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Assessing the potential of quantum annealers for track reconstruction at LUXE

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, positrons are generated and directed towards a four-layered silicon pixel detector, with occupancies of up to 100 hits/mm2 for the initial phase. Reconstructing tracks from a substantial set of hits poses a significant challenge for classical computers.

To address this challenge, we adopt a novel approach based on formulating the track pattern recognition task as a quadratic unconstrained binary optimisation (QUBO) problem. This formulation allows the problem to be solved with a quantum annealer. Classically, the expected performance of a quantum annealer for QUBO problems can be studied using Simulated Annealing. In this talk, a comprehensive study of various aspects of the problem, including QUBO encoding, algorithm scalability and tracking performance, will be given.

Collaboration / Activity

LUXE

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Track Classification: Detector R&D and Data Handling