the Short Baseline Neutrino program at Fermilab.

Friday, 23 September 2022 11:30 (15 minutes)

The Short Baseline Neutrino (SBN) program at the Fermi National Laboratory in the US is an extensive experimental programme based on three Liquid Argon Time Projection Chambers (LAr-TPCs) aiming at searching for sterile neutrino(s), whose existence is one of the fundamental open questions of neutrino physics. The SBN program aims to study neutrino oscillations and interactions in the hundreds-of-MeV to a few GeV energy range, using the Booster Neutrino Beam (BNB) and some off-axis neutrinos from the NuMI (Neutrinos at the Main Injector) beam. The SBN detectors, working near the Earth's surface, are also exposed to a substantial cosmic background, which can mimic genuine neutrino interactions. Thus, it is fundamental to distinguish the signals related to the neutrino beams from those induced by the cosmic rays. The subject of this talk is related to the ICARUS detector with a focus on its light detection system. The ICARUS detector is equipped with 360 8" R5912 Hamamatsu Photomultiplier Tubes (PMTs) to detect VUV photons produced after the passage of ionizing particles in LAr. This system is fundamental for the TPC operation, providing an efficient trigger and contributing to the 3D reconstruction of events.
Moreover, the light detection system allows for the time reconstruction of events, contributing to the identification and selection of neutrino interactions within the beam spill gates. The light detection system calibration and further development of the trigger system, aiming at increasing their efficiencies for physics data taking, had been performed for the final detector configuration during the detector commissioning at Fermilab. The trigger system effectively exploits the information given by the scintillation light detection system. This contribution also presents a way of using the PMT information for filtering neutrino interactions and cosmic muons by applying a Convolutional Neural Network (CNN) to the simulated data. The results show that with this method, the cosmic background can be reduced by up to 76% with a neutrino selection efficiency of 99%. However, this work aims at filtering the real data cases, which are usually not identical to the simulated ones. Thus, a way to mitigate biases from imperfect simulations will also be presented by applying Domain Adversarial Neural Networks (DANNs). The results demonstrate that adversarial training through a DANN can alleviate the loss of efficiency at a relatively low cost of reduced background rejection. This is the first application of DANN for CNN as an event classifier for a LAr TPC.

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