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Towards an EIC Software Expression of Interest

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EIC Key Software Needs

- Firmware/software for continuous, on-the-fly data collection, processing, and reduction (can be common across a given experiment's subsystems)
- Full detector simulations capable of leveraging *hardware acceleration* and *exascale computers*
- Improved tools and automation for diagnosis and optimization of machine learning models and parameters
- Federated/GRID computing capable of leveraging geographically distributed nation's HPC resources
- Easy setup and replication of common user analysis environment and tools across platforms. (Needed soon and throughout the next years.)
- Driving all the above: high channel count, large distributed teams, large distributed resources, fast time to publication, … economically (true for multiple scientific fields)

EIC Enabling Software Technologies & Techniques

- Machine Learning including tools to optimize/analyze/visualize machine parameters (TensorBoard for TensorFlow, ….).
- Celeritas and Geant4 development to leverage *hardware acceleration* for full simulations.
- ACTS common tracking software: detector-agnostic, framework-independent tools for high-level tracking reconstruction software. Thread-safe parallel execution.
- Shared cloud computing (including commercial resources)
- Federated computing (including GRID) for major data processing
- Firmware for massively parallel, on-the-fly data reduction (likely experiment-specific but can be as uniform as possible across subsystems)
- Tools for uniform common environment
  - Containerized software delivery (Docker, …) for easy setup of common uniform user environment
  - Virtual machines for common environment delivery
  - Integrated development environments (Jupyter, PyCharm, …)

Potential Resources & On-going Actitivies at ORNL

- Interested in further discussions concerning specifics for the EIC Software EOI. Here is relevant work active now.
- Machine Learning (and Artificial Intelligence) is a core strength at ORNL across multiple groups. TensorFlow (with GPU acceleration) used by multiple projects on Summit. Local ALICE physicists have developed published machine learning analyses for ALICE Experiment data.
- Celeritas: Developing GPU-accelerated particle transport application library for HEP/NP simulation, with Geant4 geometry models. Pathway to incorporate GPU acceleration into Geant4.
  - https://indico.cern.ch/event/904385/
- Working to implement ACTS tracking software for sPHENIX
- Tier 2 Grid Site at ORNL CADES providing 50% of US computing obligations to ALICE Experiment 24/7. CADES provides cloud computing resources.
- OLCF: Successful opportunistic use of supercomputer cycles for ATLAS Experiment. Extensive experience porting codes to accelerated architectures. Potential for massive event generation on leadership supercomputers.