

Contribution submission to the conference SMuK 2023

QUBO partitioning and choice of quantum device for charged particle track reconstruction at LUXE — •ANNABEL KROPF^{1,2}, ARIANNA CRIPPA^{1,3}, LENA FUNCKE^{4,5}, TOBIAS HARTUNG⁶, BEATE HEINEMANN^{1,2}, KARL JANSEN^{1,3}, STEFAN KUEHN¹, FEDERICO MELONI¹, DAVID SPATARO^{1,2}, CENK TÜYSÜZ^{1,3}, and YEE CHINN YAP¹ — ¹DESY — ²Albert-Ludwigs-Universität Freiburg — ³Humboldt-Universität zu Berlin — ⁴Universität Bonn — ⁵MIT — ⁶Northeastern University, London

LUXE (Laser Und XFEL Experiment) is a proposed experiment at DESY using the electron beam of the European XFEL and a high-intensity laser. The experiment's primary aim is to investigate the transition from the well-probed perturbative to the non-perturbative Quantum Electrodynamics regime. In LUXE's initial phase, positrons are produced that impinge on a four-layered pixel detector with occupancies of up to 100 hits/mm². Reconstructing positron trajectories is a combinatorial problem challenging for a classical computer to solve. Our group explores the novel approach of expressing the track pattern recognition problem as a quadratic unconstrained binary optimization (QUBO), allowing the algorithm to be mapped onto a quantum computer. Splitting the QUBO term into mappable subQUBOS is required because the size of the QUBO exceeds the number of qubits of state-of-the-art quantum computers. This talk investigates the influence of the QUBO splitting algorithm on the final track reconstruction efficiency. Additionally, the effectiveness of a gate-based quantum computer and a quantum annealer for applying the QUBO approach will be compared.

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