

AI and Quantum Information for Particle Physics

Report of Contributions

Contribution ID: 1

Type: **not specified**

Quantum World

Primary author: PARK, Myeonghun (Seoul National University of Science and Technology)

Presenter: PARK, Myeonghun (Seoul National University of Science and Technology)

Contribution ID: 2

Type: **not specified**

Welcome

Tuesday, 14 November 2023 10:00 (10 minutes)

Presenter: SON, Minho (KAIST)

Session Classification: Quantum Information

Contribution ID: 3

Type: **not specified**

Entanglement Theory

Tuesday, 14 November 2023 10:10 (1 hour)

Entanglement, that is, quantum correlations that do not have a classical counterpart, is a resource for quantum information processing. I provide an overview on the entanglement theory by focusing on the structure of entangled states. I also discuss the experimental verification of entangled states given assumptions made on sources and measurements.

Presenter: Dr BAE, Joonwoo (KAIST)

Session Classification: Quantum Information

Contribution ID: 4

Type: **not specified**

Quantum Position Verification and Time-Constrained Nonlocal Computation

Tuesday, 14 November 2023 11:30 (1 hour)

Quantum position verification (QPV) is a cryptographic task in which the spatial location of an untrusted agent is certified using the principles of quantum mechanics and special relativity. The problem of QPV has deep connections to computational complexity and the AdS/CFT correspondence. In this talk I will introduce the general task of QPV and review some results. I will then turn to recent theoretical work analyzing the structure of QPV protocols in which the distribution of product states is used to certify a spatial location, and an honest prover must perform a joint measurement on the signals. This particular class of QPV protocols reveals separations in security based on whether the adversaries are restricted to classical versus quantum communication.

Presenter: Dr CHITAMBAR, Eric (UIUC)

Session Classification: Quantum Information

Contribution ID: 5

Type: **not specified**

Quantum computing for high-energy physics

Thursday, 16 November 2023 15:00 (1 hour)

Presenter: Dr SPANNOWSKY, Michael (University of Durham)

Session Classification: Quantum Computing

Contribution ID: 6

Type: **not specified**

Expressing non-Abelian gauge-field dynamics in the quantum age

Wednesday, 15 November 2023 11:30 (1 hour)

Presenter: Dr STRYKER, Jesse R. (LBNL, Berkeley)

Session Classification: Quantum Computing

Contribution ID: 7

Type: **not specified**

Towards Building Large HEP Models with Self-Supervised Learning

Thursday, 16 November 2023 10:00 (1 hour)

Presenter: Dr KAGAN, Michael A. (SLAC)

Session Classification: Machine Learning

Contribution ID: 8

Type: **not specified**

The Vision of End-to-End ML models in HEP

Thursday, 16 November 2023 11:30 (1 hour)

Presenter: Dr HEINRICH, Lukas (echnical University Munich)

Session Classification: Machine Learning

Contribution ID: 9

Type: **not specified**

Constructing Novel Nonparametric Estimators for f-divergences and Its Applications to High-energy Physics

Wednesday, 15 November 2023 14:00 (1 hour)

Nonparametric methods, such as nearest neighbor and kernel methods, can offer simple and parallelizable algorithms without the need for manual structure tuning. However, these methods may suffer from severe performance degradation due to biases from the high-dimensionality of data. I will introduce recently derived equations for understanding and addressing the high-dimensional bias and present some principled algorithms. These algorithms can be used to estimate the f-divergences, which can be employed in objective functions to select important features or decorrelate information that should be irrelevant. Examples of the applications in high-energy physics and other fields will be provided.

Presenter: Dr NOH, Yung-Kyun (Hanyang University)

Session Classification: Machine Learning

Contribution ID: 10

Type: **not specified**

Scalar and Grassmann Neural Network Field Theories

Wednesday, 15 November 2023 15:30 (1 hour)

Neural Networks (NN), the backbones of Deep Learning, define field theories through output ensembles at initialization. Certain limits of NN architecture give rise to free field theories via Central Limit Theorem (CLT), whereas other regimes give rise to weakly coupled, and non-perturbative field theories, via small, and large deviations from CLT, respectively. I will present a systematic construction of free, weakly interacting, and non-perturbative field theories by tuning different attributes of NN architectures, bringing in methods from statistical physics, and a new set of Feynman rules. Some interacting field theories of our choice can be exactly engineered at initialization, by parametrically deforming distributions over stochastic variables in NN architectures. As an example, I will present the construction of ⁴ scalar field theory via statistical independence breaking of NN parameters in the infinite width limit. Lastly, I will introduce free and interacting regimes in Grassmann field theories defined via initialized Grassmann NN architectures.

