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Track reconstruction using a Quantum Computer for LUXE

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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 into the non-perturbative regime of Quantum Electrodynamics that occurs at very high energies. In LUXE, the number of produced positrons is one of the most crucial quantities for investigating the transition between regimes. Since the reconstruction of trajectories from a set of hits 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. The poster will cover the methods and the latest progress of quantum algorithm-based tracking, which relies on Variational Quantum Algorithms to minimize the QUBO. The results are then benchmarked against classical methods using Graph Neural Network or a Combinatorial Kalman Filter.

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