



<https://eic.ai/>

C. Fanelli, T. Horn

3rd AI4EIC Workshop

3rd AI4EIC Workshop, November 28 - December 1, 2023, Catholic University of America



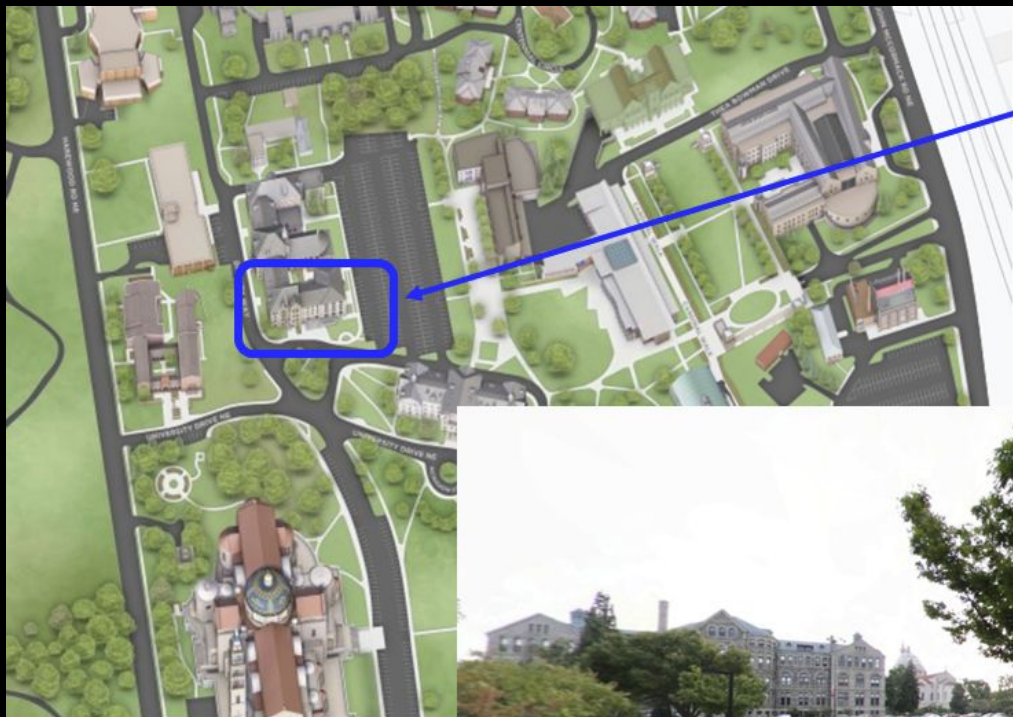
Physics Department, Hannan Hall



<https://eic.ai>

CUA Guest (no password required)

Meeting Location

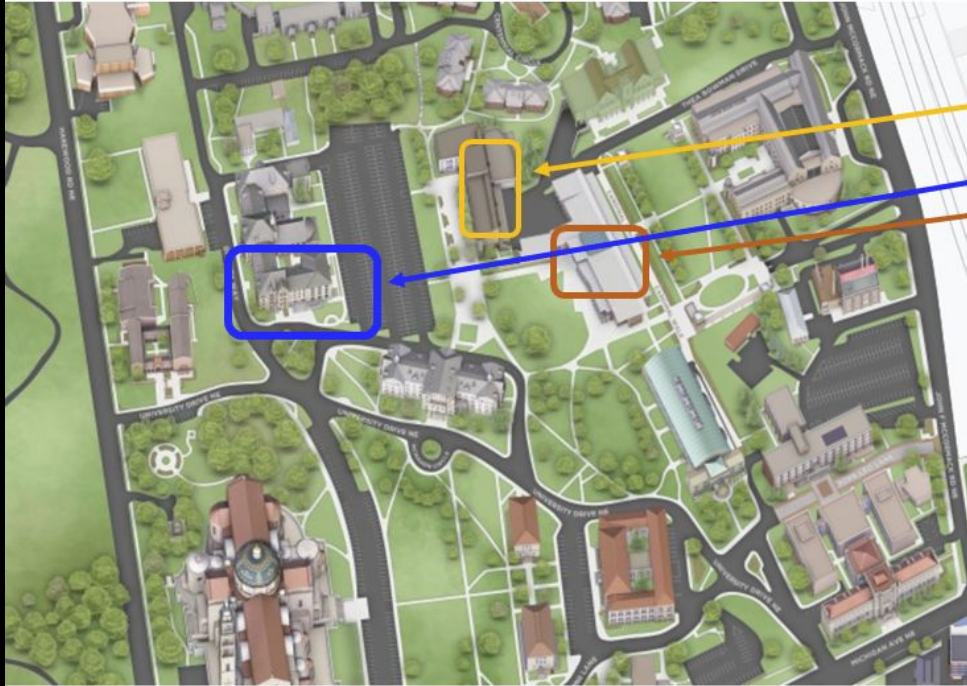


All sessions Tuesday to Thursday and Friday morning tutorial take place in the Caldwell auditorium. If you enter at the side of the building facing towards us here the auditorium is the first room on the right



