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Exploring position reconstruction of HPGe detector events in LEGEND with a deep neural network

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LEGEND1000 is a ton scale experiment searching for neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. The experiment uses High Purity Germanium (HPGe) crystals, which, enriched by ^{76}Ge, serve as source and detector simultaneously. The discovery potential of LEGEND1000 lies at half-lives greater than 10^{28} years.
Due to the complexity of the data produced by this experiment, it becomes more and more attractive to analyze data with machine learning, as machine learning features can extract more information from data than classical analysis methods can. As an example, large germanium detectors, as the ones manufactured for LEGEND, exhibit a pulse shape dependence on the positions of the energy depositions. A reconstruction of these positions with classical methods is very limited. Therefore, a machine-learning-based approach is investigated, which analyzes the features of varying waveforms to create a position reconstruction algorithm. The application of position reconstruction can provide an additional method for background reduction and has the potential to spot local impurities in the germanium crystal. The use of machine learning for position reconstruction additionally explores the possibilities of this technique in experimental physics.
This poster presents the current progress on a preliminary neural network to reconstruct Ge-detector event positions, which is trained and tested with simulated pulses. An optimized neural network may in future be applied to real data.

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Poster prize

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