Software Working Group

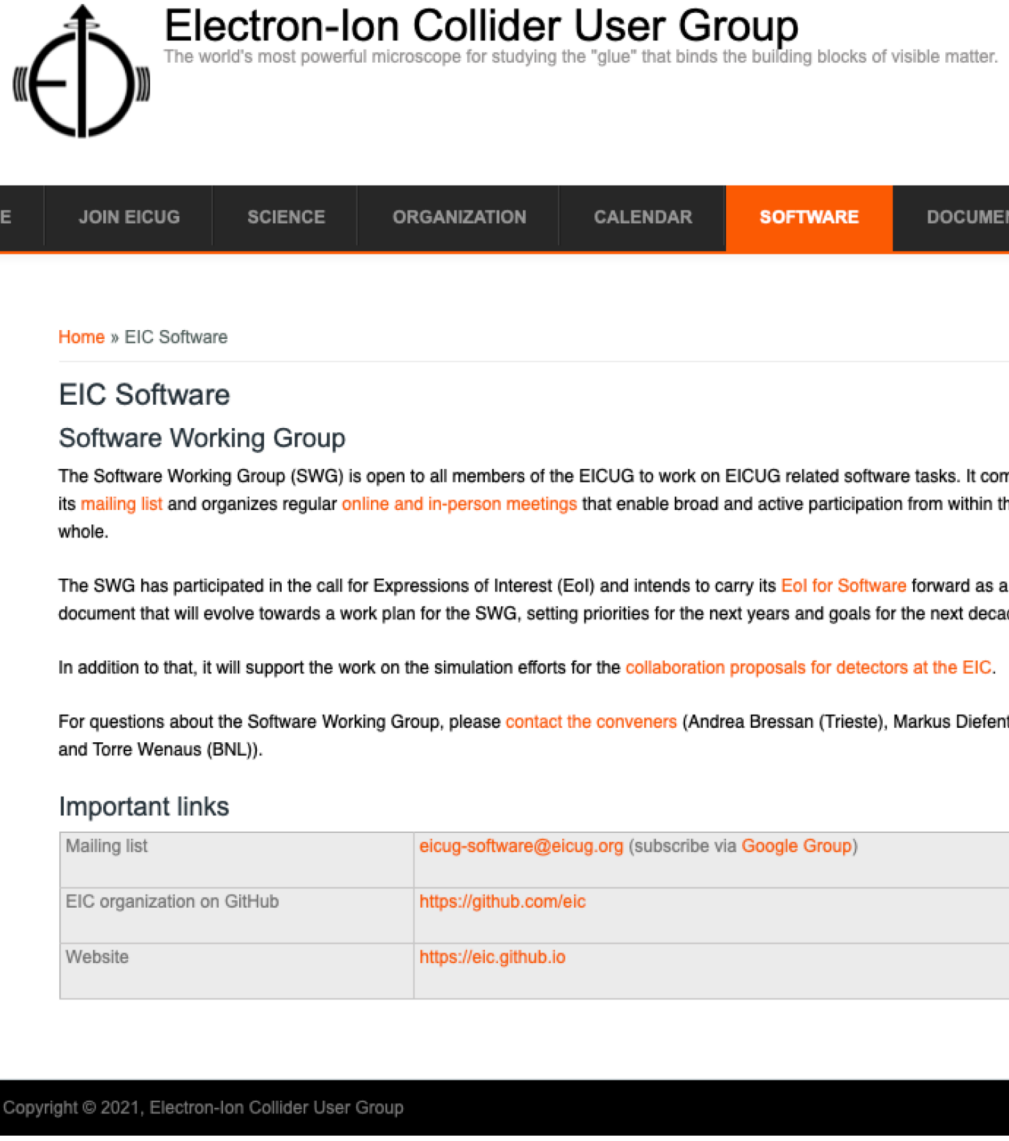
Andrea Bressan (Trieste), Markus Diefenthaler (JLab), Torre Wenaus (BNL)

BROOKHAVEN NATIONAL LABORATORY

Jefferson Lab

UNIVERSITÀ DEGLI STUDI DI TRIESTE

EICUG Software Working Group



Electron-Ion Collider User Group

The world's most powerful microscope for studying the "glue" that binds the building blocks of visible matter.

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EIC Software

Software Working Group

The Software Working Group (SWG) is open to all members of the EICUG to work on EICUG related software tasks. It communicates via its mailing list and organizes regular online and in-person meetings that enable broad and active participation from within the EICUG as a whole.

The SWG has participated in the call for Expressions of Interest (EoI) and intends to carry its EoI for Software forward as a living document that will evolve towards a work plan for the SWG, setting priorities for the next years and goals for the next decade.

In addition to that, it will support the work on the simulation efforts for the collaboration proposals for detectors at the EIC.

For questions about the Software Working Group, please contact the conveners (Andrea Bressan (Trieste), Markus Diefenthaler (JLab), and Torre Wenaus (BNL)).

