Quantum Computing and Machine Learning Workshop 2024

Report of Contributions

https://indico.ihep.ac.cn/e/22572

Contribution ID: **1** Type: **not specified**

Summer School

Contribution ID: **2** Type: **not specified**

Summer School

Contribution ID: **3** Type: **not specified**

Registration for Quantum Computing and Machine Learning Workshop

Monday, 5 August 2024 13:30 (5h 30m)

Contribution ID: **4** Type: **not specified**

TBA

Contribution ID: **5** Type: **not specified**

TBA

Contribution ID: **6** Type: **not specified**

TBA

Contribution ID: **7** Type: **Talk**

Sophon meets LHC: Accelerating resonance discovery via signature-oriented pre-training

The search for heavy resonances beyond the Standard Model (BSM) is a key objective at the LHC. While the recent use of advanced deep neural networks for boosted-jet tagging significantly enhances the sensitivity of dedicated searches, it is limited to specific final states, leaving vast potential BSM phase space underexplored. In this talk, we introduce a novel experimental method, Signature-Oriented Pre-training for Heavy-resonance ObservatioN (Sophon), which leverages deep learning to cover an extensive number of boosted final states. Pre-trained on the comprehensive JetClass-II dataset, the Sophon model learns intricate jet signatures, ensuring the optimal constructions of various jet tagging discriminates and enabling high-performance transfer learning capabilities. We show that the method can not only push widespread model-specific searches to their sensitivity frontier, but also greatly improve model-agnostic approaches, accelerating LHC resonance searches in a broad sense.
This talk is based on arXiv:2405.12972.

I am

student/ postdoc

Primary author: LI, Congqiao (Peking University)

Presenter: LI, Congqiao (Peking University)

Track Classification: Machine Learning

Contribution ID: **8** Type: **not specified**

GNN Track Reconstruction of Non-helical BSM Signatures

Accurate track reconstruction is essential for high sensitivity to beyond Standard Model (BSM) signatures. However, many BSM particles undergo interactions that produce non-helical trajectories, which are difficult to incorporate into traditional tracking techniques.

We present a version of the ML-based GNN4ITk track reconstruction pipeline, applied to a custom detector environment for non-helical particles simulation.

We explore the ability of an SM-trained graph neural network (GNN) to handle BSM track reconstruction out-of-the-box. Further, we explore the extent to which a pre-trained SM GNN requires fine-tuning to specific BSM signatures. Finally, we get GNN performance in the simplified detector environment, for both helical SM and non-helical BSM cases.

One important non-helical signature in our analysis is produced by "quirks", pairs of particles bound by a new, long-range confining force with a confinement scale much less than the quirk mass, leading to a stable, macroscopic flux tube that generates large oscillations between the quirk pair. The length scale of these oscillations is dependent on the confinement scale, and in general can be shorter than a micron, or longer than a kilometer.

We obtain a good reconstruction performance for this non-helical BSM signature using this ML-based method.

I am

student/ postdoc

Primary author: SHA, Qiyu

Presenter: SHA, Qiyu

Contribution ID: **9** Type: **Talk**

Simulation Based Inference for Future Collider

We apply machine-learning techniques to the effective-field-theory analysis of the $e^+e^- \to W^+W^-$ processes at future lepton colliders, and demonstrate their advantages in comparison with conventional methods, such as optimal observables. In particular, we show that machine-learning methods are more robust to %effects of systematic uncertainties, initial state radiations
detector effects and backgrounds, and could in principle produce unbiased results with sufficient Monte Carlo simulation samples that accurately describe experiments. This is crucial for the analyses at future lepton colliders given the outstanding precision of the $e^+e^- \to W^+W^-$ measurement ($\sim 10^{-4}$ in terms of anomalous triple gauge couplings or even better) that can be reached. Our framework can be generalized to other effective-field-theory analyses, such as the one of $e^+e^- \to \bar{t}$ or similar processes at muon colliders.

