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(G*) Quantum Machine Learning Towards the Development of Automated Analysis of Data from Large-Scale Gamma-Ray Spectrometers

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Many outstanding fundamental topics in nuclear physics are addressed in the NSERC Subatomic Physics Long Range Plan. For several of these critical research drivers, such as " How does nuclear structure emerge from nuclear forces and ultimately from quarks and gluons?", gamma-ray spectroscopy is the investigative technique of choice. However, analysis of data from large-scale gamma-ray spectrometers is often a bottleneck for progress due to the extremely complex nature of the decays of excited nuclear states. In some cases, thousands of individual gamma rays must be analyzed in order to construct excited state decay schemes. To date, this is largely done laboriously by hand with the final result depending on the skill of the individual performing the analysis.

This project aims to develop an efficient machine-learning algorithm to perform the analysis of large spectroscopic data sets, initially concentrating on the analysis of gamma-gamma coincidence matrices. The essence of this research lies in its multi-pronged approach, enabling a rigorous comparison of two dominant machine learning paradigms: supervised and unsupervised techniques. The ultimate goal is to determine the most effective framework for solving problems of this nature and, if applicable, to subsequently enhance the chosen framework by integrating quantum computing, harnessing the power of qubits and quantum operations to overcome the computational restrictions inherent in classical computing.

Keyword-1

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Keyword-2

Machine Learning

Keyword-3

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