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Flow Matching Mitigates Gaussian Error Approximations in Neutrino Cross-Section Measurements

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Uncertainties in neutrino-nucleus cross-section measurements are usually evaluated by considering the spread of a measurement over an ensemble of variations of systematic parameters under the assumption they are distributed as a multivariate gaussian.

However, this cannot always be expected to be a safe assumption, in particular as we enter an era of systematic-limited measurements.

We showcase examples in which this assumption leads to incorrect conclusions when benchmarking neutrino interaction models and propose a solution to the issue.

We propose a method of directly learning the density of throws based on flow matching - a state-of-the-art generative modelling paradigm for training continuous normalizing flows.

We test our method in a realistic cross-section measurement example, showing it achieves excellent high-dimensional density estimation, surpassing the gaussian baseline and other machine learning methods.

Poster prize

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