Quantum Computing and Machine Learning Workshop

Report of Contributions

https://indico.ihep.ac.cn/e/19757

Contribution ID: **4** Type: **Talk**

Symmetry Preserving Attention Networks for resolved top quark reconstruction at the LHC

The reconstruction of top-quarks from their decay components is a complex problem which limits the sensitivity of many analyses. A novel approach to this problem, utilizing Symmetry Preserving Attention Networks, has been previously presented for all-hadronic ttbar decays. In this talk, we present new features implemented in the algorithm as well as its extended application to semi-leptonic ttbar decays. Its potential impact on ttbar-related and ttH analyses will also be shown.

I am

non-PhD student

Primary author: Prof. OKAWA, Hideki (高能所)

Co-authors: FENTON, Michael (UC Irvine); SHMAKOV, Alexander (UC Irvine); HSIAO, Ko-Yang (National Tsing Hua); HSU, Shih-Chieh (University of Washington); LI, Yuji (Fudan); WHITESON, Daniel (UC Irvine); BALDI, Pierre (UC Irvine)

Presenter: Prof. OKAWA, Hideki (高能所)

Track Classification: Machine Learning

Contribution ID: **5** Type: **Talk**

Quantum Tracking for Future Colliders

At the High Luminosity Large Hadron Collider (HL-LHC), we will enter the "exa-byte" era, where the annual computing cost will increase by a factor of 10-20 from the ongoing LHC program. Without various innovations, the experiments will not be able to operate. The Graphical Processing Units (GPU) and other state-of-the-art artificial intelligence technologies will be the baseline at the HL-LHC. Quantum computing may also bring another "leap". Two of the highly CPU consuming components are the track reconstruction in both data/simulation and simulation of shower development in the calorimeter. Tackling these challenges will be useful not just for the HL-LHC, but for other future colliders, such as the Circular Electron Positron Collider (CEPC). In this talk, I will present recent studies on the former topic, namely on an application of quantum machine learning for the track reconstruction.

I am

non-PhD student

Primary author: Prof. OKAWA, Hideki (高能所)

Presenter: Prof. OKAWA, Hideki (高能所)

Track Classification: Quantum Machine Learning

Contribution ID: **6** Type: **Talk**

Scattering Amplitude from Quantum Computing with Reduction Formula

Utilizing the Lehmann-Symanzik-Zimmermann (LSZ) reduction formula, we present a new general framework for computing scattering amplitudes in quantum field theory with quantum computers in a fully nonperturbative way. In this framework, one only has to construct one-particle states of zero momentum, and no wave packets of incoming particles are needed. The framework is able to incorporate scatterings of bound states, and is ideal for scatterings involving a small number of particles. We expect this framework to have particular advantages when applied to exclusive hadron scatterings. As a proof of concept, by simulations on classical hardware, we demonstrate that the 2-point function and the 4-point function in the Gross-Neveu model obtained from our proposed quantum algorithm has the desired pole structure crucial to the implementation of the LSZ reduction formula.

I am

student/postdoc

Primary authors: WANG, Enke (South China Normal University); LAI, Wai Kin (South China Normal University); XING, Hongxi (South China Normal University); LI, Tianyin (South China Normal University)

Presenter: LAI, Wai Kin (South China Normal University)

Track Classification: Quantum Simulation

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

Boost Physics Analysis at BESIII with Deep Learning

This talk will focus on the application of Deep Learning, specifically Graph Neural Networks (GNNs), in physics analysis at BESIII. It will explore their effectiveness in studying Lambda_c semileptonic decays and hadronic decays, leveraging the power of GNNs to analyze data with complex relational structures. We will also try to discuss the systematic uncertainry treatment, which is still an open question in experimental particle physics. Finally, this talk also showcases the promise of GNNs in advancing physics analysis at both BESIII and future collider experiments.

