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The use of Geant4 simulations for training the artificial neural network used for the NeuLAND data analysis

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Precise experimental knowledge on a wide variety of observables is a key ingredient for improving our understanding of nuclear structure. As a result, each new generation of accelerator facilities produces larger amounts of data than the previous generation in order to improve the precision of the measurements. Hence, more advanced analysis tools are required to deal with these large amounts of data. Recently, the use of artificial neural networks is gaining popularity as such a tool for analysis. However, using an artificial neural network requires one to train the network beforehand using data with a known outcome. Access to data with a known outcome can be a bottleneck, because no experiment has a result that is known beforehand. As a workaround, neural networks can be trained using simulated data instead. However, for this training to be effective, the physical processes included in the simulation must provide an accurate description of reality. We shall discuss this problem in a case-study for fast-neutron detection using the NeuLAND neutron detector of the R3B experiment at the FAIR facility in Darmstadt, Germany. The detector responses (multi-neutron detection in particular) of NeuLAND have been studied extensively through Geant4 Monte Carlo simulations, which we hope to use for training an artificial neural network that can
analyze the NeuLAND data. However, before these simulations can be used for training a neural network, we need to make sure that the interactions used in Geant4 are well under control and have been benchmarked properly. In this presentation, some results will be shown indicating how inaccuracies in the Geant4 interactions can propagate through the neural network data processing.

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