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Quantum clustering and jet reconstruction at the LHC

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Clustering is one of the most frequent problems in many domains, in particular, in particle physics where jet reconstruction is central in experimental analyses. Jet clustering at the CERN's Large Hadron Collider is computationally expensive and the difficulty of this task is expected to increase with the upcoming High-Luminosity LHC (HL-LHC).
In this work, we study the case in which quantum computing algorithms might improve jet clustering by considering two novel quantum algorithms which may speed up the classical jet clustering algorithms. The first one is a quantum subroutine to compute a Minkowski-based distance between two data points, whereas the second one consists of a quantum circuit to track the maximum into a list of unsorted data. The latter algorithm could be of value beyond particle physics, for instance in statistics. When one or both of these algorithms are implemented into the classical versions of well-known clustering algorithms (K-means, Affinity Propagation and k_T-jet) we obtain efficiencies comparable to those of their classical counterparts. Even more, we achieve an exponential speed-up in data dimensionality, when the distance algorithm is applied and an exponential speed-up in data length, when the maximum is selected through the quantum routine.

In-person participation

Yes

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