I am

student/postdoc

Primary author: LI, Yangu (Peking University)

Presenter: LI, Yangu (Peking University)

Track Classification: Machine Learning

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

PandaX-III 实验中基于机器学习的粒子径迹特征分析

对马约拉纳中微子的研究是当前粒子物理领域探索超出标准模型新物理的热点研究方向，无中微子双贝塔衰变（NLDBD）是实验上可以确认中微子马约拉纳属性的稀有核衰变。PandaX-III 合作组致力于打造具有国际竞争力的百公斤靶质量实验，采用基于气体微结构探测器技术的高压气氙时间投影室来寻找 Xe-136 的 NLDBD 过程，其最显著优势在于能够通过带电粒子径迹特征进行信号本底鉴别，进而大幅提高实验对 NLDBD 的探测灵敏度。本报告将从 PandaX-III 实验中带电粒子径迹特征分析入手，基于机器学习方法开展信号鉴别、事例顶点重建等粒子特征分析工作，推动 PandaX-III 朝着零本底实验条件发展。

I am

student/postdoc

Primary author: 李, 涛 (Sun Yat-Sen University)

Presenter: 李, 涛 (Sun Yat-Sen University)

Track Classification: Machine Learning

Contribution ID: **9** 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 1D and 2D calorimeter outputs on quantum simulators. The impact of quantum noise is also investigated.

I am

student/postdoc

Primary author: HUANG, xiaozhong (高能所)

Presenter: HUANG, xiaozhong (高能所)

Track Classification: Quantum Machine Learning

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

Jet clustering and matching with QAOA

Jet clustering and matching these jets to bosons are two important steps for realizing Color Singlet Identification. Using the benchmark of fully hadronic WW/ZZ separation, we demonstrated the performance of traditional jet clustering and matching algorithms. Next, we aim to implement jet clustering and matching using the Quantum Approximate Optimization Algorithm (QAOA). Compared to traditional methods, we have not yet observed clear advantages from the quantum computation approach. However, exploring quantum algorithms for these tasks remains a valuable endeavor.

I am

student/postdoc

Primary author: 朱, 永峰

Presenter: 朱, 永峰

Track Classification: Quantum Simulation

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

高质量发展量子计算赋能第四次工业革命

Saturday, 12 August 2023 08:40 (1 hour)

Primary author: Prof. 俞, 大鹏 (南方科技大学)

Presenter: Prof. 俞, 大鹏 (南方科技大学)

Session Classification: Plenary

Contribution ID: **12** Type: **not specified**

Quantum computing for High energy physics (online)

I am

Primary author: Prof. LAMM, Henry (Fermilab)

Presenter: Prof. LAMM, Henry (Fermilab)

Session Classification: Plenary

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

Pion/Kaon Identification at STCF DTOF Based on Classical/Quantum Convolutional Neural Network

The Super Tau Charm Facility (STCF) proposed in China is a new-generation electron–positron collider with center-of-mass energies covering 2-7 GeV. In STCF, the discrimination of high momentum hadrons is a challenging and critical task for various physics studies. In recent years, machine learning methods have gradually become one of the mainstream methods in the PID field of high energy physics experiments, with the advantage of big data processing.

In this work, targeting at the pion/kaon identification problem at STCF, we have developed a convolutional neural network (CNN) in the endcap PID system, which is a
time-of-flight detector based on detection of internally reflected Cherenkov light (DTOF). By combining the hit position and arrival time of each Cherenkov photon at multi-anode microchannel plate photomultipliers, a twodimensional pixel map is constructed as the CNN input. The preliminary results show that the CNN model has a promising performance against the pion/kaon identification problem. In addition, based on the traditional CNN, a quantum convolution neural network (QCNN) is developed as well, as a proof-of-concept work exploring possible quantum advantages provided by quantum machine learning methods.

