

AI WG kickoff meeting

EICUG



- Welcome to the kickoff meeting of the AI WG of the EICUG! We will take notes in the [Live Document](#).
- The AI WG is a sector of the EICUG SWG dedicated to AI/ML for the EIC community. It is anticipated that AI will be an essential part of the future EIC.

Working Groups

❖ The Software Working Group maintains a web site [eic.github.io](#) and a [GitHub Organization](#). It also coordinates the AI activity for the EIC community. Please contact the conveners to get involved in the working group. Conveners:

- ❖ Andrea Bressan - INFN - andrea.bressan@ts.infn.it
- ❖ Markus Diefenthaler - JLab - mdiefent@jlab.org
- ❖ Torre Wenaus - BNL - wenaus@gmail.com
- ❖ Cristiano Fanelli - AI sector - MIT - cfanelli@mit.edu
- ❖ Tanja Horn - AI sector - CUA - hornt@cua.edu

❖ Computing Coordination Group - contacts:

- ❖ Jerome Lauret - BNL - jerome.l@bnl.gov
- ❖ Graham Heyes - JLab - heyeg@jlab.org

❖ Working Group on Polarimetry - conveners:

- ❖ Elke Aschenauer - BNL - elke@bnl.gov
- ❖ Dave Gaskell - JLab - gaskell@jlab.org

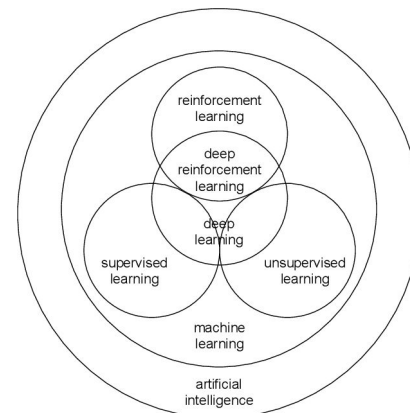
❖ IR/luminosity Working Group - conveners:

- ❖ Charles Hyde - ODU - chye@odu.edu
- ❖ Alexander Kiselev - BNL - ayk@bnl.gov
- ❖ Christoph Montag - BNL - montag@bnl.gov
- ❖ Vasily Morozov - JLab - morozov@jlab.org

❖ Theoretical Physics Working Group has a [Wiki page](#). Conveners:

- ❖ Wim Cosyn (FIU, USA) - wcocsyn@fiu.edu
- ❖ Anna Stasto (PSU, USA) - ams52@psu.edu
- ❖ Alessandro Bacchetta (Univ. and INFN - Pavia, Italy) - alessandro.bacchetta@unipv.it
- ❖ Felix Ringer (YITP, Stony Brook, USA) - felix.ringer@stonybrook.edu

<http://eicug.org>



Build an AI community working on the future EIC

**Identify problems where AI is needed for
accelerator, detector, data analysis, theory**

Disseminate AI in the EIC community

AI4EIC Workshop



- We had a very successful workshop in September 2021
 - 243 participants
 - AI4EIC website <https://eic.ai>
 - Active involvement of participants through [Live Document](#) (~35 pages!)
 - Invited talks by leaders/experts

The first workshop had a focus on experimental activities (accelerator and detector) reflecting the EIC schedule

Conveners: Friederike Bock (ORNL), Malachi Schram (JLab)

Accelerator and Detector Design

Conveners: Corey Adams (ANL), Makoto Asai (SLAC)

Simulations

Conveners: Liliana Teodorescu (Brunel U.), Thomas Ullrich (BNL), Yulia Furltova (JLab)

Reconstruction and Analysis

Conveners: Benjamin Nachman, Thomas Britton (JLab)

