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Fast and Accurate Electromagnetic and Hadronic Showers from Generative Models

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Generative machine learning models are a promising way to efficiently amplify classical Monte Carlo generators' statistics for event simulation and generation in particle physics. The high computational cost of the simulation and the expected increase in data in the high-precision era of the LHC and at future colliders indicate that we urgently need such fast surrogate simulators. We present a status update on simulating particle showers in high granularity calorimeters for future colliders. Building on prior work using Generative Adversarial Networks (GANs), Wasserstein-GANs, and the information-theoretically motivated Bounded Information Bottleneck Autoencoder (BIB-AE), we achieve further improvements of the fidelity of generated photon showers. The key to this improvement is a detailed understanding and optimization of the latent space. The richer structure of hadronic showers compared to electromagnetic ones makes their precise modeling an important yet challenging problem. We present initial progress towards accurately simulating the core of hadronic showers in a highly granular scintillator calorimeter

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