Important links

Mailing list	eicug-software@eicug.org (subscribe via Google Group)
EIC organization on GitHub	https://github.com/eic
Website	https://eic.github.io

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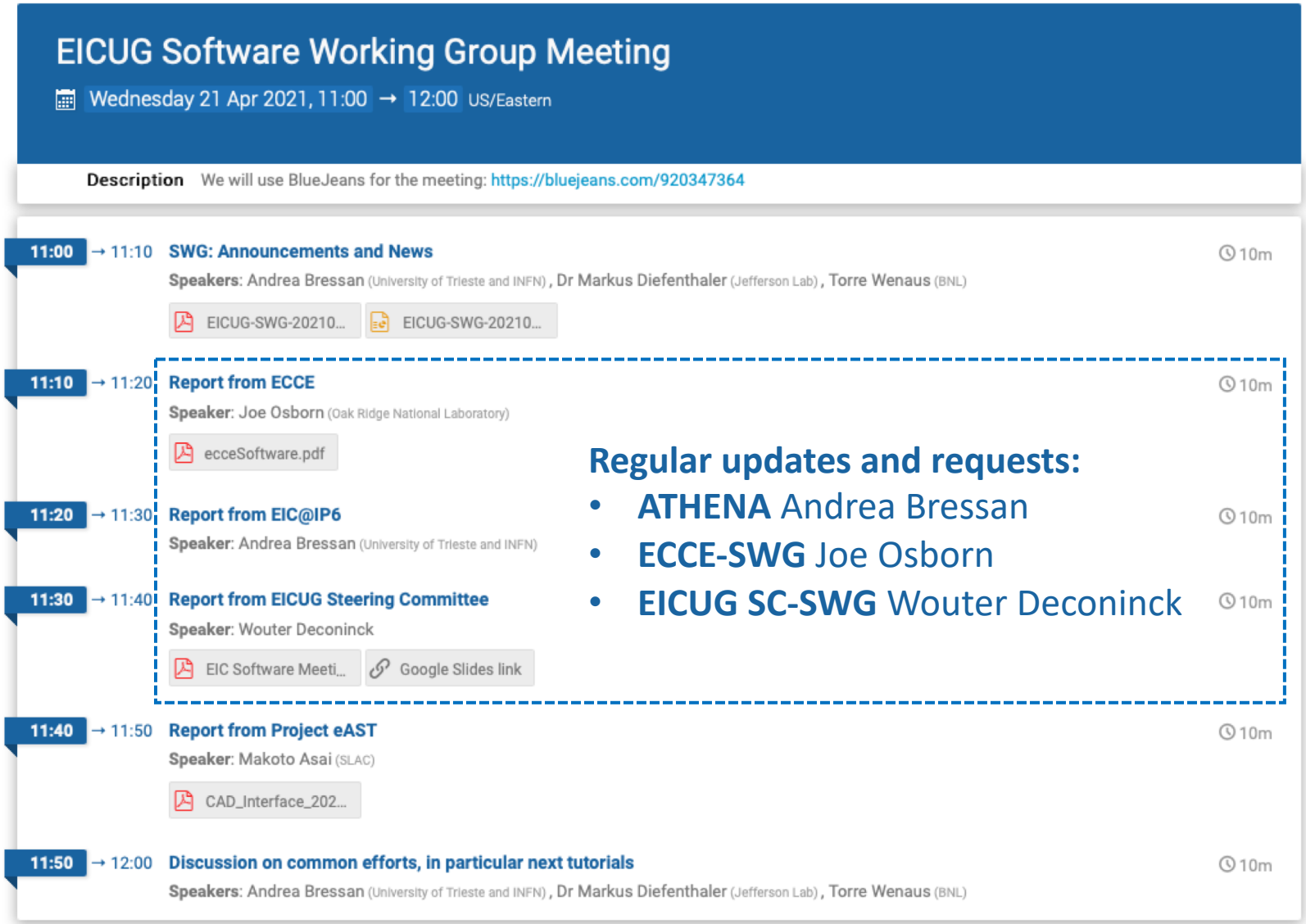
Working Together



EICUG Software Working Group Meeting

Wednesday 21 Apr 2021, 11:00 → 12:00 US/Eastern

Description We will use BlueJeans for the meeting: https://bluejeans.com/920347364

11:00 → 11:10 **SWG: Announcements and News** 10m

Speakers: Andrea Bressan (University of Trieste and INFN), Dr Markus Diefenthaler (Jefferson Lab), Torre Wenaus (BNL)

EICUG-SWG-20210... EICUG-SWG-20210...

11:10 → 11:20 **Report from ECCE** 10m

Speaker: Joe Osborn (Oak Ridge National Laboratory)

ecceSoftware.pdf

11:20 → 11:30 **Report from EIC@IP6** 10m

Speaker: Andrea Bressan (University of Trieste and INFN)

11:30 → 11:40 **Report from EICUG Steering Committee** 10m

Speaker: Wouter Deconinck

EIC Software Meeti... Google Slides link

11:40 → 11:50 **Report from Project eAST** 10m

Speaker: Makoto Asai (SLAC)

CAD_Interface_202...

