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Application of the Quantum Kernel Algorithm on the Particle Identification at the BESIII Experiment

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Particle identification is one of most fundamental tools in various particle physics experiments. For the BESIII experiment on the BEPCII, the realization of numerous physical goals heavily relies on advanced particle identification algorithms. In recent years, the emerging of quantum machine learning could potentially arm particle physics experiments with a powerful new toolbox. In this work, targeting at the muon/pion discrimination problem at BESIII, we have developed a quantum SVM classifier under the Noisy Intermediate-Scale Quantum (NISQ) device. By studying and optimizing various encoding circuits, the quantum SVM trained with the BESIII simulation data shows comparable discrimination power than other traditional machine learning models. This has demonstrated the potential of using quantum machine learning techniques to form a new approach for particle identification in particle physics experiments. In this talk, we present the application of the quantum SVM for particle identification at BESIII, and demonstrate how to construct and optimize the quantum kernel. Furthermore, we present results obtained from the noisy simulator as well as the small-scale hardware to show the potential advantage of the quantum SVM algorithm.

Significance

This study is among one of the first attempts applying quantum machine learning on PID, using both noisy simulator and real quantum hardware. This study was never reported in other conferences.

References

Speaker time zone

Compatible with Asia

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