Contribution ID: **69** Type: **Poster**

Quantum Computing applications at LHCb

Given the recent developments and successes, Quantum Computing (QC) has seen a tremendous increase in relevance and interest. Particularly in the last years, QC algorithms have been developed to study their use in solving typical problems in High Energy Physics.
In this poster, we present the recent QC applications to jet tagging and track reconstruction currently pursued by the "Data Processing and Analysis"project at the LHCb experiment. A recently published paper presents an application of Quantum Machine Learning to the identification of b-jets at the LHCb: a 16-qubit Variational Quantum Classifier trained on a noiseless quantum simulator has been used to distinguish b-jets from $\bar{b}$-jets using the particle substructure of the jets. A similar model is currently being developed for b-jet versus c-jet classification, with the possibility of deploying these models on the IBM Q quantum computers.
Focusing on track identification, the particles trajectories can be seen as a minimum for a suitable Ising-like Hamiltonian, and solved as a minimization problem. Two approaches based on quantum algorithms are currently under study: the first one involves the use of the Quantum Approximate Optimization Algorithm, solving track reconstruction as a combinatorial optimization problem; the second one uses the framework of Quantum Hopfield neural networks and the Harrow-Hassidim-Lloyd algorithm for solving linear systems of equations, mapping the track reconstruction task into a quantum linear algebra problem.

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Short summary of your poster content

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Poster printing

Yes

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Session Classification: Networking cocktail and Poster Session