

Quantum Computing and Quantum Machine Learning Algorithms for High Energy Physics

Report of Contributions

Contribution ID: 2

Type: **not specified**

Quantum Computing: Challenges and Prospects

Wednesday, 1 June 2022 10:00 (50 minutes)

Presenter: Dr SEVERINI, Simone (University College London and Amazon Web Service)

Session Classification: Quantum Computing and Machine Learning: Status and Prospects

Contribution ID: 3

Type: **not specified**

Overview of Classical Machine Learning

Wednesday, 1 June 2022 11:00 (50 minutes)

Presenters: Dr NACHMAN, Benjamin (Lawrence Berkley National Laboratory); Dr NACHMAN, Benjamin

Session Classification: Quantum Computing and Machine Learning: Status and Prospects

Contribution ID: 4

Type: **not specified**

Overview of Quantum Machine Learning

Wednesday, 1 June 2022 12:00 (50 minutes)

Presenter: Dr KERENIDIS, Iordanis (QC Ware and CNRS)

Session Classification: Quantum Computing and Machine Learning: Status and Prospects

Contribution ID: 6

Type: **not specified**

Quantum Compiling, Black Holes, and a Quantum LHC

Wednesday, 1 June 2022 09:00 (50 minutes)

Primary author: Dr SORNBORGER, Andrew (Los Alamos National Laboratory)

Presenter: Dr SORNBORGER, Andrew (Los Alamos National Laboratory)

Session Classification: Quantum Computing and Machine Learning: Status and Prospects

Contribution ID: 7

Type: **Oral Presentation**

Quantum Neural Networks and their application to generative learning

Wednesday, 1 June 2022 14:00 (30 minutes)

Presenters: Dr ZOUFAL, Christa; Dr TACCHINO, Francesco

Session Classification: Quantum Algorithms: Status and Prospects

Contribution ID: 8

Type: **Oral Presentation**

Quantum Anomaly Detection for Collider Physics

Thursday, 2 June 2022 10:20 (20 minutes)

Presenter: Mr SULAIMAN, Avli (Berkeley Laboratoy)

Session Classification: Parallel Session

Contribution ID: 9

Type: **Oral Presentation**

Application of Quantum Machine Learning at the LHC

Thursday, 2 June 2022 09:00 (20 minutes)

In this talk I summarize my work on the application of Application of Quantum Machine Learning on High Energy Physics Analysis at the LHC.

Presenter: SUN, Shaojun (University of Wisconsin)

Session Classification: Parallel Session

Contribution ID: 10

Type: **Oral Presentation**

Quantum K-Means Algorithm for Signal Processing and Quantum Entanglement in Higgs Boson Decay to Four Leptons

Thursday, 2 June 2022 09:20 (20 minutes)

Presenter: QENANI, Daniel (Yale University)

Session Classification: Parallel Session

Contribution ID: 11

Type: **Oral Presentation**

Quantum Anomaly Detection for Collider Physics

Quantum Machine Learning (QML) is an exciting tool that has received significant recent attention due in part to advances in quantum computing hardware. While there is currently no formal guarantee that QML is superior to classical ML for relevant problems, there have been many claims of an empirical advantage with high energy physics datasets. These studies typically do not claim an exponential speedup in training, but instead, usually focus on an improved performance with limited training data. Most actual problems in collider physics are not limited by training data and so it is not clear thus far where these potential improvements could be deployed in practice. We study a particular anomaly detection task in the four-lepton final state at the Large Hadron Collider that is limited by a small dataset. We explore the application of QML in a semi-supervised mode to look for new physics without specifying a particular signal model hypothesis. We find no evidence that QML provides any advantage over classical ML. It could be that a case where QML is superior to classical ML for collider physics will be established in the future, but for now, classical ML is a powerful tool that will continue to expand the science of the LHC and beyond.

Primary authors: Dr NACHMAN, Benjamin (Lawrence Berkley National Laboratory); ALVI, Sulaiman (member@berkeley.edu;affiliate@berkeley.edu); Mr BAUER, Christian (Lawrence Berkeley National Laboratory)

Presenter: ALVI, Sulaiman (member@berkeley.edu;affiliate@berkeley.edu)

Session Classification: Parallel Session

Contribution ID: 12

Type: **not specified**

Introduction to Hybrid Quantum-Classical Machine Learning

Wednesday, 1 June 2022 14:50 (30 minutes)

Recent advances in machine learning (ML) and quantum computing (QC) hardware draw significant attention to building quantum machine learning (QML) applications. In this talk, I will first provide an overview of the hybrid quantum-classical machine learning paradigm. Important ideas such as calculating quantum gradients will be described. Then I will present the recent progress of QML in various application fields such as classification, distributed or federated learning and reinforcement learning. Potential advantage and scalability in the NISQ era will be discussed as well. Finally, I will briefly discuss several promising research directions.

Presenter: Dr CHEN, Yen-Chi

Session Classification: Quantum Algorithms: Status and Prospects

Contribution ID: 13

Type: **Oral Presentation**

Implementation and Analysis of Quantum Search Methods for Higgs Boson Reconstruction at the LHC

Thursday, 2 June 2022 09:40 (20 minutes)

Presenter: ARMENAKAS, Anthony (Harvard University)

Session Classification: Parallel Session

Contribution ID: 14

Type: **Oral Presentation**

Matrix Model simulations using Quantum Computing, Deep Learning, and Lattice Monte Carlo

Thursday, 2 June 2022 10:00 (20 minutes)

Presenter: FENG, Yuan (UC Berkeley)

Session Classification: Parallel Session