Artificial Intelligence for the Electron Ion Collider (AI4EIC) 2025

Report of Contributions

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

Explainable and Differential Reinforcement Learning for Multi Objective Optimization in Particle Accelerators

Monday 27 October 2025 10:00 (25 minutes)

Presenter: RAJPUT, Kishansingh (Jefferson Lab)

Session Classification: AI/ML for Accelerators

Contribution ID: **27** Type: **not specified**

Differentiable beam dynamics codes, their use in AI-ML for accelerators and potential applications to the EIC

Monday 27 October 2025 10:25 (25 minutes)

Presenter: XU, Chenran (Argonne National Laboratory)

Session Classification: AI/ML for Accelerators

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

Symplectic machine learning model for fast simulation of space-charge effects

Monday 27 October 2025 10:50 (25 minutes)

Presenter: WAN, Jinyu (Facility for Rare Isotopes, Michigan State University)

Session Classification: AI/ML for Accelerators

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

Use of AI/ML for higher brightness and higher polarization of hadron beams

Monday 27 October 2025 11:30 (25 minutes)

We report on the use of AI/ML techniques to advance the pursuit of higher brightness and polarization of hadron beams in the RHIC/EIC injector chain. Bayesian inference applied to individual magnet strengths reduced quadrupole field uncertainty by a factor of two while shifting mean values away from prior expectations, thereby improving the reliability of accelerator models. Bayesian optimization has enabled automated, high-performance tuning of injection alignment and matching, reaching results comparable to expert operators but at faster timescales. Reinforcement learning agents have achieved one-shot optimization of RF voltages for bunch merging and are now being trained for the stabilization of Booster-to-AGS beam transfer under drifting machine conditions. Collectively, these developments demonstrate the capacity of AI/ML methods to deliver adaptive and precise control strategies in support of next-generation polarized hadron beams.

Presenter: HAMWI, Eiad (Cornell University)

Session Classification: AI/ML for Accelerators

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

Framework for the Development of Virtual Accelerator Models for Machine Learning Applications

Monday 27 October 2025 11:55 (20 minutes)

Presenter: RAVICHANDRAN, Adwaith (Argonne National Laboratory)

Session Classification: AI/ML for Accelerators

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

Machine-Learning–Accelerated Bayesian Uncertainty Quantification for Digital Twin Modeling and Control of the AGS Booster

Monday 27 October 2025 12:15 (20 minutes)

Presenter: KELLY, Christopher (Brookhaven National Laboratory)

Session Classification: AI/ML for Accelerators

Contribution ID: **32** Type: **not specified**

Machine Learning Approaches to Improved Ion Profile Monitor Measurements

Monday 27 October 2025 12:35 (20 minutes)

Presenter: HALL, Christopher (RadiaSoft LLC)

Session Classification: AI/ML for Accelerators

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

Use of Generative AI and LLMs for Accelerator Design

Monday 27 October 2025 12:55 (20 minutes)

Presenter: GILANLIOGULLARI, Onur (member@anl.gov)

Session Classification: AI/ML for Accelerators

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

ePIC AI/ML Overview

Tuesday 28 October 2025 10:00 (20 minutes)

Presenter: KALINKIN, Dmitrii (Brookhaven National Laboratory)

Session Classification: AI/ML for ePIC and Beyond

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

Accessing x-dependent generalized parton distribution from generative AI

Presenter: YU, Zhite (Jefferson Lab)

Session Classification: AI/ML for ePIC and Beyond

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

Toward Unified Deep Learning Models for Simulation and PID with Cherenkov Detectors: the hpDIRC case

Tuesday 28 October 2025 10:20 (15 minutes)

Presenter: FANELLI, Cristiano (W&M)

Session Classification: AI/ML for ePIC and Beyond

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

Tools for Unbinned Unfolding

Tuesday 28 October 2025 10:35 (15 minutes)

Presenter: MILTON, Ryan (UCR)

Session Classification: AI/ML for ePIC and Beyond

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

Quantum Tomography for Collider Physics: From Data-Driven Foundations to AI-Enhanced Methods

Presenter: TAPIA TAKAKI, Daniel (University of Kansas)

Session Classification: AI/ML for ePIC and Beyond

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

Multi-FPGA distributed MLP NN model for data reduction in ePIC dRICH readout system

Tuesday 28 October 2025 10:50 (15 minutes)

Presenter: ROSSI, Cristian (INFN Sezione di Roma)