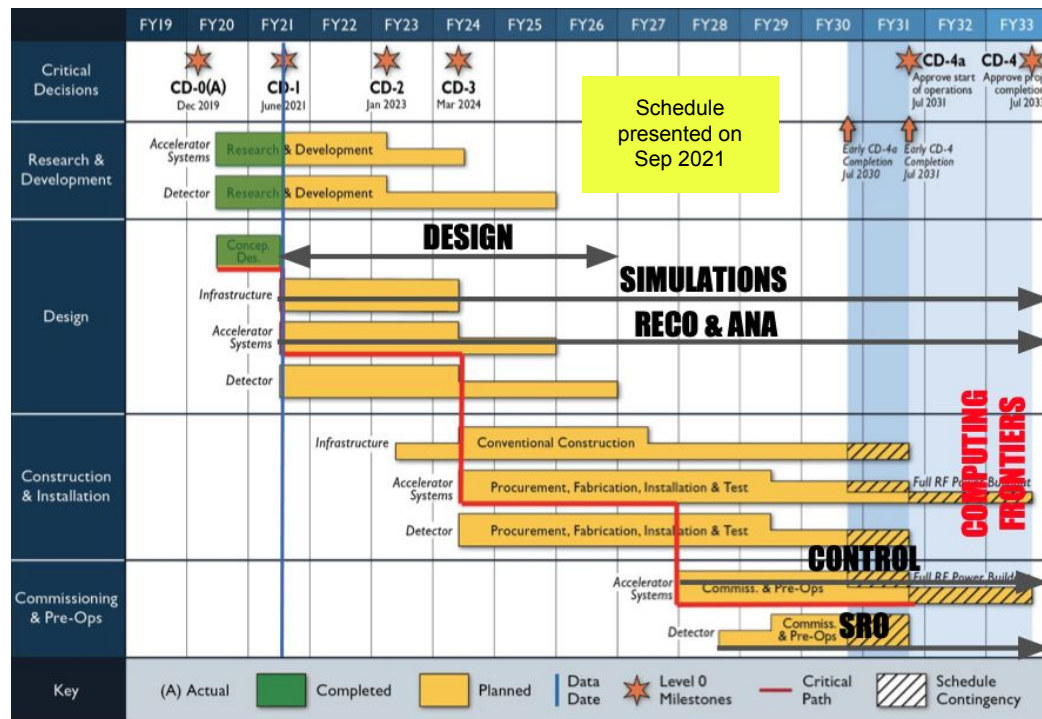
Accelerator and Detector Control

Conveners: Jin Huang (BNL), Philip Harris (MIT)

Detector Readout

Conveners: Gabriel Perdue (Fermilab)

Computing Frontiers



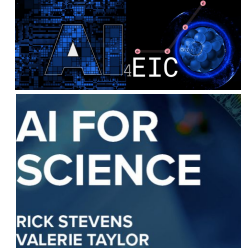
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 - AI4EIC website <https://eic.ai>
 - Active involvement of participants through [Live Document](#) (~35 pages!)
 - Invited talks by leaders/experts
- 50+ contributions and a panel discussion on Computing Frontiers
- Proceedings produced and currently being published by JINST

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- **D.W. Higinbotham, EIC Detector Overview** (session: Detector Design)
- **C. Fanelli, Design of detectors at the EIC with AI** (session: Detector Design)
- **L. Anderlini, Machine learning for the LHCb simulation** (session: Simulations)
- **L. Graczykowski et al., Using machine learning for PID in ALICE** (session: Reconstruction and analysis)
- **L.-G. Gagnon, Machine learning for track reconstruction at the LHC** (session: Reconstruction and analysis)
- **C. Fanelli and A. Mahmood, Artificial Intelligence for imaging Cherenkov detectors at the EIC** (session: Reconstruction and analysis)
- **T. Jeske et al., AI for Experimental Controls at Jefferson Lab** (session: Accelerator and Detector Control)
- **T. Britton and B. Nachman, Accelerator and Detector Control for the EIC with machine learning — (SUMMARY of the entire session on Accelerator and Detector Control)**
- **T. Xuan et al., High performance FPGA embedded system for machine learning based tracking and trigger in sPHENIX and EIC** (session: Streaming Readout)
- **S. Furletov et al., Machine Learning on FPGA for Event Selection** (session: Streaming Readout)
- **T.S. Humble et al., Frontiers in computing for artificial intelligence — (SUMMARY of the entire session on Computing Frontiers and Panel Discussion)**

Take-away messages

"AI techniques that can optimize the design of complex, large-scale experiments have the potential to revolutionize the way experimental nuclear physics is currently done".



