Contribution ID: **3** Type: **not specified**

TrackHHL: LHCb Track Reconstruction using novel quantum algorithms

Friday, 8 November 2024 13:50 (20 minutes)

The imminent high-luminosity era of the Large Hadron Collider (LHC) presents significant computational challenges for event reconstruction in high-energy physics. This study investigates a novel approach to charged particle track reconstruction, using the LHCb vertex locator as a case study. Our method employs an Ising-like Hamiltonian minimization through matrix inversion, achieving reconstruction efficiency comparable to state-of-the-art algorithms. While classical implementation suffers from unfavorable time complexity, the quantum Harrow-Hassadim-Lloyd (HHL) algorithm offers potential for exponential speedup, contingent upon efficient quantum phase estimation (QPE) and intuitive post processing. Building on previous work, we present substantial improvements: up to a 10^4-fold reduction in circuit depth and a modified HHL algorithm restricting QPE to one-bit precision. We introduce a novel post-processing algorithm for estimating event Primary Vertices and computing tracks via an Adaptive Hough Transform. These advancements significantly reduce circuit depth and address HHL's readout challenges, bringing event reconstruction closer to current hardware capabilities. This research illuminates the potential of quantum computing in advancing particle track reconstruction for high-energy physics.

Primary author: CHIOTOPOULOS, Xenofon

Presenter: CHIOTOPOULOS, Xenofon

Session Classification: Parallel Sessions (II)