Caldwell auditorium.
Enter from the left side
of the building

Rooms for the Hackathon



For the hackathon on Friday, the following rooms are available:

- Hannan Hall (Physics building) Rooms 203 and 231
- Caldwell auditorium
- Pryzbyla Room 321



Caldwell Hall



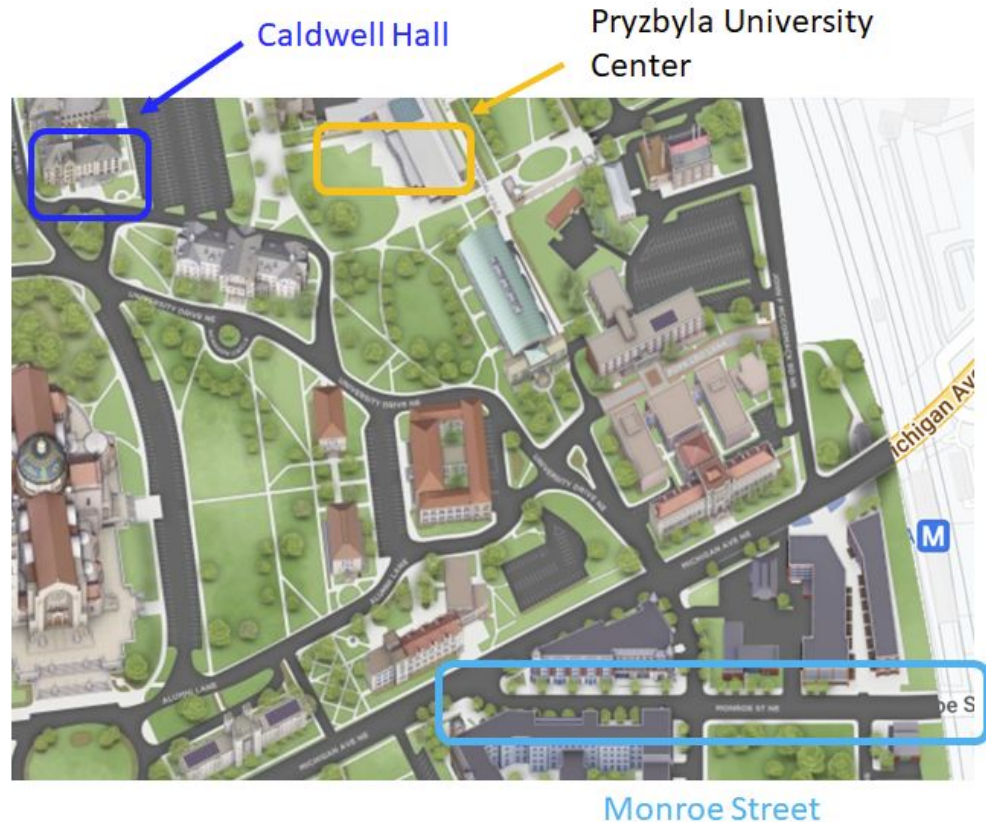
Pryzbyla University Center



Hannan Hall

Meals

- There will be coffee/tea available in the room every day. However, there is also a Starbucks available in the Pryzbyla Center across the parking lot
- Lunch: on your own
 - Pryzbyla Food Court
 - Murphy's Grill (also in the Pryzbyla University Center)
 - Restaurants on Monroe St NE (, e.g., Busboys and Poets, & pizza Brookland, Chipotle, etc.)
- Dinner: on your own



Nov 28 to Nov 30 - two sessions per day

AI/ML for ePIC and Beyond (Nov 28, morning)

- Derek Anderson (Iowa State University), Anselm Vossen (Duke University)

Calibration, Monitoring, and Experimental Control in Streaming Environments (Nov 28, afternoon)

- Yeonju Go (Brookhaven National Lab), Torri Jeske (Jefferson Lab)