I am

student/postdoc

Primary authors: 姚, 志鹏 (Shandong University); 李, 腾 (Shandong University); HUANG, Xingtao (Shandong University)

Presenter: 姚, 志鹏 (Shandong University)

Session Classification: Registration

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

BESIII track reconstruction algorithm based on machine learning

Track reconstruction is one of the most important and challenging tasks in the offline data processing of collider experiments. For the BESIII detector working in the tau-charm energy region, plenty of efforts were made previously to improve the tracking performance with traditional methods, such as template matching and Hough transform etc. However, for difficult tracking tasks, such as the tracking of low momentum tracks, tracks from secondary vertices and tracks with high noise level, there is still large room for improvement.
In this contribution, we demonstrate a novel tracking algorithm based on machine learning method. In this method, a hit pattern map representing the connectivity between drift cells is established using an enormous MC sample, based on which we design an optimal method of graph construction, then an edge-classifying Graph Neural Network is trained to distinguish the hit-on-track from noise hits. Finally, a clustering method based on DBSCAN is developed to cluster hits from multiple tracks. Track fitting algorithm based on GENFIT is also studied to obtain the track parameters, where deterministic annealing filter are implemented to deal with ambiguities and potential noises.
The preliminary results on BESIII MC sample presents promising performance, showing potential to apply this method to other trackers based on drift chamber as well, such as the CEPC and STCF detectors under pre-study.

I am

student/postdoc

Primary authors: 贾, 晓倩 (山东大学); QIN, Xiaoshuai (Shandong University); LI, Teng (Shandong University); HUANG, Xingtao (Shandong University); ZHANG, xueyao (Shandong University); ZHANG, Yao (Institute of high energy physics, Beijing China); YUAN, Ye (高能所)

Presenter: 贾, 晓倩 (山东大学)

Track Classification: Machine Learning

Contribution ID: **15** Type: **Talk**

百度量子计算平台量易伏 3.0 持续演进

Saturday, 12 August 2023 16:25 (25 minutes)

Primary author: Dr 刘, 树森 (百度量子计算研究所)

Presenter: Dr 刘, 树森 (百度量子计算研究所)

Session Classification: Plenary

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

百度量子硬件平台 (online)

Saturday, 12 August 2023 16:50 (25 minutes)

Primary author: Dr 王, 宇轩 (百度量子计算研究所)

Presenter: Dr 王, 宇轩 (百度量子计算研究所)

Session Classification: Plenary

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

量子云服务及进展

Saturday, 12 August 2023 14:25 (25 minutes)

Primary author: Dr 王, 正安 (北京量子信息研究院)

Presenter: Dr 王, 正安 (北京量子信息研究院)

Session Classification: Plenary

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

国内高性能量子计算机的使用及需求探索

Saturday, 12 August 2023 11:35 (25 minutes)

Primary author: 梁, 福田 (中国科学技术大学)

Presenter: 梁, 福田 (中国科学技术大学)

Session Classification: Plenary

Contribution ID: **19** Type: **Talk**

量子软件工程与量子程序测试简介

Saturday, 12 August 2023 14:00 (25 minutes)

Primary author: Dr 龙, 沛洵 (中国科学院软件所)

Presenter: Dr 龙, 沛洵 (中国科学院软件所)

Session Classification: Plenary

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

基于国产异构计算平台的 Qiskit 移植与优化

Saturday, 12 August 2023 14:50 (20 minutes)

Primary author: BI, Yujiang (IHEP)

Presenter: BI, Yujiang (IHEP)

Session Classification: Plenary

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

Quantum machine learning (online)

Saturday, 12 August 2023 15:40 (45 minutes)

I am

Primary author: Prof. SPANNOWSKY, Michael (Durham University)

Presenter: Prof. SPANNOWSKY, Michael (Durham University)

Session Classification: Plenary

Contribution ID: **22** Type: **not specified**

Quantum machine learning algorithms in HEP

Saturday, 12 August 2023 10:45 (25 minutes)

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

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

Session Classification: Plenary

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

Quantum Tracking for Future Colliders

Saturday, 12 August 2023 11:10 (25 minutes)

Primary author: OKAWA, Hideki (IHEP)

Presenter: OKAWA, Hideki (IHEP)

Session Classification: Plenary

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

高能物理人工智能平台（HepAI) 发展和大模型在高能物理中的应用 (online)

Sunday, 13 August 2023 10:45 (25 minutes)

I am

Primary author: ZHANG (张正德), Zheng-De (中科院高能物理研究所)

