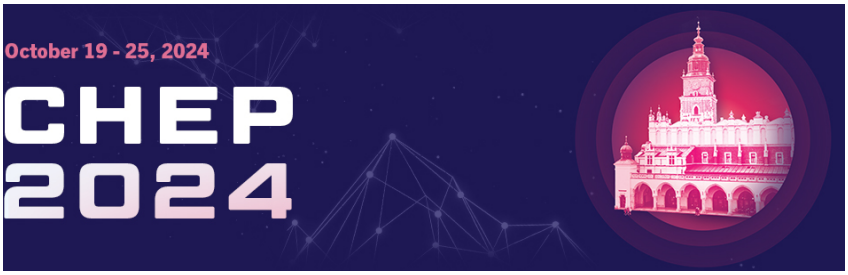

Contribution ID: **474** Type: **Talk**

Generative AI for fast simulations in LHCb

Tuesday 22 October 2024 17:09 (18 minutes)

In high energy physics, fast simulation techniques based on machine learning could play a crucial role in generating sufficiently large simulated samples. Transitioning from a prototype to a fully deployed model usable in a full scale production is a very challenging task.

In this talk, we introduce the most recent advances in the implementation of fast simulation for calorimeter showers in the LHCb simulation framework based on Generative AI. We use a novel component in Gaussino to streamline the incorporation of generic machine learning models. It leverages on the use of fast simulation hooks from Geant4 and machine learning backends such as PyTorch and ONNXRuntime.

Using this infrastructure the first implementation of selected ML models is trained and validated on the LHCb calorimeters. We will show a Variational Autoencoder (VAE) equipped with a custom sampling mechanism, as well as a transformer-based diffusion model (DiT). Both are compatible with the setup used in the CaloChallenge initiative, a collaborative effort aimed at training generic models for calorimeter shower simulation. We will share insights gained from the validation of these models on dedicated physics samples, including how to cope with handling and versioning multiple ML models in production in a distributed environment.

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