Accelerator and Detector Design: Summary

Day 1 morning

Conveners: Friederike Bock (ORNL) , Malachi Schram

10:00	**Accelerator and Detector Design: Introduction** **Speakers**: Friederike Bock (ORNL) , Malachi Schram (JLab)	5m
10:05	**Accelerator Overview** **Speaker**: Todd Satogata (JLAB) 2021-09-07-AI4EIC-...	30m
10:35	**Detector Overview** **Speaker**: Douglas Higinbotham (Jefferson Lab) AI4EIC-Higinbotham...	30m
11:10	**break**	15m
11:25	**AI/ML supported design** **Speaker**: Cristiano Fanelli (MIT) AI4EIC_Talk_AI_ML_...	30m
11:55	**AI-optimized design for ECCE** **Speaker**: William Phelps (Christopher Newport University/Jefferson Lab) ecce_ai_phelps_09_...	20m
12:15	**AI for accelerator design** **Speaker**: Yue Hao (Brookhaven National Laboratory) AI for EIC accelerat...	20m
12:35	**Discussion**	25m

Accelerator Design for AI4EIC

- The majority of the parameters are tightly constrained based on the exiting infrastructure (RHIC tunnel, etc).
- Broader-scope AI/ML adoption in accelerator design is challenging
- Suggests narrow-scope technical design optimization is most acceptable for new methods of optimization
  - Component design optimization and evaluation
    - MOGA techniques helpful for Crab Cavity R&D
  - Develop ML approaches to predict beam lifetime and integrated luminosity
- Some recently started AI/ML studies:
  - Machine tuning using XGBoost, GP, NN
  - Dimension reduction to address large parameter space
- EIC commissioning may benefit from AI/ML techniques being developed now:
  - Development/convergence of high-fidelity commissioning models
  - Develop ML-based noise reduction models for processing large datasets during commissioning
  - Accelerate fault/anomaly identification

Detector Design for AI4EIC

- Photo-collaborations are presently working on collaboration proposals: Athena, CORE and ECCE
- Several ongoing AI/ML detector design optimization studies:
  - The ECCE Inner Tracker using MOEA shows improvement over “baseline”
  - Improving mechanical strength of aerogel using MOEA
  - Bayesian Optimization of EIC Dual Rich
- Current optimization studies focus on single system.
  - Generalize tools to accommodate other detectors
  - A multi-dimensional / multi-objective optimization for a global design could be a good next step
  - Increase the effort to make scalable solutions
- New opportunities to contribute:
  - AIDE (AI for the Design of EIC) at (https://eic.ai/)