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Reconstructing proton-proton collision positions at the Large Hadron Collider with a D-Wave quantum computer ANDREW WILDRIDGE, SOUVIK DAS, CMS, SACHIN VAIDYA, Purdue University, ANDREAS JUNG, CMS — Clustering of charged particle tracks along the beam axis is the first step in reconstructing the positions of proton-proton (p-p) collisions at Large Hadron Collider (LHC) experiments. In this talk, we formulate this problem for a 2048 qubit D-Wave quantum computer that works by quantum annealing. We showcase the performance of the quantum annealer on artificial events generated from p-p collision and track distributions measured by the Compact Muon Solenoid experiment at the LHC. This performance is enhanced via multiple hardware optimizations which are outlined in the talk. The quantum clustering algorithm is found to be limited by the connectivity of the qubits and the overall efficiency of the algorithm in addressing event topologies with more than 5 collisions. Current research directions are highlighted in extending this algorithm to be compatible with operating at the full LHC-scale problem complexities relevant for particle physics research.

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