Presenter: ZHANG (张正德), Zheng-De (中科院高能物理研究所)

Session Classification: Plenary

Contribution ID: **25** Type: **Talk**

量子-经典混合计算概述

Sunday, 13 August 2023 09:00 (25 minutes)

Primary author: Dr 王, 升斌 (本源量子)

Presenter: Dr 王, 升斌 (本源量子)

Session Classification: Plenary

Contribution ID: **26** Type: **Talk**

非微扰物理的量子模拟

Sunday, 13 August 2023 09:25 (25 minutes)

I am

Primary author: 张, 旦波 (华南师范大学)

Presenter: 张, 旦波 (华南师范大学)

Session Classification: Plenary

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

Scattering Amplitude from Quantum Computing with Reduction Formula

Sunday, 13 August 2023 09:50 (25 minutes)

I am

Primary author: LAI, Wai Kin (South China Normal University)

Presenter: LAI, Wai Kin (South China Normal University)

Session Classification: Plenary

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

Jet clustering and matching with QAOA

Sunday, 13 August 2023 15:10 (20 minutes)

I am

Primary author: 朱, 永峰

Presenter: 朱, 永峰

Session Classification: Plenary

Contribution ID: **29** Type: **Talk**

Quantum GAN for fast shower simulation

Sunday, 13 August 2023 14:50 (20 minutes)

I am

Primary author: HUANG, xiaozhong (高能所)

Presenter: HUANG, xiaozhong (高能所)

Session Classification: Plenary

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

高能物理人工智能平台（HepAI) 发展和大模型在高能物理中的应用

Primary author: 张, 正德

Presenter: 张, 正德

Session Classification: Plenary

Contribution ID: **31** Type: **Talk**

物理模型嵌入的 AI for Physics 研究

Sunday, 13 August 2023 11:10 (25 minutes)

I am

Primary author: 赵丽娜 (高能所)

Presenter: 赵丽娜 (高能所)

Session Classification: Plenary

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

深度学习技术在分波分析中的应用

Sunday, 13 August 2023 11:35 (25 minutes)

Primary author: 蔡, 浩 (武汉大学)

Presenter: 蔡, 浩 (武汉大学)

Session Classification: Plenary

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

Boost Physics Analysis at BESIII with Deep Learning

Sunday, 13 August 2023 14:00 (25 minutes)

Primary author: LI, Yangu (Peking University)

Presenter: LI, Yangu (Peking University)

Session Classification: Plenary

Contribution ID: **34** Type: **Talk**

Implement ParticleNet on FPGA

Sunday, 13 August 2023 14:25 (25 minutes)

I am

Primary author: 张玉涛

Presenter: 张玉涛

Session Classification: Plenary

Contribution ID: **35** Type: **Talk**

PandaX-III 实验中基于机器学习的粒子径迹特征分析

Monday, 14 August 2023 09:25 (25 minutes)

I am

Primary authors: 王, 少博 (Shanghai Jiao Tong University); 李, 涛 (Sun Yat-Sen University)

Presenter: 王, 少博 (Shanghai Jiao Tong University)

Session Classification: Plenary

Contribution ID: **36** Type: **Talk**

FastCaloGAN: A fast calorimeter simulation tool exploiting Generative Adversarial Networks (online)

Sunday, 13 August 2023 16:00 (25 minutes)

I am

Primary author: 张, 瑞 (University of Wisconsion)

Presenter: 张, 瑞 (University of Wisconsion)

Session Classification: Plenary

Contribution ID: **37** Type: **Talk**

Symmetry Preserving Attention Networks for resolved top quark reconstruction at the LHC

Monday, 14 August 2023 09:00 (25 minutes)

Primary author: OKAWA, Hideki (IHEP)

Presenter: OKAWA, Hideki (IHEP)

Session Classification: Plenary

Contribution ID: **38** Type: **Talk**

Progress on the Global analysis on CEPC Higgs using ParticleTransformer

Monday, 14 August 2023 10:45 (20 minutes)

Presenter: 王, 书栋 (高能所)