I am

student/ postdoc

Primary author: LI, Lingfeng (Brown University)

Presenter: LI, Lingfeng (Brown University)

Track Classification: Machine Learning

Contribution ID: **10** Type: **Talk**

Hadron Identification based on DNN at BESIII

BESIII provides an important research platform for physics topics in the tau-charm energy region. The physics processes in the tau-charm energy region involve a significant amount of hadronic components in the final state, making particle identification crucial.
Currently, BESIII achieves particle identification through the combination of dE/dx and TOF measurements. Due to the absence of a Cherenkov detector, the particle identification efficiency in the high momentum region is relatively low and cannot fully meet the physics requirements.
In fact, all four sub-detectors of BESIII have a certain degree of particle identification capability. However, due to the complex correlations between information from different detectors, traditional methods are extremely challenging to handle and cannot achieve the optimal particle identification performance. Machine learning methods have a strong advantage in addressing such complex correlation problems.
Therefore, I conducted research on particle identification using machine learning methods in BESIII. In order to meet the requirements of particle identification efficiency and computing speed at the same time, I select the deep neural network (DNN) method. After feature selection and model structure adjustment, obtained a machine learning model suitable for particle identification of ,, in BESIII. Compared to traditional methods, the particle identification algorithm based on DNN significantly improves particle identification efficiency in the high momentum region, with minimal increase in time consumption. By separately training on real data and MC, the systematic error has also been significantly reduced. The more efficient particle identification efficiency and smaller systematic error will effectively enhance signal significance and improve physical accuracy.

I am

non-PhD student

Primary authors: 袁, 昊 (高能所); Dr 陈, 正元 (中国科学院高能物理研究所); SUN, Sheng-Sen (Institute of High Energy Physics); ZHAO, Guang (高能所)

Co-authors: LIUHM@IHEP.AC.CN, LIU Huaimin (高能所); DENG, Ziyan (高能所); LI, Gang (高能所); WEN, Shuopin (IHEP)

Presenter: 袁, 昊 (高能所)

Track Classification: Machine Learning

Contribution ID: **11** Type: **Talk**

Cluster counting reconstruction with classical supervised learning and transfer learning

Particle identification (PID) is crucial in particle physics experiments. A promising breakthrough in PID involves cluster counting, which quantifies primary ionizations along a particle's trajectory in a drift chamber (DC), rather than relying on traditional dE/dx measurements. However, a significant challenge in cluster counting lies in developing an efficient reconstruction algorithm to recover cluster signals from DC cell waveforms.

In PID, machine learning algorithms have emerged as the state-of-the-art. For simulated samples, an updated supervised model based on LSTM and DGCNN achieves a remarkable 10% improvement in separating K from pi compared to traditional methods. For test beam data samples collected at CERN, due to label scarcity and data/MC discrepancy, a semi-supervised domain adaptation model, which exploits Optimal Transport to transfer information between simulation and real data domains, is developed. The model is validated using pseudo data and further applied to real data. The performance is superior to the traditional methods and maintains consistent across varying track lengths.

There are two related papers that have been submitted to journals: 2402.16270 and 2402.16493. The previous one about the transfer learning has been accepted by the Computer Physics Communications (https://doi.org/10.1016/j.cpc.2024.109208).

I am

non-PhD student

Primary authors: ZHAO, Guang (高能所); TIAN, Zhefei (Wuhan University)

Co-authors: WU, Linghui (IHEP); ZHANG, Zhenyu (Wuhan University)

Presenter: ZHAO, Guang (高能所)

Track Classification: Machine Learning

Contribution ID: **12** Type: **Talk**

MVAs in Belle II experiment

In this presentation, we discuss the latest developments and applications of Multivariate Analysis (MVA) techniques within the Belle II experiment. The Belle II experiment, operating at the SuperKEKB accelerator in Japan, aims to explore the fundamental interactions of particles and test the limits of the Standard Model of particle physics.

MVA techniques are essential tools in the analysis of complex data sets obtained from high-energy physics experiments. These techniques allow for the efficient separation of signal from background and the identification of rare events, enhancing the overall sensitivity of the experiment.

Furthermore, we will highlight the integration of MVA techniques with the Belle II software framework, enabling streamlined data processing and analysis workflows. The impact of these advanced analysis methods on the precision and accuracy of Belle II measurements will be discussed, alongside future prospects for further improvements.