Session Classification: AI/ML for ePIC and Beyond

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

Scalable AI-assisted Workflow Management for EIC Detector Design Across Distributed Heterogeneous Resources with PanDA-iDDS

Tuesday 28 October 2025 11:20 (15 minutes)

Presenter: GUAN, Wen (BNL)

Session Classification: AI/ML for ePIC and Beyond

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

Machine Learning for the pfRICH Particle Identification subsystem

Tuesday 28 October 2025 11:35 (15 minutes)

We present an overview of the proximity-focusing Ring Imaging Cherenkov (pfRICH) detector developed for the ePIC experiment at the Electron-Ion Collider (EIC). Designed for the backward pseudorapidity region (−3.5 ⊠ η ⊠ −1.5), the pfRICH enables at least 3σ separation of pions, kaons, and protons up to 7 GeV/c, which is crucial for Semi-Inclusive Deep Inelastic Scattering (SIDIS) studies. In this talk, we explore the use of AI/ML techniques for pattern recognition of Cherenkov photon rings on photosensors in order to improve the PID capabilities of the pfRICH as a function of particle momentum. We use data from simulations of optical photon transport in Geant4, accelerated with NVIDIA OptiX and GDML-based detector geometries.

Co-authors: DONGWI, Bishoy; NAÏM, Charles-Joseph (Stonybrook)

Presenters: DONGWI, Bishoy; NAÏM, Charles-Joseph (Stonybrook)

Session Classification: AI/ML for ePIC and Beyond

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

RAG-inspired Open-source based Q&A system for scholarly articles in EIC

Tuesday 28 October 2025 11:50 (15 minutes)

Presenter: GHOSH, Tapasi (Ramaiah University of Applied Sciences)

Session Classification: AI/ML for ePIC and Beyond

Contribution ID: **43** Type: **not specified**

ESI-Fastlight: a Conditional Normalizing Flow for Fast pfRICH Hitmap Generation

Tuesday 28 October 2025 12:05 (15 minutes)

Presenter: GALGOCZI, Gabor (BNL)

Session Classification: AI/ML for ePIC and Beyond

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

ML for the hKLM at the 2nd Detector

Tuesday 28 October 2025 12:20 (10 minutes)

Presenter: KELLEHER, Rowan (student@umich.edu;member@umich.edu;employee@umich.edu;student@annarbor.umich

Session Classification: AI/ML for ePIC and Beyond

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

SRO AI/ML Models for Meson Structure Function Extraction

Tuesday 28 October 2025 12:30 (10 minutes)

Presenter: SHIRASKAR, Sandeep (Catholic University of America)

Session Classification: AI/ML for ePIC and Beyond

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

Discussion

Tuesday 28 October 2025 12:40 (35 minutes)

Session Classification: AI/ML for ePIC and Beyond

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

A Unified Vision of AI/ML at the Electron-Ion Collider: Infrastructure and Capabilities

Wednesday 29 October 2025 14:45 (25 minutes)

Presenter: NGUYEN, Linh (Brookhaven National Laboratory)

Session Classification: AI/ML in Production and Distributed ML

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

Developing Fast ML on FPGA for Particle Identification and Tracking

Wednesday 29 October 2025 15:35 (25 minutes)

Presenter: FURLETOV, Denis (Brandeis University)

Session Classification: AI/ML in Production and Distributed ML

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

ML in Production at SNS Accelerator

Wednesday 29 October 2025 15:10 (25 minutes)

Presenter: RAJ, Anant (ORNL)

Session Classification: AI/ML in Production and Distributed ML

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

Title to Come

Presenter: FURLETOV, Sergey (Jefferson Lab)

Session Classification: AI/ML in Production and Distributed ML

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

ML methods for statistical data analysis

Presenter: COELHO LOPES DE SA, Rafael (University of Massachusetts)

Session Classification: AI/ML in Production and Distributed ML

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

MCP Agents in PanDA

Wednesday 29 October 2025 16:15 (25 minutes)

Presenter: NILSSON, Paul (BNL)

Session Classification: AI/ML in Production and Distributed ML

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

FastML on FPGA

Wednesday 29 October 2025 16:40 (25 minutes)

Presenter: Dr LIU, Ming (Los Alamos)

Session Classification: AI/ML in Production and Distributed ML

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

Discussion

Wednesday 29 October 2025 17:05 (25 minutes)

Session Classification: AI/ML in Production and Distributed ML

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

Relativity Wasn’t in the Training Set

Tuesday 28 October 2025 14:30 (20 minutes)

