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CaloLatent: Score-based Generative Modelling in the Latent Space for Calorimeter Shower Generation

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The simulation of particle interactions with detectors plays a central role in many high energy physics experiments. In the simulation pipeline, the most computationally expensive process is calorimeter shower generation. Looking into the future, as the size and granularity of calorimeters increase and we approach the high luminosity operational phase of the LHC, the severity of the simulation bottle neck presented by calorimeter shower generation is expected to increase. Recent developments in the field of generative modelling have led to models that are able to produce high-dimensional high-fidelity samples. When applied to calorimeter shower generation, generative models take orders of magnitude less time to produce the desired high granularity detector response. In this work we introduce a new fast surrogate model based on latent diffusion models named CaloLatent able to reproduce, with high fidelity, the detector response in a fraction of the time required by similar generative models. We evaluate the generation quality and speed using the Calorimeter Simulation Challenge 2022 dataset.

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Session Classification: Generative: Diffusion Models