- “EIC has the possibility to incorporate AI from the start” [see [Michelle Kuchera’s talk](#)]

Unique opportunity to start addressing NOW how to take advantage of AI:

- No existing experiment has been designed with the support of AI. **EIC can be one of the first large scale experiments (if not the first one) to use AI in the next few years for that!**
 - AI for design is something relevant for EIC right now and for the next few years during **design and R&D phases**
 - **Accelerator + Detector:** EIC is an integrated detector - opportunities for collaborations on AI
- **Need to accelerate simulations** (as well as **design and reconstructions**)
- Reco & Analysis --- **EIC has unique challenges in PID** (see, e.g., discussion on Cherenkov)
- EIC can be one of the first “**automated**” experiments (see Control Session) control workflows
- **Streaming readout at EIC will further the convergence of online and offline analysis:** AI will play a major role in providing fast alignment/calibration/reconstruction for near real-time analyses.
- What opportunities from “**computing frontiers**” in > 2030?

3. Advances in the Next Decade

Industrial investment by large-scale cloud companies as well as AI hardware start-ups will continue to drive performance and energy efficiency at scale and at the edge for commercial applications such as image/face recognition, natural language, logistics, voice assistants, and autonomous vehicles. These commercial drivers will infuse AI capabilities broadly, in the scale of data, complexity of function, and robustness that can be achieved. Within the next 10 years, we expect to see the following:

- Introduction of novel AI algorithms, as they are changing quickly and it is difficult to predict popular algorithms for the next decade. Five years ago, LSTMs were new, ResNets were not in use, and transformer networks had not yet been invented.
- Steady increase in the size of largest AI models trainable as well as improvements in training algorithms that reduce the order of growth in training cost per weight. If the largest model training costs continue their current growth rate of 10x/year, economic and environmental consequences will ultimately be the practical limits.
- Steady reduction and plateau in inference latency and cost to commercially important thresholds (i.e., ~5 milliseconds for human and automobile response times).
- Integration of AI acceleration hardware into all mobile/IoT, and server devices.

These advances will be enhanced by the numerous electronics technology initiatives underway such as the IEEE Rebooting Computing, DARPA Electronics Resurgence Initiative, and SRC’s activities like JUMP.

[Live Document](#)

Cross-cutting / multidisciplinary, open data to boost AI, increase AI literacy in EIC, educational outreach

- EIC is being designed now... will be built over ~ 10 years.
- Opportunity to engage with other communities: message from AI4EIC was this should start “now”!
 - Initiatives in NP, HEP
 - Computer Science, Data Science
- Encourage participation from industry. Running theme at AI4EIC was partnership with industry. What is the most productive way going forward?
 - [Computing Frontiers, Panel Discussion at AI4EIC](#) and [Meeting Live Document AI4EIC Workshop](#)
 - [AISIS: Artificial Intelligence for Science, Industry and Society — Particle and Nuclear Physics — panel discussion](#)
- We may need to think of new data policy to make data - not necessarily real data - accessible to a broader community --- this involves hackathons, educational events) — **Open, FAIR data; open-source software**
- Today’s students might have leading role in EIC in ~10 years — We need outreach

AI4EIC WG (announcement)



Fatemi, Renee <rhfate2@g.uky.edu>

Wed 11/17/2021 12:35 PM

Inbox

Mark as unread

To: eicug-users@eicug.org;

Dear Colleagues,

After the successful experience of the first workshop on AI for the EIC (AI4EIC, <https://eic.ai/workshops>) and given the growth of AI applications in our field, we are excited to announce the formation of an AI Working Group (AIWG) in the EICUG.

The EIC has the unique opportunity to start incorporating AI from the very beginning and to systematically leverage it during all phases of the project. AI approaches include (but are not limited to) machine learning (ML) and deep learning (DL). A decade from now, when we will start data taking, AI will be an integral part of the EIC software and we will take advantage of intelligent decisions in all aspects of data processing from detector readout and control to analysis.

