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Generating muonic forces carriers with classical and quantum neural networks

Generative models (GM) are powerful tools to help validate theories by reducing the computation time of Monte Carlo (MC) simulations. GMs can learn expensive MC calculations and generalize to similar situations. In this work, we propose comparing a classical generative adversarial network (GAN) approach with a Born machine, both in his discrete (QCBM) and continuous (CVBM) form while addressing their strength and limitations, to generate muon force carrier (MFC) events. The former uses a neural network as a discriminator to train the generator, while the latter takes advantage of the probabilistic nature of quantum mechanics to generate samples. We consider a muon fixed\hyp target collison from the ForwArd Search ExpeRiment (FASER) at the large hadron collider (LHC), with the ATLAS calorimeter as the target. The independent muon measurements performed by the inner detector (ID) and muon system (MS) can help to observe new force carriers coupled to muons, which are usually not detected. We concentrate on muons coming from W and Z bosons decays. MFCs could potentially be part of dark matter (DM), making them interesting for physic searches beyond the standard model.

Significance

We introduce the use of quantum generative models and GAN to an area where it has not been applied before. Quantum technology is emerging and the community is therefore looking for applications area. Also GAN are interesting because they could be able to deal with different energy regime simultaneously.

References

Speaker time zone

Compatible with Europe

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