Contribution ID: **71** Type: **Poster**

Search for Higgs decay into two tau leptons using Variational Quantum Algorithms

In the Standard Model framework, the Higgs-boson gives rise to the mass of elementary particles. Measuring the coupling of a Higgs-boson to charged leptons is an important process to test the Standard Model predictions. In this work, we only focus on the Higgs' decay into two tau leptons as the masses of electron and muon leptons are too small for the detection of their coupling to Higgs by ATLAS. This forms the main signal for this study. However, there are considerable background processes which can leave a similar signature in the detector to that of the signal. Our main goal is to classify these signal events against three possible background candidates: Z boson decay into two tau leptons, decay of top quarks into a lepton and hadronic taus and decay of a W-boson into an electron or a muon accompanied by a hadronic tau. We perform this classification using variational quantum (VQ) algorithms and benchmark the performance against the state-of-the-art XGBoost decision tree algorithm. The comparison is performed using the area under the Receiver-Operating Characteristic (ROC) curve. We also show our results for combined prediction scores from VQ and XGBOOST algorithms using a quantum ensemble learning method. In addition, we also discuss some of the challenges with VQ-algorithms in this study and suggest improved circuit design for future work.

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Short summary of your poster content

The poster will start with the "Introduction" where I will discuss the motivation for this search. Then I will talk about the VQ-algorithms, quantum circuit design and XGBOOST architecture in the "Methods" section. I will then present my "Results" which will include VQ and XGBOOST comparison plots for the ROC curve and approximate median significance (AMS) metric for the designation of cuts. Subsequently, I will present the "Challenges" where I discuss the problems with the VQ-algorithms related to this study. Finally, I will summarise the main results in the "Conclusions" section and suggest improvements for the circuit design.

Poster printing

Yes

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