AI/ML for Accelerators (Nov 29, morning)

- Kevin Brown (Brookhaven National Lab), Elena For (CERN)

AI/ML for Data Analysis and Theory (Nov 29, afternoon)

- Brandon Kriesten (Argonne National Laboratory), Vinicius Mikuni (National Energy Research Scientific Computing Center)

Foundation Models and Trends in Data Science (Nov 30, morning)

- Yaohang Li (Old Dominion University), Daniel Murnane (Lawrence Berkeley National Laboratory)

AI/ML in Production, Distributed ML (Nov 30, afternoon)

- David Lawrence (Jefferson Lab), Rui Zhang (UW Madison)

Nov 28

Morning

	Welcome and Introduction		09:30 - 10:00
10:00	Introduction: ePIC Overview	<i>John Lajoie</i>	10:00 - 10:15
	Performance optimization for a scintillating glass electromagnetic calorimeter at EIC	<i>Dmitrii Kalinkin</i>	10:15 - 10:40
	Object Condensation for Track Building in a Backward Electron Tagger at the EIC	<i>Dr Simon Gardner</i>	10:40 - 11:05
11:00	Coffee break		11:05 - 11:20
	The Optimal use of Segmentation for Sampling Calorimeters	<i>Fernando Torales Acosta</i>	11:20 - 11:45
	AID(2)E: AI-Assisted Detector Design at EIC	<i>Cristiano Fanelli</i>	11:45 - 12:10
12:00	Flash Talks		12:10 - 12:52
	Discussion		12:52 - 13:00
13:00	Lunch		13:00 - 14:00
	(on your own)		

Afternoon

14:00	LHCb Calibration/Alignment	<i>Biljana Mitreska</i>	14:00 - 14:23
	ML-based Calibration and Control of the GlueX Central Drift Chamber	<i>David Lawrence</i>	14:23 - 14:46
	Towards Fast Calibration with the ePIC Barrel Hadronic Calorimeter	<i>Derek Anderson</i>	14:46 - 15:09
15:00	Coffee break		15:09 - 15:29
	Hydra: Computer Vision for Data Quality Monitoring	<i>Thomas Britton</i>	15:29 - 15:52
16:00	Fast 2D Bicephalous Convolutional Autoencoder for Compressing 3D Time Projection Chamber Data	<i>Yi Huang</i>	15:52 - 16:15
	Autonomous selection of physics events: A RHIC demonstrator for EIC physics	<i>Cameron Dean</i>	16:15 - 16:38
	Discussion		16:38 - 17:00
17:00			

<https://indico.bnl.gov/event/19560/timetable/#all.detailed>

Nov 29

Morning

09:00	Tutorial: Continual Learning 1st Tutorial	<i>Andrea Cossu</i>
		09:00 - 10:00
10:00	Bayesian Optimization Techniques for Accelerator Control and Characterization	<i>Ryan Roussel</i>
		10:00 - 10:20
	Machine learning for digital twin development and polarization optimization at BNL hadron injectors	<i>Lucy Lin</i>
		10:20 - 10:40
	Beam Condition Forecasting with non-destructive measurements at FACET-II	<i>Matt Kilpatrick</i>
		10:40 - 11:00
11:00	Machine Learning applications for collider luminosity maximization	<i>Ji Qiang et al.</i>
		11:00 - 11:20
	Coffee Break	
		11:20 - 11:35
	Anomaly detection at an X-ray FEL	<i>Daniel Ratner</i>
		11:35 - 11:55
12:00	Uncertainty estimation and RL applications at JLab	<i>Malachi Schram</i>
		11:55 - 12:15
	Using Machine Learning to Improve Dynamic Aperture Estimates	<i>Frederik Van der Veken</i>
		12:15 - 12:35
	Discussion	
		12:35 - 13:00
13:00	Lunch	
	(on your own)	
		13:00 - 14:00

Afternoon

14:00	The EXCLAIM collaboration approach to deeply virtual exclusive processes	<i>simonetta liuti</i>
		14:00 - 14:25
	Decoding inverse problems in QCD with ML-based algorithms	<i>Yaohang Li</i>
		14:25 - 14:50
	What can AI do for lattice-QCD parton distribution calculations?	<i>Huey Wen</i>
15:00		14:50 - 15:15
	Coffee Break	
		15:15 - 15:30
	Interpretable Machine Learning applications to Jet Background Subtraction	<i>Charles Hughes</i>
		15:30 - 15:55
16:00	Hadronization Models Using Machine Learning	<i>Manuel Szwec</i>
		15:55 - 16:20
	High Dimensional Unfolding using Machine Learning	<i>Benjamin Nachman</i>
		16:20 - 16:45
	Discussion	
		16:45 - 17:00
17:00		

