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CaloDiffusion with GLaM for High Fidelity Calorimeter Simulation

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Generative machine learning models are a promising avenue to resolve computing challenges by replacing intensive full simulations of particle detectors. We introduce CaloDiffusion, a denoising diffusion model that generates calorimeter showers, trained on the public CaloChallenge datasets. Our algorithm employs 3D cylindrical convolutions that take advantage of symmetries in the underlying data. We also introduce a new technique to handle irregular geometries called Geometry Latent Mapping or GLaM, which learns forward and reverse transformations to a regular geometry suitable for symmetry-preserving operations such as convolutions. The showers generated by our approach are nearly indistinguishable from the full simulation, as measured by several different metrics. We also report on several different approaches to speed up the generation process of diffusion models.

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