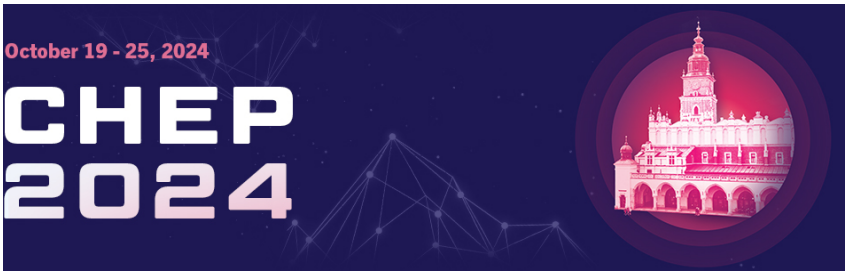

Contribution ID: **278** Type: **Talk**

End-to-end event simulation with Flow Matching and generator Oversampling

Tuesday 22 October 2024 17:27 (18 minutes)

The event simulation is a key element for data analysis at present and future particle accelerators. We show [1] that novel machine learning algorithms, specifically Normalizing Flows and Flow Matching, can be effectively used to perform accurate simulations with several orders of magnitude of speed-up compared to traditional approaches when only analysis level information is needed. In such a case it is indeed feasible to skip the whole simulation chain and directly simulate analysis observables from generator information (end-to-end simulation). We simulate jets features to compare discrete and continuous Normalizing Flows models. The models are validated across a variety of metrics to select the best ones. We discuss the scaling of performance with the increase in training data, as well as the generalization power of these models on physical processes different from the training one. We investigate sampling multiple times from the same inputs, a procedure we call oversampling, and we show that it can effectively reduce the statistical uncertainties of a sample. This class of ML algorithms is found to be highly expressive and useful for the task of simulation. Their speed and accuracy, coupled with the stability of the training procedure, make them a compelling tool for the needs of current and future experiments.

[1] arXiv:2402.13684

Primary authors: CATTAFESTA, Filippo (Scuola Normale Superiore & INFN Pisa (IT)); VASELLI, Francesco (Scuola Normale Superiore & INFN Pisa (IT)); ASENOV, Patrick (Universita & INFN Pisa (IT)); RIZZI, Andrea (Universita & INFN Pisa (IT))

Presenter: CATTAFESTA, Filippo (Scuola Normale Superiore & INFN Pisa (IT))

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