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Deep Generative Models in Particle Physics

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LHC run 3 has just started and in the years leading up to 2040, we will see a 20-fold increase in available data. This forthcoming dataset will have enormous potential for a deeper understanding of the Standard Model and possible physics beyond it. At the same time, the endless possibilities of new physics hiding in this dataset pose a challenge, both for our analyses and also our simulation algorithms.
In the past months, deep generative models (DGMs) like Midjourney, Dall-E, Stable Diffusion, or ChatGPT have attracted a lot of attention. Such models are not only able to generate images or text, but also help us in our understanding of the fundamental building blocks of nature. I will show how DGMs have become a standard tool in our numerical tool box, not only boosting the performance of existing algorithms, but also allowing for new analysis or simulation strategies. My talk not only considers the use of DGMs, but also addresses questions on how to control and evaluate such models against the precision requirements we have at the LHC.

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