I am

student/ postdoc

Primary author: LIU, Meihong (Jilin University)

Presenter: LIU, Meihong (Jilin University)

Track Classification: Machine Learning

Contribution ID: **13** Type: **Talk**

Variational ansatz inspired by quantum imaginary time evolution

Exact solutions to combinatorial optimization problems are challenging to obtain using classical computing. The current tenet in the field is that quantum computers can address these problems more efficiently. While promising algorithms require fault-tolerant quantum hardware, variational algorithms have emerged as viable candidates for near-term devices. The success of these algorithms hinges on multiple factors, with the design of the ansatz having utmost importance. In this work, we propose a variational ansatz inspired by quantum imaginary time evolution (QITE) to solve the MaxCut problem. We introduce a tree arrangement of the parametrized quantum gates, enabling the exact solution of arbitrary tree graphs using the one-round QITE-inspired ansatz. For randomly generated D-regular graphs, we numerically demonstrate that the QITE-inspired ansatz solves the MaxCut problem with a small constant number of rounds and sublinear depth, outperforming the quantum approximate optimization algorithm (QAOA), which requires increasing rounds with system size. Furthermore, our ansatz improves the approximation ratio gap by at least 4.8 times for graphs with up to 24 nodes and $D \leq 5$ compared to the classical near-optimal Goemans-Williamson algorithm. Lastly, we prove that the constant-round QITE-inspired ansatz for regular graphs avoids the barren plateaus.

I am

student/ postdoc

Primary authors: Dr WANG, Xiaoyang (Peking University); Dr CHAI, Yahui (Deutsches Elektronen-Synchrotron (DESY)); Prof. FENG, Xu (Peking University); Dr GUO, Yibin (Deutsches Elektronen-Synchrotron); Prof. JANSEN, Karl (Deutsches Elektronen-Synchrotron (DESY)); Mr TUYSUZ, Cenk (Deutsches Elektronen-Synchrotron (DESY))

Presenter: Dr WANG, Xiaoyang (Peking University)

Track Classification: Quantum Machine Learning

Contribution ID: **14** Type: **Talk**

Integration of quantum computing into transformer architectures for High Energy Physics

This presentation delves into integrating quantum computing into transformer architectures to enhance High Energy Physics (HEP) analysis performance. By encoding classical HEP data into quantum states using a quantum-trainable circuit, we aim to harness the strengths of both quantum and classical computing. This hybrid approach is designed to improve data processing and analysis. The implementation ensures compatibility with both CPUs and GPUs, highlighting the potential of quantum-enhanced transformer models in scientific research.

I am

student/ postdoc

Primary author: MOHAMMED, Abdualazem (Institute of High Energy Physics)

Presenter: MOHAMMED, Abdualazem (Institute of High Energy Physics)

Track Classification: Quantum Machine Learning

Contribution ID: **15** Type: **not specified**

Enhancing GRB Detection: Machine Learning Optimization of Triggerless Data Analysis Algorithms for LHAASO-WCDA

Detecting Gamma-Ray Burst (GRB) signals from triggerless data poses significant challenges due to high noise levels, a problem similarly encountered in the Large High Altitude Air Shower Observatory's Water Cherenkov Detector Array (LHAASO-WCDA) triggerless data analysis. This research aims to enhance the GRB triggerless data algorithm that leverages gamma-ray showers' distinct spatial properties. By incorporating advanced machine learning techniques such as Bayesian optimization, we refine the algorithm to detect GRB signals within noisy background signals more effectively. Preliminary findings indicate a marked improvement in the detection of GRB events, suggesting that machine learning methods can substantially enhance existing astrophysical data analysis techniques. These methods could lead to more accurate and reliable identification of GRB signals, thereby contributing to our understanding of these cosmic phenomena.

Keywords: Gamma-Ray Bursts, Triggerless Data, Machine Learning, Bayesian Optimization, LHAASO-WCDA, Noise Reduction, Astrophysical Data Analysis, Gamma-Ray Showers, Signal Detection, Cosmic Phenomena.