Presenter: Dr MAITI, Anindita (Perimeter Institute)

Session Classification: Machine Learning

Contribution ID: 11

Type: **not specified**

Theory-driven Quantum Machine Learning for HEP

Tuesday, 14 November 2023 14:00 (1 hour)

Machine Learning is, in most cases, powerful but a black-box application. In this talk, we will tackle this very problem from a quantum mechanics point of view, arguing that an optimisation problem, such as classification or anomaly detection, can be studied by “rephrasing” the problem as a quantum many-body system or a mixed state. Such an approach allows us to employ the entire arsenal of quantum theory for data analysis techniques. Hence, this talk will present a small step towards fully theory-driven and interpretable quantum machine learning applications.

Presenter: Dr ARAZ, Jack Y. (Jefferson Lab.)

Session Classification: Quantum Computing

Contribution ID: 12

Type: **not specified**

Digitization and Propagation in quantum computing for lattice gauge theories

Tuesday, 14 November 2023 15:30 (1 hour)

Presenter: Dr LI, Ying-Ying (University of Science and Technology of China)

Session Classification: Quantum Computing

Contribution ID: 13

Type: **not specified**

TBA

Session Classification: Machine Learning

Contribution ID: 14

Type: **not specified**

TBA

Presenter: Dr SON, Minho (KAIST)

Session Classification: Machine Learning

Contribution ID: 15

Type: **not specified**

TBA

Presenter: Dr LEE, Jong-Wan (CTPU-IBS)

Session Classification: Machine Learning

Contribution ID: 16

Type: **not specified**

TBA

Presenter: PARK, Myeonghun (Seoul National University of Science and Technology)

Session Classification: Machine Learning

Contribution ID: 17

Type: **not specified**

TBA

Presenter: Dr JONG-WAN, Lee (IBS-CTPU)

Session Classification: Quantum Computing

Contribution ID: **18**

Type: **not specified**

TBA

Presenter: PARK, Myeonghun (Seoul National University of Science and Technology)

Session Classification: Quantum Computing

Contribution ID: **19**

Type: **not specified**

TBA

Session Classification: Quantum Computing

Contribution ID: 20

Type: **not specified**

TBA

Presenter: YOON, Sangwoon (KIAS AI)

Session Classification: Quantum Computing

Contribution ID: 21

Type: **not specified**

TBA

Presenter: Dr PARK, Myeonghun (Seoul National University of Science and Technology)

Session Classification: Quantum Computing

Contribution ID: 22

Type: **not specified**

Mixture Density Network for Neutrino Reconstruction in Collider Physics

Friday, 17 November 2023 10:00 (40 minutes)

Presenter: Dr YANG, SeungJin (Kyung Hee University)

Session Classification: Machine Learning

Contribution ID: 23

Type: **not specified**

Exploring local and global feature integration in Multi-Model Deep Neural Networks

Friday, 17 November 2023 10:40 (40 minutes)

Presenter: Ms BAN, Kayoung (Yonsei University)

Session Classification: Machine Learning

Contribution ID: 24

Type: **not specified**

TBA

Session Classification: Machine Learning

Contribution ID: 25

Type: **not specified**

TBA

Session Classification: Machine Learning

Contribution ID: 26

Type: **not specified**

TBA

Presenter: SON, Minho (Korea Advanced Institute of Science and Technology)

Session Classification: Machine Learning

Contribution ID: 27

Type: **not specified**

Why autoencoders fail at anomaly detection and what we can do about it

Thursday, 16 November 2023 14:00 (1 hour)

Presenter: Dr YOON, Sangwoong (KIAS-AI)

Session Classification: Machine Learning

Contribution ID: 28

Type: **not specified**

Quantum Amplitude Amplification Operators: Quantum Search in the NISQ era

Friday, 17 November 2023 11:50 (40 minutes)

Presenter: KWON, Hyeokjea (KAIST)

Session Classification: Quantum Computing

Contribution ID: 29

Type: **not specified**

Combinatorial optimization using QC for collider physics

Wednesday, 15 November 2023 10:00 (1 hour)

Presenter: PARK, Myeonghun (Seoul National University of Science and Technology)

Session Classification: Quantum Computing

Contribution ID: **30**

Type: **not specified**

TBA

Friday, 17 November 2023 14:00 (1 hour)

Presenter: SON, Minho (Korea Advanced Institute of Science and Technology)

Session Classification: Future Prospective

Contribution ID: 31

Type: **not specified**

Summary and Future prospective

Friday, 17 November 2023 15:30 (1 hour)

Presenters: SON, Minho (Korea Advanced Institute of Science and Technology); PARK, Myeonghun (Seoul National University of Science and Technology)

Session Classification: Future Prospective