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Track reconstruction using quantum algorithms at LUXE

Wednesday, 26 October 2022 11:00 (30 minutes)

LUXE (Laser Und XFEL Experiment) is a proposed experiment at DESY using the electron beam of the European XFEL and a high-intensity laser. LUXE will study Quantum Electrodynamics (QED) in the strong-field regime, where QED becomes non-perturbative. One of the key measurements is the positron rate from electron-positron pair creation, which is enabled by the use of a silicon tracking detector. Precision tracking of positrons becomes very challenging at high laser intensities due to the high rates, which can be computationally expensive for classical computers. The talk will present the latest progress of quantum algorithm-based tracking, which relies on Variational Quantum Eigensolver (VQE) or Quantum Approximate Optimisation Algorithm (QAOA) to reconstruct tracks, and compare the results with classical methods using Graph Neural Networks or a Combinatorial Kalman Filter.

Significance

This talk will present the first results reconstructing tracks from a full LUXE bunch-crossing (instead of just a test subset) and a set of studies on candidate algorithms (e.g. QUBO splitting) to solve a the quadratic unconstrained binary optimisation problem.

References

https://indico.cern.ch/event/1103637/contributions/4821835/ (CTD 2022)
https://indico.cern.ch/event/855454/contributions/4597417/ (ACAT 2021)

Experiment context, if any

LUXE

Primary authors: FUNCKE, Lena (MIT); HARTUNG, Tobias (University of Bath and The Cyprus Institute); HEINEMANN, Beate (DESY and University of Freiburg (Germany)); JANSEN, Karl (DESY); KROPF, Annabel (DESY Hamburg); KÜHN, Stefan (The Cyprus Institute); MELONI, Federico (Deutsches Elektronen-Synchrotron (DE)); SPATARO, David (DESY); TUYSUZ, Cenk; YAP, Yee Chinn (Deutsches Elektronen-Synchrotron (DE))

Presenter: KROPF, Annabel (DESY Hamburg)

Session Classification: Poster session with coffee break

Track Classification: Track 2: Data Analysis - Algorithms and Tools