I am

non-PhD student

Primary authors: Mr MUSTOFA, Abdulhafiz Ahmed (IHEP); CHENG, Yaodong (IHEP); YAO, Zhiguo (IHEP, Beijing, China)

Presenter: Mr MUSTOFA, Abdulhafiz Ahmed (IHEP)

Track Classification: Machine Learning

Contribution ID: **16** Type: **Talk**

Quantum GAN for fast shower simulation

High-energy physics relies on large and accurate samples of simulated events, but generating these samples with GEANT4 is CPU intensive. The ATLAS experiment has employed generative adversarial networks (GANs) for fast shower simulation, which is an important approach to solving the problem. Quantum GANs, leveraging the advantages of quantum computing, have the potential to outperform standard GANs.

Considering the limitations of the current quantum hardware, we conducted preliminary studies utilizing a hybrid quantum-classical GAN model to produce downsampled 1D(8 pixels) and 2D(64 pixels) calorimeter average shower shapes on quantum simulators. The impact of quantum noise is also investigated on the noisy simulator, and the performance is checked on the real quantum hardware.
After producing the average shower shape, we implemented a new generator model to produce the actual shower image with event fluctuation.

I am

student/ postdoc

Primary author: Dr HUANG, Xiaozhong (IHEP)

Presenter: Dr HUANG, Xiaozhong (IHEP)

Track Classification: Quantum Machine Learning

Contribution ID: **17** Type: **Talk**

Deep Learning-Based C14 Pile-Up Identification in the JUNO Experiment

Measuring neutrino mass ordering (NMO) poses a fundamental challenge in neutrino physics. To address this, the Jiangmen Underground Neutrino Observatory (JUNO) experiment is scheduled to commence data collection in late 2024, aiming to determine the NMO at a 3-sigma confidence level within 6 years. A key factor in achieving this is ensuring a high-quality energy resolution of positrons. However, the presence of residual C14 isotopes in the liquid scintillator introduces pile-up effects that can impact the positron energy resolution. Mitigating these effects requires identifying pile-up events, which presents a significant challenge. The signal from C14 is considerably smaller compared to the positron signal, making its identification difficult. The close event time and vertex between a positron and a C14 further compound the identification challenge.
This contribution focuses on the application of deep learning models for the identification of C14 pile-up events. It encompasses a range of models, including convolutional-based models and advanced transformer models. Through performance evaluation, the study showcases the robust capabilities of deep learning models in accurately and effectively identifying pile-up events.

I am

student/ postdoc

Primary author: 方, 文兴 (高能所)

Presenter: 方, 文兴 (高能所)

Contribution ID: **18** Type: **Talk**

机器学习驱动的同步辐射实验“智慧终端”应用研究

我国同步辐射实验装置硬设施建设的水平、数量均跻身世界前列，但分析破解海量、多模态实验数据的软设施建设却发展严重滞后，直接阻碍了重大科学突破的发现与产出。报告人基于机器学习方法驱动，结合多尺度模拟、数字孪生等技术，构建了先进同步辐射实验“智慧终端”多维解析计算系统，实现多种重要材料的结构及性能的精准解析，推动了包括新型纳米药物、功能新材料性能提升的应用研究。
相关代表论文：
1. Molybdenum derived from nanomaterials incorporates into molybdenum enzymes and affects their activities in vivo, Nature Nanotechnology, 16, 708 (2021)
2. Water-Regulated Lead Halide Perovskites Precursor Solution: Perovskite Structure Making and Breaking, The Journal of Physical Chemistry Letters, 14, 4876 (2023)
3. Fast extraction of three-dimensional nanofiber orientation from WAXD patterns using machine learning, IUCrJ, 10, 297 (2023)
4. Synchrotron radiation data-driven artificial intelligence approaches in materials discovery, Artificial Intelligence Chemistry, 2, 100045 (2024)
5. Xiwu: A Basis Flexible and Learnable LLM for High Energy Physics, arXiv preprint arXiv:2404.08001 (2024)

I am

Primary author: 赵丽娜, UNKNOWN (高能所)

Presenter: 赵丽娜, UNKNOWN (高能所)

Track Classification: Machine Learning

Contribution ID: **19** Type: **not specified**

Learning powerful jet representations via self-supervision

We propose a new approach to learning powerful jet representations directly from unlabelled data. The method employs a Particle Transformer to predict masked particle representations in a latent space, overcoming the need for discrete tokenization and enabling it to extend to arbitrary input features beyond the Lorentz four-vectors. We demonstrate the effectiveness and flexibility of this method in several downstream tasks, including jet tagging and anomaly detection. Our approach provides a new path to a foundation model for particle physics.