Given the close connection between AI and software, the AIWG will form under the Software Working Group (SWG). We welcome Cristiano Fanelli (MIT) and Tanja Horn (CUA) to organize the activities of the new working group. They will also be conveners of the SWG and will work with the EICUG at large on AI for the EIC.

The first kickoff meeting is anticipated to happen after the EIC detector proposal deadline of December 1st, and further details will be announced soon. For any questions related to the new AIWG, please reach out to the conveners of the SWG (eicug-software-conveners@eicug.org).

Best regards,

Renee for the EICUG Steering Committee

AI Community @ EIC

- AI4EIC Workshops
- Tutorials
- Schools
- Jamboree
- Hackathons
- Kaggle Challenges
- Outreach

It may develop “sub-WG” groups...

(From the AI4EIC Workshop):

- AI for EIC Design*
- AI for EIC (Fast) Simulations
- AI for EIC Data Reco & Analysis
- AI for EIC Control*: automated workflows; data quality monitoring; anomaly detection
- AI for EIC Streaming Readout
- AI for EIC Computing frontiers
- AI for EIC theory; phenomenology;

(From our meetings):

- Additional areas



- Regular meetings (monthly): topic-oriented (e.g. uncertainty quantification); create a forum to exchange information in AI within the EIC community
- Identify problems and areas of common interest for EIC where AI is needed or could make a difference
- Establish “working groups” / “task forces” for longer term developments
- Organize workshops and other activities such as tutorials, schools to continue building a stronger AI community working in EIC
- Steer the creation of common benchmarks; promote open data
- Development/interface/integration of AI with EIC SWG

complete Charge will be published on eic.ai

- AI4EIC will develop a diverse workforce cultivating an environment of inclusivity and a culture of belonging.
- AI4EIC will organize monthly meetings on a variety of subjects. The primary goal of these meetings is a topic-oriented discussion (focusing on a certain ML technique useful for the EIC) that may include external experts.
- Every year AI4EIC organizes annual workshops, which includes, e.g., invited data scientists' talks, submitted talks, and may also include tutorials.
- AI4EIC aims at identifying problems where AI can have an impact and at finding solutions that can be cross-cutting for the EIC community. We plan to create a database with benchmark datasets and challenges to allow testing new approaches/methods and compare to previous ones.
- These activities may evolve in sub-working groups, reflecting macro-areas relevant for the EIC realization such as AI for design, simulations, reconstruction and analysis, control of experimental systems, streaming readout, AI in computing frontiers, AI for theory/phenomenology.
- AI4EIC will create network with ongoing efforts and initiatives in NP, HEP and beyond.
- We aim to provide a forum for community-driven solutions, announce EIC-centered schools/tutorials, and maintain a living list of papers relevant to EIC and people involved. We also plan to organize hackathons and Kaggle-like on EIC challenges.
 - Promote / announce meetings in our community; other relevant AI/ML-related announcements
 - Venue for showing AI-related research applied to EIC and broadly update the EIC community

- Organizing meetings; promote discussions and possible formation of sub-working groups.
- Next EIC Workshop will happen on Sep/Oct 2022 — an announcement will be sent shortly.
- Organize first hackathon and kaggle-like challenge: dates to be decided.
 - Surveys will be sent out soon to identify problems/challenges.
 - Awards/prizes (great for early career scientists).

Broader goal:

- (longer-term) White Paper?

- Will soon send surveys asking
 - Topic you want to start a discussion about (AI-related for EIC)
 - What topics for hackathon? For a kaggle-like challenge?
 - General survey on AI/ML tools and background

Get involved and help build the AI4EIC!



- Institutions/Lab who already expressed interest
 - BNL, CNU, CUA, FSU, JLab, LBNL, MIT, SBU, UVA, W&M + other that will join (please reach out to support@eic.ai to collaborate)
- Hackathons
- How to get in contact and get info
 - support@eic.ai
 - <https://ai4eic.slack.com/>
 - Mailing list

Questions / Comments / Suggestions

