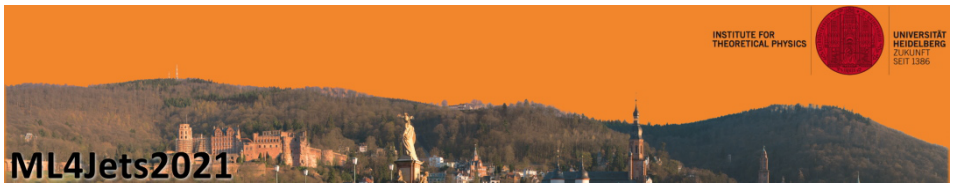

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CaloFlow: Fast and Accurate Generation of Calorimeter Showers with Normalizing Flows

Wednesday, 7 July 2021 14:00 (20 minutes)

We introduce CaloFlow, a fast detector simulation framework based on normalizing flows. For the first time, we demonstrate that normalizing flows can reproduce high-granularity calorimeter simulations with extremely high fidelity, providing a fresh alternative to computationally expensive GEANT4 simulations, as well as other state-of-the-art fast simulation frameworks based on GANs and VAEs. Besides the usual histograms of physical features and images of calorimeter showers, we introduce a new metric for judging the quality of generative modeling: the performance of a classifier trained to differentiate real from generated images. We show that GAN-generated images can be identified by the classifier with 100% accuracy, while images generated from CaloFlow are able to fool the classifier much of the time. More broadly, normalizing flows offer several advantages compared to other state-of-the-art approaches (GANs and VAEs), including: tractable likelihoods; stable and convergent training; and principled model selection. Normalizing flows also provide a bijective mapping between data and the latent space, which could have other applications beyond simulation, for example, to detector unfolding.

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Session Classification: Simulation and Generative Models