I am

student/ postdoc

Primary authors: Prof. QU, Huilin (CERN); LIU, Qibin (TDLI., Shanghai JiaoTong University); LI, Congqiao (Peking University); WANG, Shudong (高能所)

Presenter: WANG, Shudong (高能所)

Track Classification: Machine Learning

Contribution ID: **20** Type: **not specified**

欢迎致辞

Tuesday, 6 August 2024 08:30 (10 minutes)

Session Classification: Plenary

Contribution ID: **21** Type: **Talk**

机器学习驱动的同步辐射实验“智慧终端”应用研究

Tuesday, 6 August 2024 09:45 (25 minutes)

I am

Primary author: 赵丽娜, UNKNOWN (高能所)

Presenter: 赵丽娜, UNKNOWN (高能所)

Session Classification: Plenary

Contribution ID: **22** Type: **Talk**

Overview of ML studies at CMS and ATLAS

Tuesday, 6 August 2024 08:40 (40 minutes)

Presenter: 张, 瑞 (University of Wisconsion)

Session Classification: Plenary

Contribution ID: **23** Type: **not specified**

Overview of ML studies at ATLAS

Session Classification: Plenary

Contribution ID: **24** Type: **Talk**

Overview of ML studies at JUNO (online)

Wednesday, 7 August 2024 16:20 (25 minutes)

I am

Presenter: 李, 腾 (Shandong University)

Session Classification: Plenary

Contribution ID: **25** Type: **not specified**

AI assistant for ATLAS - chATLAS

Tuesday, 6 August 2024 14:00 (25 minutes)

I am

Presenter: RANDAZZO, Cary (ATLAS Collaboration)

Session Classification: Plenary

Contribution ID: **26** Type: **not specified**

AI agent for BESIII - Dr. Sai

Tuesday, 6 August 2024 14:25 (25 minutes)

Presenter: LI, Ke (IHEP)

Session Classification: Plenary

Contribution ID: **27** Type: **Talk**

AI platform and software framework at IHEP

Tuesday, 6 August 2024 15:15 (25 minutes)

Presenter: ZHANG, Yiyu

Session Classification: Plenary

Contribution ID: **28** Type: **not specified**

Multi-agents system for BESIII analysis

Tuesday, 6 August 2024 16:00 (25 minutes)

Presenter: ZHANG, bolun (IHEP)

Session Classification: Plenary

Contribution ID: **29** Type: **not specified**

Data cleaning for LLM

Tuesday, 6 August 2024 16:25 (25 minutes)

Presenter: JIAO, Junkun (Jilin University)

Session Classification: Plenary

Contribution ID: **30** Type: **not specified**

LLM model for HEP - Xiwu

Tuesday, 6 August 2024 14:50 (25 minutes)

Presenter: CHEN, Siyang (Institude of High Energy Physics)

Session Classification: Plenary

Contribution ID: **31** Type: **not specified**

Dr. Sai tutorial

Session Classification: Plenary

Contribution ID: **32** Type: **Talk**

TBD（院士报告）

Session Classification: Plenary

Contribution ID: **33** Type: **not specified**

Scattering amplitude from quantum computing with reduction formula

Wednesday, 7 August 2024 09:00 (25 minutes)

I am

Presenter: GUO, Xingyu

Session Classification: Plenary

Contribution ID: **34** Type: **not specified**

量子计算在核物理的应用研究 (online)

Wednesday, 7 August 2024 09:50 (25 minutes)