Presenter: CRANMER, Miles (University of Cambridge)

Session Classification: AI/ML for Data Analysis and Theory

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

Symbolic Regression

Tuesday 28 October 2025 14:50 (20 minutes)

Presenter: ADAMS, Douglas (University of Virginia)

Session Classification: AI/ML for Data Analysis and Theory

Contribution ID: **57** Type: **not specified**

Neural Net ensembles for Bayesian inference of PDFs

Tuesday 28 October 2025 15:10 (20 minutes)

Presenter: UBIALI, Maria (University of Cambridge)

Session Classification: AI/ML for Data Analysis and Theory

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

Artificial Intelligence in the EIC era at the BSM-PDF frontier

Tuesday 28 October 2025 15:45 (20 minutes)

Presenter: HOBBS, Tim (Argonne National Laboratory)

Session Classification: AI/ML for Data Analysis and Theory

Contribution ID: **59** Type: **not specified**

ML-accelerated sampling for theory

Tuesday 28 October 2025 16:05 (20 minutes)

Presenter: SHANAHAN, Phiala (MIT)

Session Classification: AI/ML for Data Analysis and Theory

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

Generative AI for data analysis and preservation

Tuesday 28 October 2025 16:25 (20 minutes)

Presenter: BATTAGLIERI, Marco (Jefferson Lab)

Session Classification: AI/ML for Data Analysis and Theory

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

DeepSub: Deep Image Reconstruction for Background Subtraction in Heavy-Ion Collisions

Tuesday 28 October 2025 17:20 (10 minutes)

Author: SOHAIL QURESHI, Umar (Stanford University)

Presenter: SOHAIL QURESHI, Umar (Stanford University)

Session Classification: AI/ML for Data Analysis and Theory

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

What we talk about when we talk about gluon saturation

Tuesday 28 October 2025 16:45 (20 minutes)

Presenter: JACOBS, Peter (Lawrence Berkeley National Laboratory)

Session Classification: AI/ML for Data Analysis and Theory

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

Quantum Tomography for Collider Physics: From Data-Driven Foundations to AI-Enhanced Methods

Presenter: TAKAKI, Daniel (Kansas University)

Session Classification: AI/ML for Data Analysis and Theory

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

Deep Neural Networks for Extracting the 3D Structure of Nucleon at the EIC

Tuesday 28 October 2025 17:30 (10 minutes)

Presenter: Dr FERNANDO, Ishara (University of Virginia)

Session Classification: AI/ML for Data Analysis and Theory

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

Extraction of Chiral Odd Compton form factors using Maximum Likelihood Method from Exclusive 0 production experiment.

Tuesday 28 October 2025 17:40 (10 minutes)

Presenter: Dr PANDEY, Saraswati (member@virginia.edu;staff@virginia.edu;employee@virginia.edu)

Session Classification: AI/ML for Data Analysis and Theory

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

SAGIPS: A scalable Framework for SciDAC QuantOM

Presenter: LERSCH, Daniel (Jefferson Lab)

Session Classification: AI/ML for Data Analysis and Theory

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

Neural Network Generalized Parton Distributions

Tuesday 28 October 2025 17:50 (10 minutes)

Presenter: PANJSHEERI, Zaki (member@virginia.edu;student@virginia.edu;alum@virginia.edu;employee@virginia.edu;s

Session Classification: AI/ML for Data Analysis and Theory

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

A Generative AI Approach to Unbiased TMD Extraction

Presenter: ZACCHEDDU, Marco (Università degli studi di Cagliari & INFN)

Session Classification: AI/ML for Data Analysis and Theory

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

Tree-distilled autoencoders on FPGA for anomaly detection and data compression

Monday 27 October 2025 14:30 (25 minutes)

Presenters: HONG, Tae Min (University of Pittsburgh (US)); HONG, Tae Min (University of Pittsburgh)

Session Classification: AI/ML for Calibration, Monitoring, and Experimental Control with Data Streams

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

Compression by Importance and More

Monday 27 October 2025 14:55 (25 minutes)

In this talk, we present our work on compressing Time Projection Chamber data by signal importance. We also discuss the challenge of achieving more flexible compression after the neural network is trained.