<https://indico.bnl.gov/event/19560/timetable/#all.detailed>

Nov 30

Morning

09:00	Tutorial: Reinforcement Learning 2nd tutorial	09:00 - 10:00
10:00	Introduction and Overview of Foundation Models <i>Kazuhiro Terao</i>	10:00 - 10:30
	The Trillion Parameter Consortium <i>Rick Stevens</i>	10:30 - 10:50
	A Large Language Model-based Assistant for the Electron Ion Collider <i>Dr Karthik Suresh</i>	10:50 - 11:10
11:00	Chatlas - the ATLAS AI Assistant <i>Daniel Murnane</i>	11:10 - 11:30
	Coffee break	11:30 - 11:45
	TrackBERT - Generalist Learning of Trackers for Downstream Tasks <i>Xiangyang Ju</i>	11:45 - 12:05
12:00	Adversarial Methods for Generative Data Understanding <i>Eric Yeats</i>	12:05 - 12:25
	ATLAS generative sim group: Diffusion Generation of Calorimetry Data	12:25 - 12:45
	Discussion	12:45 - 13:00
13:00	Lunch (on your own)	13:00 - 14:00

Afternoon

14:00	Machine learning as a service for HEP using cloud <i>Luca Giommi</i>	14:00 - 14:20
	Particle identification with machine learning from incomplete data in the ALICE experiment <i>Maja Karwowska</i>	14:20 - 14:40
	Scalable AI/ML Workflow Management Across Distributed Heterogeneous Resources With PanDA <i>Wen Guan</i>	14:40 - 15:05
15:00	The Exa.TrkX Project <i>Xiangyang Ju</i>	15:05 - 15:30
	Coffee break	15:30 - 15:45
	ATLAS data analysis using a parallelized workflow on distributed cloud-based services with GPUs <i>Jay Sandersara</i>	
16:00	Online Track Reconstruction and Physics Analysis in CLAS12 <i>Gagik Gavalian</i>	16:10 - 16:30
	MLaaS4HEP, Machine Learning for Columnar High Energy Physics Analysis <i>Elliott Kaufman</i>	16:30 - 16:50
	Discussion	16:50 - 17:00
17:00	Closing: Closing <i>Caldwell auditorium, Catholic University of America, Washington D.C.</i>	17:00 - 17:30

Dec 1 - Hackathon

Home

Submit

Login

All Teams

2022



AI4EIC Hackathon

Congrats Team JINR!!!!!! (submission on 10-14-2022)

Hackathon Leaderboard

RANK	TEAM	SCORE	QUESTIONS ATTEMPTED
1	JINR	293.896	Q1, Q2, Q3
2	Jets	293.535	Q1, Q2, Q3
3	PLYD	248.504	Q1, Q2, Q3
4	JB and EC	233.473	Q1, Q2, Q3
5	In Principle	229.323	Q1, Q2, Q3
6	Team Manitoba	177.200	Q1, Q2, Q3
7	Team WM and DK	62.075	Q1



09:00 Tutorial: Hackathon

Caldwell auditorium, Catholic University of America, Washington D.C. 09:00 - 10:00

10:00 Hackathon

11:00

12:00

13:00


14:00

15:00

16:00

17:00

Caldwell auditorium, Catholic University of America, Washington D.C. 10:00 - 17:00



2023 AI4EIC Hackathon

AI4EIC Proceedings (from 1st workshop, 2021)

Papers

Using machine learning for particle identification in ALICE

Łukasz Kamil Graczykowski *et al* 2022 *JINST* 17 C07016

[+ Open abstract](#) [View article](#) [PDF](#)

Artificial Intelligence for imaging Cherenkov detectors at the EIC

C. Fanelli and A. Mahmood 2022 *JINST* 17 C07011

[+ Open abstract](#) [View article](#) [PDF](#)

High performance FPGA embedded system for machine learning based tracking and trigger in sPhenix and EIC

T. Xuan *et al* 2022 *JINST* 17 C07003

[+ Open abstract](#) [View article](#) [PDF](#)

Machine learning on FPGA for event selection

S. Furlotov *et al* 2022 *JINST* 17 C06009

[+ Open abstract](#) [View article](#) [PDF](#)