I am

Presenter: WEI, Shijie

Session Classification: Plenary

Contribution ID: **35** Type: **not specified**

TBD

I am

Presenter: WANG, Xiaoyang

Session Classification: Plenary

Contribution ID: **36** Type: **not specified**

Quantum simulations of non-perturbative effects in strong field QED

Wednesday, 7 August 2024 09:25 (25 minutes)

I am

Presenter: XU, Bin (Peking University)

Session Classification: Plenary

Contribution ID: **37** Type: **not specified**

Variational ansatz inspired by quantum imaginary time evolution

Wednesday, 7 August 2024 10:45 (25 minutes)

I am

Presenter: WANG, Xiaoyang (P)

Session Classification: Plenary

Contribution ID: **38** Type: **not specified**

数字化反向透热补偿算法对于优化问题的求解

Wednesday, 7 August 2024 11:10 (25 minutes)

I am

Presenter: 关, 卉杰

Session Classification: Plenary

Contribution ID: **39** Type: **not specified**

Machine Learning Accelerated CALYPSO Structure Prediction Method

Wednesday, 7 August 2024 14:40 (25 minutes)

Presenter: 高, 朋越

Session Classification: Plenary

Contribution ID: **40** Type: **not specified**

AI for complex physical simulation and inverse design (online)

Wednesday, 7 August 2024 14:00 (40 minutes)

I am

Presenter: 吴, 泰霖

Session Classification: Plenary

Contribution ID: **41** Type: **not specified**

Peak finding algorithm for cluster counting with domain adaptation

Presenter: ZHAO, Guang (高能所)

Session Classification: Plenary

Contribution ID: **42** Type: **not specified**

Jet tagging at CEPC (online)

Tuesday, 6 August 2024 09:20 (25 minutes)

I am

Primary author: RUAN, Manqi (IHEP)

Presenter: RUAN, Manqi (IHEP)

Session Classification: Plenary

Contribution ID: **43** Type: **Talk**

GNN for tracking at BESIII and STCF (online)

Thursday, 8 August 2024 14:00 (25 minutes)

I am

Presenter: QIN, Xiaoshuai (Shandong University)

Session Classification: Plenary

Contribution ID: **44** Type: **not specified**

Pipeline for Installing ML Algorithms in Athena's Offline Data Quality Monitoring via Onnx

Thursday, 8 August 2024 16:00 (25 minutes)

I am

Presenter: RANDAZZO, Cary (ATLAS Collaboration)

Session Classification: Plenary

Contribution ID: **45** Type: **not specified**

GNN Track Reconstruction of Non-helical BSM Signatures

Thursday, 8 August 2024 14:25 (25 minutes)

Presenter: SHA, Qiyu

Session Classification: Plenary

Contribution ID: **46** Type: **not specified**

Quantum annealing inspired algorithms for reconstruction (online)

Thursday, 8 August 2024 09:00 (25 minutes)

I am

Presenter: OKAWA (大川), Hideki (英希) (IHEP)

Session Classification: Plenary

Contribution ID: **47** Type: **not specified**

Quantum GAN for fast shower simulation

Thursday, 8 August 2024 09:25 (25 minutes)

I am

Presenter: HUANG, Xiaozhong (IHEP)

Session Classification: Plenary

Contribution ID: **48** Type: **not specified**

Integration of quantum computing into transformer architectures for High Energy Physics

Thursday, 8 August 2024 09:50 (25 minutes)

I am

Presenter: MOHAMMED, Abdualazem (Institute of High Energy Physics)

Session Classification: Plenary

Contribution ID: **49** Type: **not specified**

Particle Indentification based on CNN/QCNN

Thursday, 8 August 2024 11:10 (25 minutes)

I am

Presenter: 姚, 志鹏 (Shandong University)

Session Classification: Plenary

Contribution ID: **50** Type: **not specified**

Deep Learning-Based C14 Pile-Up Identification in the JUNO Experiment

Wednesday, 7 August 2024 17:35 (25 minutes)

I am

Presenter: 方, 文兴 (高能所)

Session Classification: Plenary

Contribution ID: **51** Type: **not specified**

Enhancing GRB Detection: Machine Learning Optimization of Triggerless Data Analysis Algorithms for LHAASO-WCDA