Presenter: HUANG, Yi (Brookhaven national lab)

Session Classification: AI/ML for Calibration, Monitoring, and Experimental Control with Data Streams

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

AI-Enabled Data Quality Monitoring with Hydra

Monday 27 October 2025 15:20 (25 minutes)

Presenter: BRITTON, Thomas (JLAB)

Session Classification: AI/ML for Calibration, Monitoring, and Experimental Control with Data Streams

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

SMOCS –JLab's Streaming Monitoring Optimization Control System

Monday 27 October 2025 16:00 (25 minutes)

Presenter: KASPARIAN, Armen (Jefferson Lab)

Session Classification: AI/ML for Calibration, Monitoring, and Experimental Control with Data Streams

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

Real-time AI-based dead hot map in the ePIC detector: a self-adaptive alternative to traditional big data calibration pipelines

Monday 27 October 2025 16:25 (25 minutes)

Presenter: UJVARI, Balazs (University of Debrecen)

Session Classification: AI/ML for Calibration, Monitoring, and Experimental Control with Data Streams

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

Optimal Control of Polarized Sources and Targets

Monday 27 October 2025 16:50 (25 minutes)

Presenter: MORAN, Patrick (W&M)

Session Classification: AI/ML for Calibration, Monitoring, and Experimental Control with Data Streams

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

Welcome and Introduction

Monday 27 October 2025 09:30 (30 minutes)

Presenters: FANELLI, Cristiano (William & Mary); LAFLEUR, Marisa (MIT)

Session Classification: Introduction

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

AuroraGPT: A Foundation Model for Science

Wednesday 29 October 2025 10:00 (20 minutes)

Presenter: THAKUR, Rajeev (Argonne National Laboratory)

Session Classification: Trends in Data Science

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

Smart Pixel Project : AI for pixel readout

Wednesday 29 October 2025 10:20 (20 minutes)

Presenter: GRAY, Lindsey (Fermilab)

Session Classification: Trends in Data Science

Contribution ID: **78** Type: **not specified**

Fast ML for Science

Wednesday 29 October 2025 10:40 (20 minutes)

Presenter: TRAN, Nhan (Fermilab)

Session Classification: Trends in Data Science

Contribution ID: **79** Type: **not specified**

Geometric GNNs for Charged Particle Tracking

Wednesday 29 October 2025 11:00 (10 minutes)

Presenter: MOHAMMED, Ahmed (member@jlab.org;employee@jlab.org)

Session Classification: Trends in Data Science

Contribution ID: **80** Type: **not specified**

Electron-Proton Scattering Event Generation using Structured Tokenization

Wednesday 29 October 2025 11:10 (10 minutes)

Presenter: GOLDENBERG, Steven (Jefferson Lab)

Session Classification: Trends in Data Science

Contribution ID: **81** Type: **not specified**

FM4NPP: A Scaling Foundation Model for Nuclear and Particle Physics

Wednesday 29 October 2025 11:20 (10 minutes)

Presenter: LI, Shuhang (Columbia University)

Session Classification: Trends in Data Science

Contribution ID: **82** Type: **not specified**

Examples of AI for Particle Physics

Wednesday 29 October 2025 11:45 (20 minutes)

We give two examples of using the diffusion model for Physics. The first is in the LHC CaloChallenge. The second study is unfolding and surrogates for Jefferson Laboratory physics.

Presenter: FOX, Geoffrey (University of Virginia)

Session Classification: Trends in Data Science

Contribution ID: **83** Type: **not specified**

SAGIPS: A scalable Framework for SciDAC QuantOm

Wednesday 29 October 2025 12:05 (20 minutes)

Presenter: LERSCH, Daniel (Jefferson Lab)

Session Classification: Trends in Data Science

Contribution ID: **84** Type: **not specified**

LLMs for particle physics analysis: results from studies on a toy model

Wednesday 29 October 2025 12:25 (20 minutes)

Presenter: SAMUEL, Deepak (Central University of Karnataka)

Session Classification: Trends in Data Science

Contribution ID: **85** Type: **not specified**

AI Reasoning for Theoretical Physics

Wednesday 29 October 2025 12:45 (20 minutes)

Presenter: KVASIUK, Yurii (University of Wisconsin)

Session Classification: Trends in Data Science

Contribution ID: **86** Type: **not specified**

Discussion

Wednesday 29 October 2025 13:05 (10 minutes)

Session Classification: Trends in Data Science

Contribution ID: **87** Type: **not specified**

RAG4EIC Tutorial

Tuesday 28 October 2025 09:00 (1 hour)

Presenter: SURESH, Karthik (member@wm.edu;employee@wm.edu;faculty@wm.edu;staff@wm.edu)

Session Classification: Tutorial