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Application of machine learning methods for the identification of proton decay in liquid argon detector

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The Deep Underground Neutrino Experiment (DUNE) is a long baseline neutrino oscillation experiment hosted by the Fermi National Accelerator Laboratory (Fermilab). Beyond its primary focus on advancing neutrino physics, DUNE also aspires to explore the possibility of proton decay, which holds the potential to provide evidence for grand unified theories.
The DUNE far detector comprising four 10 kiloton liquid argon time projection chambers (LArTPCs), which utilize ionization charge collection as a detector technology, will enable the search.
Currently, data simulations are being conducted to generate both signal samples (proton decay via $p \rightarrow K+\nu$) and background samples (atmospheric neutrino interactions on argon). Distinguishing between these types of events poses a considerable challenge due to the intricate nature and vast volume of the data.
To address this challenge, we explore the potential of deep neural networks for proton decay detection at DUNE. By leveraging the capabilities of neural networks, we aim to enable and improve detector event classification. It is important to note that our work is still ongoing. Currently, we are working with pretrained models, employing transfer learning and fine-tuning techniques to adapt them to our case. In the future, we aspire to develop a model specifically designed to address the task of proton decay detection.

Primary author: GUĽA GARTMAN, Anna

Presenter: GUĽA GARTMAN, Anna

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