Design of detectors at the electron ion collider with artificial intelligence

C. Fanelli 2022 *JINST* 17 C04038

[+ Open abstract](#) [View article](#) [PDF](#)

AI for Experimental Controls at Jefferson Lab

T. Jeske *et al* 2022 *JINST* 17 C03043

[+ Open abstract](#) [View article](#) [PDF](#)

Frontiers in computing for artificial intelligence

T.S. Humble *et al* 2022 *JINST* 17 C03037

[+ Open abstract](#) [View article](#) [PDF](#)

Machine learning for track reconstruction at the LHC

L.-G. Gagnon 2022 *JINST* 17 C02026

[+ Open abstract](#) [View article](#) [PDF](#)

Accelerator and detector control for the EIC with machine learning

T. Britton and B. Nachman 2022 *JINST* 17 C02022

[+ Open abstract](#) [View article](#) [PDF](#)

EIC detector overview

D.W. Higinbotham 2022 *JINST* 17 C02018

[+ Open abstract](#) [View article](#) [PDF](#)

AI4EIC Paper

[Submitted on 17 Jul 2023]

Artificial Intelligence for the Electron Ion Collider (AI4EIC)

C. Allaire, R. Ammendola, E.-C. Aschenauer, M. Balandat, M. Battaglieri, J. Bernauer, M. Bondi, N. Branson, T. Britton, A. Butter, I. Chahrouh, P. Chatagnon, E. Cisbani, E. W. Cline, S. Dash, C. Dean, W. Deconinck, A. Deshpande, M. Diefenthaler, R. Ent, C. Fanelli, M. Finger, M. Finger Jr., E. Fol, S. Furlotov, Y. Gao, J. Giroux, N. C. Gunawardhana Waduge, R. Harish, O. Hassan, P. L. Hegde, R. J. Hernández-Pinto, A. Hiller Blin, T. Horn, J. Huang, D. Jayakodige, B. Joo, M. Junaid, P. Karande, B. Kriesten, R. Kunnawalkam Elayavalli, M. Lin, F. Liu, S. Liuti, G. Matousek, M. McEaney, D. McSpadden, T. Menzo, T. Miceli, V. Mikuni, R. Montgomery, B. Nachman, R. R. Nair, J. Niestroy, S. A. Ochoa Oregon, J. Oleniacz, J. D. Osborn, C. Paudel, C. Pecar, C. Peng, G. N. Perdue, W. Phelps, M. L. Purschke, K. Rajput, Y. Ren, D. F. Renteria-Estrada, D. Richford, B. J. Roy, D. Roy, N. Sato, T. Satogata, G. Sborlini, M. Schram, D. Shih, J. Singh, R. Singh, A. Siodmok, P. Stone, J. Stevens, L. Suarez, K. Suresh, A.-N. Tawfik, F. Torales Acosta, N. Tran, R. Trotta, F. J. Twagirayezu, R. Tyson, S. Volkova, A. Vossen, E. Walter, D. Whiteson, M. Williams, S. Wu, N. Zachariou, P. Zurita

The Electron-Ion Collider (EIC), a state-of-the-art facility for studying the strong force, is expected to begin commissioning its first experiments in 2028. This is an opportune time for artificial intelligence (AI) to be included from the start at this facility and in all phases that lead up to the experiments. The second annual workshop organized by the AI4EIC working group, which recently took place, centered on exploring all current and prospective application areas of AI for the EIC. This workshop is not only beneficial for the EIC, but also provides valuable insights for the newly established ePIC collaboration at EIC. This paper summarizes the different activities and R&D projects covered across the sessions of the workshop and provides an overview of the goals, approaches and strategies regarding AI/ML in the EIC community, as well as cutting-edge techniques currently studied in other experiments.

Artificial Intelligence for the Electron Ion Collider (AI4EIC)

Abstract

The Electron-Ion Collider (EIC), a state-of-the-art facility for studying the strong force, is expected to begin commissioning its first experiments in 2028. This is an opportune time for artificial intelligence (AI) to be included from the start at this facility and in all phases that lead up to the experiments. The second annual workshop organized by the AI4EIC working group, which recently took place, centered on exploring all current and prospective application areas of AI for the EIC. This workshop is not only beneficial for the EIC, but also provides valuable insights for the newly established ePIC collaboration at EIC. This paper summarizes the different activities and R&D projects covered across the sessions of the workshop and provides an overview of the goals, approaches and strategies regarding AI/ML in the EIC community, as well as cutting-edge techniques currently studied in other experiments.

