

PanShower: One model for all calorimeter showers

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Accurate and efficient detector simulation is essential for modern collider experiments. To reduce the high computational cost, various fast machine learning surrogate models have been proposed. Traditional surrogate models for calorimeter shower modeling train separate networks for each particle species, limiting scalability and reuse. We introduce PanShower, a unified generative model that simulates calorimeter showers across multiple particle types using a single generative model. PanShower is a continuous normalizing flow model with a Transformer architecture, enabling it to generate complex spatial and energy correlations in variable-length point cloud representations of showers. Trained on a diverse dataset of simulated showers in the highly granular ILD detector, the model demonstrates the ability to generate realistic showers for electrons, photons, charged and neutral hadrons over a wide range of incident energies and angles without the need for retraining.

Authors: GAEDE, Frank (FTX (FTX Fachgruppe SFT)); KASIECZKA, Gregor (UNI/EXP (Uni Hamburg, Institut für Experimentalphysik)); DAY-HALL, Henry (FTX (FTX Fachgruppe SFT)); KRUEGER, Katja (DESY (FTX Fachgruppe DTA)); BUSS, Thorsten (Universität Hamburg)

Presenter: BUSS, Thorsten (Universität Hamburg)

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