Session Classification: Plenary

Contribution ID: **39** Type: **Talk**

W tagging in ATLAS

Primary author: 王, 书栋 (高能所)

Presenter: 王, 书栋 (高能所)

Session Classification: Registration

Contribution ID: **40** Type: **Talk**

非微扰物理的量子模拟

量子计算对模拟高能核物理中的非微扰物理问题，如含时演化、有限密度有限温核物质等，有着天然的优势。本报告讲介绍 QuNu 研究组在该方向上的一些工作，包括核子结构中部分子分布函数和碎裂函数的量子计算，以及夸克在高温时禁闭-解禁闭转变的变分量子模拟。这些工作发展了一系列适合高能核物理模拟的量子算法，通过数值模拟，演示了在近期量子计算机上初步模拟高能核物理重要物理问题的可行性。

I am

non-PhD student

Primary author: 张, 旦波 (华南师范大学)

Presenter: 张, 旦波 (华南师范大学)

Track Classification: Quantum Simulation

Contribution ID: **42** Type: **Talk**

Reconstruction of Atmospheric Neutrino's Directionality and Energy in JUNO

The Jiangmen Underground Neutrino Observatory (JUNO) is a next-generation neutrino experiment currently under construction in southern China. Its primary objective is to determine the neutrino mass ordering (NMO). While reactor neutrinos are the main source of sensitivity to NMO at JUNO, atmospheric neutrino oscillations can provide independent sensitivity, and enhance its overall sensitivity in the combined analysis. However, accurately reconstructing atmospheric neutrinos in such a large liquid scintillator detector presents a significant challenge with conventional methods. In this flash talk, I present a novel method of reconstructing atmospheric neutrinos in JUNO and it is applicable to other liquid scintillator detectors. This method uses machine learning techniques to reconstruct multiple quantities like atmospheric neutrinos' directionality and energy, based on features extracted from waveforms reflecting the relationship between PMT hit charge and time. Performances using this method with JUNO simulation are reported.

I am

Primary authors: 谭, 晓晗 (S); 杨, 泽坤 (S)

Presenter: 杨, 泽坤 (S)

Track Classification: Machine Learning

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

Identification of Atmospheric Neutrinos in JUNO with Machine Learning

The Jiangmen Underground Neutrino Observatory (JUNO) is designed to determine neutrino mass ordering (NMO) using a large liquid scintillator detector located in southern China. While JUNO's NMO sensitivity mostly comes from reactor neutrinos, atmospheric neutrino oscillation in JUNO can provide complimentary sensitivity via matter effects, and enhance its overall sensitivity in the combined analysis. Flavor identification is crucial to atmospheric neutrino oscillation measurements, but is traditionally a very difficult task in liquid scintillator detectors such as JUNO. In this talk, I present a novel method for the flavor identification of atmospheric neutrinos in JUNO with machine learning techniques. This method takes features from PMT waveforms as inputs, and has shown promising results with JUNO simulation. This method could also be applied to other liquid scintillator detectors, potentially benefiting future atmospheric neutrino oscillation experiments.

I am

student/postdoc

Primary author: 曾, 凡蕊 (山东大学前沿交叉科学青岛研究院)

Presenter: 曾, 凡蕊 (山东大学前沿交叉科学青岛研究院)

Track Classification: Machine Learning

Contribution ID: **44** Type: **Talk**

HEP ML Lab —An end-to-end framework for signal vs background analysis in high energy physics

We have developed an end-to-end data analysis framework, HEP ML Lab (HML), based on Python for signal-background analysis in high-energy physics research. It offers essential interfaces and shortcuts for event generation, dataset creation, and method application.

With the HML API, a large volume of collision events can be generated in sequence under different settings. The representations module enables easy conversion of event data into input formats required by various methodologies. The API also includes three categories of analysis methods: cut-based analysis, multivariate analysis, and neural networks, to cater to diverse needs. Coupled with built-in metric parameters, users can preliminarily assess the performance of different analytical methods while using them.