Keywords: Artificial Intelligence, Deep Learning, EIC, ePIC, Machine Learning, QCD, Physics

1 Introduction

In October 2022, the second workshop on Artificial Intelligence for the Electron-Ion-Collider (AI4EIC) has been held at William & Mary. The workshop delved into a range of active and potential application areas of AI/ML¹ for the EIC, and it was also an opportunity to showcase some of the ongoing research activities in these areas for the recently formed ePIC Collaboration.

The event also had a strong outreach and educational component with different tutorials given by experts in AI and ML from national labs, universities, and industry as well as a hackathon satellite event during the last day of the workshop.

In Table 1 at the end of this document, we list many of the methods encountered in this work, with their respective acronyms.

As discussed in the EIC Yellow Report [1] and as further deepened during the AI4EIC workshops, AI/ML will permeate all phases of the EIC schedule (shown in Fig. 2), and will involve accelerator and detector activities.

The second AI4EIC workshop broadened the scope of its predecessor. While the initial workshop was centered on experimental applications for accelerators and detectors, the subsequent meeting pivoted towards the EIC detectors program, emphasizing applications and fostering linkages between theoretical and experimental aspects.

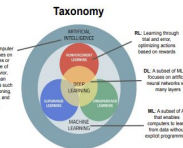


Fig. 1 Taxonomy: A diagrammatic representation of artificial intelligence, machine learning, and deep learning is provided to familiarize readers with the corresponding acronyms utilized in the text.

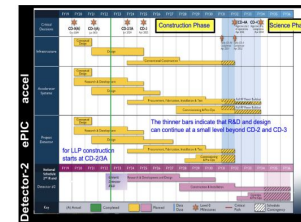


Fig. 2 EIC schedule: the Gantt chart represents different phases (design, construction, science) for accelerator, the ePIC experiment, and a potential detector-2 at EIC. Image taken from [2] and presented in October 2022.

- Design
- Intersection theory/experiment
- Reconstruction and PID
- Infrastructure and Frontiers
- Streaming
- Community efforts:
 - Tutorials
 - Hackathon

<https://arxiv.org/abs/2307.08593>

(Under review - Computing and Software for Big Science)

This Workshop

All contributions can result in a proceeding on JINST.

Note that the number of pages should not exceed 8 pages (excluding abstract page and references) for contributed talks and 4 pages (excluding abstract page and references) for flash talks.

<https://iopscience.iop.org/collections/jinst-230713-01>

The screenshot shows the IOPscience website for the JINST Proceedings 2023/2024. The page title is "Journal of Instrumentation" and "JINST Proceedings 2023/2024". The main heading is "Artificial Intelligence for the Electron-Ion Collider". The dates are "November 28 - December 1, 2023" and the location is "Washington D.C., USA". The text describes the 2023 annual workshop, which will be hosted by Catholic University of America in Washington, D.C., and will take place from November 28 to December 1, 2023. It also mentions that this year's workshop will be a hybrid event with both in-person and virtual participation options. The page includes a "Participating Journals" table and a "JOURNAL LINKS" sidebar.

Journal	Impact Factor	Citescore	Submit
Journal of Instrumentation	1.3	2.2	Submit now

JOURNAL LINKS

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<https://indico.bnl.gov/event/AI4EIC2023>

<https://indico.bnl.gov/event/19560/page/579-jinst-proceedings-ai4eic2023>

2023 Live Notes

- Link to Live Notes is [here](#)
 - **Everyone** can edit
 - Conveners can use it to make notes
 - Live Notes are useful for attendees to write down their questions;
 - Speakers can reply to any pending questions after their talks

The screenshot shows the website for the Artificial Intelligence for the Electron Ion Collider (AI4EIC) workshop. The header features the event title and dates: "28 November 2023 to 1 December 2023" at the "Catholic University of America, Washington D.C.". A search bar is present on the right. The main content area is titled "Artificial Intelligence for the Electron Ion Collider" and includes a sidebar with navigation links: Overview, Call for Abstracts, Timetable, Contribution List, My Conference, My Contributions, Registration, Participant List, Scientific Organizing Committee, Transportation, Lodging, Code of Conduct, Conveners, Agenda Overview, JINST Proceedings AI4EIC2023, Zoom Coordinates, and Live notes. The "Live notes" link is circled in red. The main text describes the workshop as a hybrid event with a registration fee of \$25 for in-person participants. A link to the Live Notes is also circled in red.

[Live notes](#)

Please find the Live Notes [here](#).

<https://eic.ai>