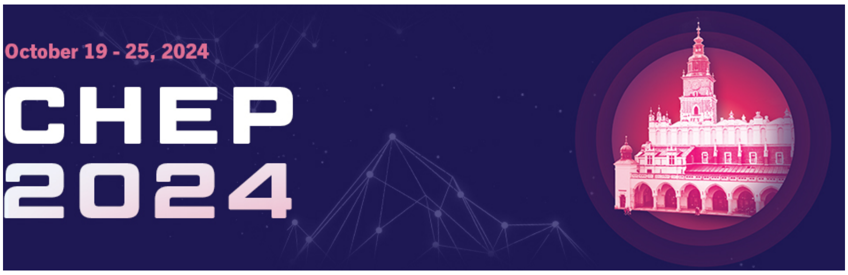

Contribution ID: **266** Type: **Talk**

NeuroMCT: Fast Monte Carlo Tuning with Generative Machine Learning in the JUNO Experiment

Monday 21 October 2024 13:30 (18 minutes)

The Jiangmen Underground Neutrino Observatory (JUNO) is a neutrino experiment under construction in the Guangdong province of China. The experiment has a wide physics program with the most ambitious goal being the determination of the neutrino mass ordering and the high-precision measurement of neutrino oscillation properties using anti-neutrinos produced in the 50 km distant commercial nuclear reactors of Taishan and Yangjiang.

To reach its aims, the detector features an acrylic sphere of 35.4 meters in diameter filled with 20 kt of liquid scintillator and equipped with 17612 20-inch photomultiplier tubes (PMTs) and 25 600 3-inch PMTs to provide an energy resolution better than 3% at 1 MeV. In addition to the cutting-edge features and performance of the detector, a critical aspect for achieving the physics goals is a deep understanding of such a complicated detector. In this respect, an accurate Monte Carlo (MC) simulation of the detector and the interactions happening inside of it is crucial. The simulation depends on many effective parameters, which must be tuned to accurately describe the data acquired.

In this contribution, we propose a novel machine-learning approach to MC tuning that combines Generative Learning and data acquired during calibration campaigns. We study Generative Adversarial Networks (GAN) as a way to speed up event simulation and as an efficient model to interpolate within the parameter space. We consider three main parameters related to the energy response of the JUNO detector and optimize their value in the MC by comparing calibration data to the GAN simulations. Parameter estimation is performed via Bayesian optimization based on a Nested Sampling algorithm to cope with the wide and complex parameter space.

The presented approach is easily scalable to include more parameters and is general enough to be employed in most modern physics experiments.

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