While the high-energy physics research community has already explored several frameworks that integrate data and analysis methods, we advocate for integrating the entire end-to-end process into a single framework. By offering a unified style of programming interface, it reduces the need for researchers to switch between different software and frameworks. This not only simplifies and clarifies the research process, but also facilitates the reproduction of previous research results, leading to more persuasive conclusions.

To demonstrate the convenience and effectiveness of HML, we provide a case study that differentiates between Z jets and QCD jets. We provide benchmark testing for the three built-in methods and ultimately export shareable datasets and model checkpoints.

I am

student/postdoc

Primary authors: LI, Jing (Dalian Unversity of Technology, Dalian, Liaoning, China); 孙, 昊 (Dalian University of Technology)

Presenter: LI, Jing (Dalian Unversity of Technology, Dalian, Liaoning, China)

Track Classification: Machine Learning

Contribution ID: **45** Type: **Talk**

Closing remark

Monday, 14 August 2023 12:25 (5 minutes)

Primary author: HUANG, Xingtao (Shandong University)

Presenter: HUANG, Xingtao (Shandong University)

Session Classification: Plenary

Contribution ID: **46** Type: **Talk**

Status of Total model for Pileup study

Primary author: 王储, UNKNOWN (IHEP)

Presenter: 王储, UNKNOWN (IHEP)

Session Classification: Registration

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

校长欢迎辞

Saturday, 12 August 2023 08:30 (10 minutes)

Primary author: Prof. 韩, 圣浩 (山东大学)

Presenter: Prof. 韩, 圣浩 (山东大学)

Session Classification: Plenary

Contribution ID: **48** Type: **Talk**

Pion/Kaon Identification Based on Classical/Quantum CNN

Sunday, 13 August 2023 16:45 (20 minutes)

Primary author: 姚, 志鹏 (Shandong University)

Presenter: 姚, 志鹏 (Shandong University)

Session Classification: Plenary

Contribution ID: **49** Type: **Talk**

Constituent-Based W-boson Tagging with the ATLAS Detector

Sunday, 13 August 2023 16:25 (20 minutes)

I am

Primary author: WANG, Shudong (高能所)

Presenter: WANG, Shudong (高能所)

Session Classification: Plenary

Contribution ID: **50** Type: **Talk**

HEP ML Lab —An end-to-end framework for signal vs background analysis in high energy physics

Monday, 14 August 2023 09:50 (25 minutes)

Primary author: LI, Jing (Dalian Unversity of Technology, Dalian, Liaoning, China)

Presenter: LI, Jing (Dalian Unversity of Technology, Dalian, Liaoning, China)

Session Classification: Plenary

Contribution ID: **51** Type: **Talk**

BESIII track reconstruction algorithm based on machine learning

Monday, 14 August 2023 11:05 (20 minutes)

Primary author: 贾, 晓倩 (山东大学)

Presenter: 贾, 晓倩 (山东大学)

Session Classification: Plenary

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

Reconstruction of Atmospheric Neutrino's Directionality and Energy in JUNO

Monday, 14 August 2023 11:25 (20 minutes)

Primary author: 杨, 泽坤 (S)

Presenter: 杨, 泽坤 (S)

Session Classification: Plenary

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

Identification of Atmospheric Neutrinos in JUNO with Machine Learning

Monday, 14 August 2023 11:45 (20 minutes)

Primary author: 曾, 凡蕊 (山东大学前沿交叉科学青岛研究院)

Presenter: 曾, 凡蕊 (山东大学前沿交叉科学青岛研究院)

Session Classification: Plenary

Contribution ID: **54** Type: **Talk**

Status of Total model for Pileup study

Sunday, 13 August 2023 17:05 (20 minutes)

I am

Primary author: 王储 (IHEP)

Presenter: 王储 (IHEP)

Session Classification: Plenary

Contribution ID: **55** Type: **Talk**

HEP in the era of AI

Saturday, 12 August 2023 09:40 (30 minutes)

Primary author: SALZBURGER, Andreas (CERN)

Presenter: SALZBURGER, Andreas (CERN)

Session Classification: Plenary

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

Discussion

Monday, 14 August 2023 12:05 (20 minutes)

Session Classification: Plenary