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Fast and Faithful Generation of Calorimeter Showers with Deep Generative Models: CaloFlow.

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Simulation of particle interactions with detector material, especially in the calorimeters are very time-consuming and resource intensive. In the upcoming LHC runs, these could provide a bottleneck that severely limits our analysis capabilities.
In recent years, approaches based on deep generative models have provided a fresh alternative to "classical" fast simulation. In this talk, I present CaloFlow, a fast detector simulation framework based on normalizing flows. Besides the usual histograms of physical features and images of calorimeter showers, I will introduce a new metric for judging the quality of generative modeling: the performance of a classifier trained to differentiate real from generated images. I will show that images generated from CaloFlow are able to fool the classifier much of the time, while images generated by other deep generative models, such as GANs, can be identified by the classifier with 100% accuracy. Using a technique called Probability Density Distillation, originally developed for speech synthesis in the ML literature, CaloFlow generates the showers a factor of 10ˆ4 faster than GEANT4, matching or surpassing all other state-of-the-art deep generative models for calorimeter shower simulation.

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