Thursday, 8 August 2024 14:50 (25 minutes)

Presenter: MUSTOFA, ABDULHAFIZ AHMED (IHEP)

Session Classification: Plenary

Contribution ID: **52** Type: **not specified**

Sophon meets LHC: Accelerating resonance discovery via signature-oriented pre-training

Tuesday, 6 August 2024 11:30 (25 minutes)

Presenter: LI, Congqiao (Peking University)

Session Classification: Plenary

Contribution ID: **53** Type: **not specified**

Hadron Identification based on DNN at BESⅢ

Thursday, 8 August 2024 11:35 (25 minutes)

Presenter: 袁, 昊 (高能所)

Session Classification: Plenary

Contribution ID: **54** Type: **not specified**

Cluster counting reconstruction with classical supervised learning and transfer learning

Wednesday, 7 August 2024 15:05 (25 minutes)

I am

Presenter: ZHAO, Guang (高能所)

Session Classification: Plenary

Contribution ID: **55** Type: **not specified**

Learning powerful jet representations via self-supervision

Wednesday, 7 August 2024 16:45 (25 minutes)

I am

Presenter: WANG, Shudong (高能所)

Session Classification: Plenary

Contribution ID: **56** Type: **not specified**

Simulation Based Inference for Future Collider

Thursday, 8 August 2024 15:35 (25 minutes)

Presenter: LI, Lingfeng (Brown University)

Session Classification: Plenary

Contribution ID: **57** Type: **Talk**

MVAs in Belle II experiment

Thursday, 8 August 2024 10:45 (25 minutes)

I am

Primary author: LIU, Meihong (Jilin University)

Presenter: LIU, Meihong (Jilin University)

Session Classification: Plenary

Contribution ID: **58** Type: **not specified**

Discussion and Remark

Thursday, 8 August 2024 16:25 (40 minutes)

Session Classification: Plenary

Contribution ID: **59** Type: **Talk**

数字化反向透热补偿算法对于优化问题的求解

量子技术的发展带来了量子比特数目和质量的提升，然而现有硬件上所能支持的量子算法的复杂度仍然有限。发展近期应用仍然是短期量子算法发展的重要议题。量子变分算法是近期应用中重要的算法框架，其设计依赖于线路拟设的选择和参数的优化方案。数字化反向透热补偿算法是一种高效的量子变分算法。其算法的设计源自对量子控制中的反向透热补偿算法的 Trotter 处理。从动力学层面加速了演化的过程，缩短了线路的长度。同时反向透热补偿算法也对线路的参数提供了最优解方案，可以获得较好的算法性能。如果在此基础上对参数做进一步优化，可以更快的收敛速度，并降低算法优化到局部极小值的概率。本报告将结合分解问题和自旋问题的最优解问题，讨论数字化反向透热补偿算法的优势和局限。算法作为相比于 QAOA 更有效的算法，可以解决常见组合优化问题。

I am

non-PhD student

Primary authors: Prof. SOLANO, Enrique (Kipu Quantum); Dr ALBARR\'AN-ARRIAGADA, Francisco (Center for the Development of Nanoscience and Nanotechnology); Dr HEGAD, Narendra (Kipu Quantum); 关, 卉杰; Prof. ZHOU, Fei (Jinan Institute of Quantum Technology); Dr HEGADE, Narendra N. (Kipu Quantum); Prof. 黄, 合良 (Henan Key Laboratory of Quantum Information and Cryptography, Zhengzhou); Prof. 陈, 玺 (EHU Quantum Center, University of the Basque Country UPV/EHU)

Presenter: 关, 卉杰

Track Classification: Quantum Machine Learning

Contribution ID: **60** Type: **not specified**

机器学习讲座-1

Saturday, 3 August 2024 09:00 (45 minutes)

I am

Primary author: 张, 瑞 (University of Wisconsion)

Session Classification: Summer School

Contribution ID: **61** Type: **not specified**

机器学习讲座-2

Saturday, 3 August 2024 10:15 (45 minutes)

Session Classification: Summer School

Contribution ID: **62** Type: **not specified**

量子计算-1

Sunday, 4 August 2024 09:00 (1h 15m)

Session Classification: Summer School

Contribution ID: **63** Type: **not specified**

量子计算-2

Sunday, 4 August 2024 10:45 (1h 15m)

Session Classification: Summer School

Contribution ID: **64** Type: **not specified**

量子计算 hands-on

Sunday, 4 August 2024 14:00 (1h 45m)

I am

Presenter: SHA, Qiyu

Session Classification: Summer School

Contribution ID: **65** Type: **not specified**

量子计算 hands-on

Sunday, 4 August 2024 16:15 (1h 15m)

I am

Presenter: SHA, Qiyu

Session Classification: Summer School

Contribution ID: **66** Type: **not specified**

大模型

Saturday, 3 August 2024 11:00 (1 hour)

I am

Presenter: 熊, 东波 (中国科学院上海应用物理研究所)

Session Classification: Summer School

Contribution ID: **67** Type: **not specified**

大模型

Saturday, 3 August 2024 16:00 (2 hours)

Session Classification: Summer School

Contribution ID: **68** Type: **not specified**

Transformer

Saturday, 3 August 2024 14:00 (1h 30m)

I am

Presenter: LI, Congqiao (Peking University)

Session Classification: Summer School

Contribution ID: **69** Type: **not specified**

A Novel Quantum Realization of Jet Clustering in High-Energy Physics Experiments

Exploring the application of quantum technologies to fundamental sciences holds the key to fostering innovation for both sides. In high-energy particle collisions, quarks and gluons are produced and immediately form collimated particle sprays known as jets. Accurate jet clustering is crucial as it retains the information of the originating quark or gluon and forms the basis for studying properties of the Higgs boson, which underlies the mechanism of mass generation for subatomic particles. For the first time, by mapping collision events into graphs—with particles as nodes and their angular separations as edges—we realize jet clustering using the Quantum Approximate Optimization Algorithm (QAOA), a hybrid quantum-classical algorithm for addressing classical combinatorial optimization problems with available quantum resources. Our results, derived from 30 qubits on quantum computer simulator and 6 qubits on quantum computer hardware, demonstrate that jet clustering performance with QAOA is comparable with or even better than classical algorithms for a small-sized problem. This study highlights the feasibility of quantum computing to revolutionize jet clustering, bringing the practical application of quantum computing in high-energy physics experiments one step closer.

I am

student/ postdoc

Primary author: 朱, 永峰

Presenter: 朱, 永峰

Track Classification: Quantum Simulation

Contribution ID: **70** Type: **not specified**

人工智能基本原理与研究进展

Tuesday, 6 August 2024 10:40 (25 minutes)

Presenter: 叶, 育鑫

Session Classification: Plenary

Contribution ID: **71** Type: **not specified**

Deep learning applications in the generation of attosecond ultrafast magnetic fields in intense laser field

Tuesday, 6 August 2024 11:05 (25 minutes)

Presenter: YAN, Shujuan

Session Classification: Plenary

Contribution ID: **72** Type: **not specified**

源 2.0 模型的开发和经验

I am

Presenter: WANG, CHAO (nssc)

Session Classification: Plenary

Contribution ID: **73** Type: **not specified**

多模态大模型的实践与思考

Tuesday, 6 August 2024 16:50 (25 minutes)

I am

Presenter: 朱, 优松

Session Classification: Plenary

Contribution ID: **74** Type: **not specified**

基于国产加速卡的科学大模型研究与实践

Tuesday, 6 August 2024 17:15 (25 minutes)

I am

Presenter: 杨, 超

Session Classification: Plenary

Contribution ID: **75** Type: **not specified**

A Novel Quantum Realization of Jet Clustering in High-Energy Physics Experiments

Wednesday, 7 August 2024 17:10 (25 minutes)

I am

Presenter: 朱, 永峰

Session Classification: Plenary

Contribution ID: **76** Type: **not specified**

多模态大模型的实践与思考

Presenter: 朱, 优松

Session Classification: Plenary

Contribution ID: **77** Type: **not specified**

Registration for Summer School

Friday, 2 August 2024 13:30 (5h 30m)