11:50 → 12:00 **Discussion on common efforts, in particular next tutorials** 10m

Speakers: Andrea Bressan (University of Trieste and INFN), Dr Markus Diefenthaler (Jefferson Lab), Torre Wenaus (BNL)

Regular updates and requests:

- **ATHENA** Andrea Bressan
- **ECCE-SWG** Joe Osborn
- **EICUG SC-SWG** Wouter Deconinck

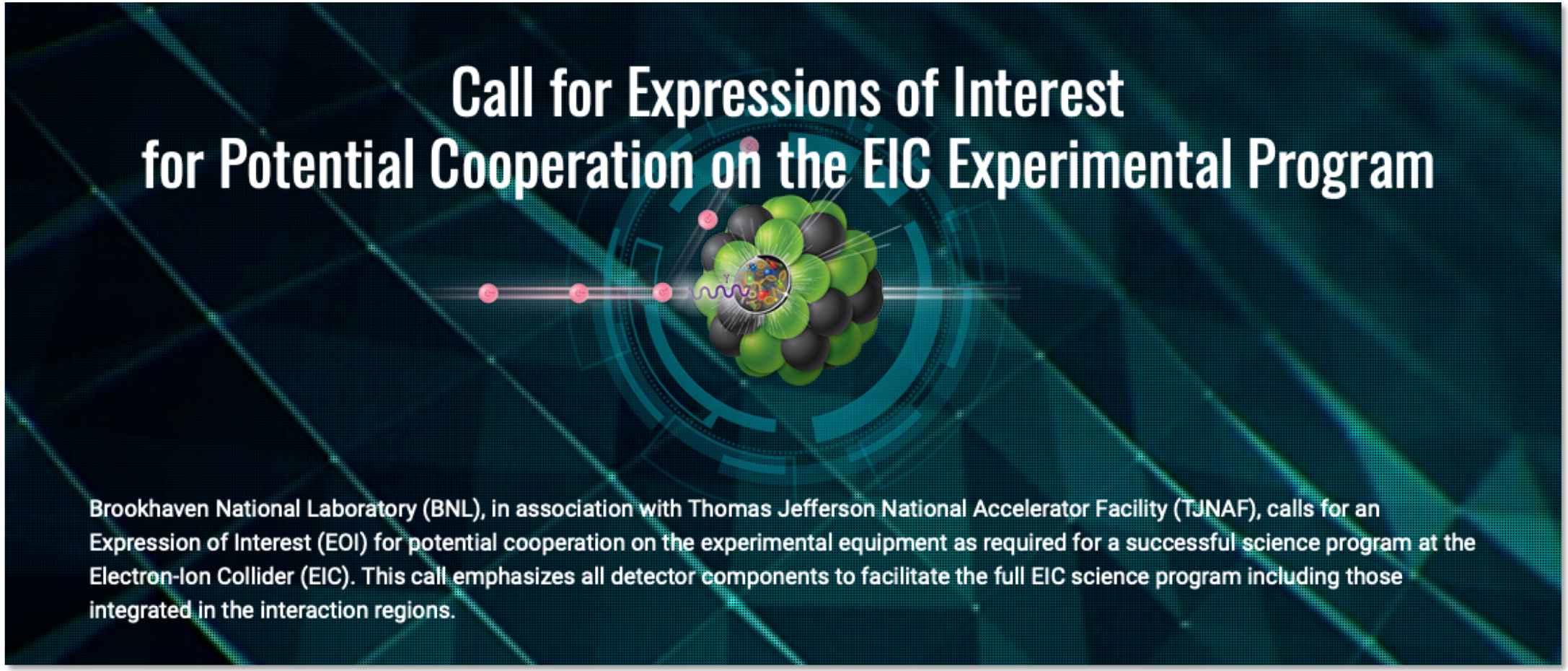
Since EIC User Group meeting in July 2020

- **55+ Meetings**
  - 29 SWG Meetings
  - 20+ Validation Meetings with EIC-India
  - 6 Meetings on Project eAST
- **4 Tutorials** with 1600 views on YouTube
- **1 Software Town Hall**

Highlights since EICUG Remote Meeting in May 2021

- Preparations for EIC Software & Computing meeting
- Reproducibility with computer scientists from OTH Regensburg and University of Passau

SWG Priority: Realize Software EoI



Common Projects: Expression of Interest for Software

https://eic.github.io/activities/eoi.html

Expression of Interest (EOI) for Software

Please indicate the name of the contact person for this submission:

Conveners of the Software Working Group:
- A. Bressan, M. Diefenthaler, and T. Wenaus
- eicug-software-conveners@eicug.org

Please indicate all institutions collectively involved in this submission of interest:

29 institutions

ANL	Argonne National Laboratory
BNL	Brookhaven National Laboratory
CEA/Irfu	IRFU at CEA /Saclay institute
EIC-India	Akal University, Central University of Karnataka, DAV College Chandigarh, Goa University, Indian Institute of Technology Bombay, Indian Institute of Technology Delhi, Indian Institute of Technology Indore, Indian Institute of Technology Patna, Indian Institute of Technology Madras, Malaviya National Institute of Technology Jaipur, Panjab University, Ramkrishna Mission Residential College Kolkata
IMP-CAS	Institute of Modern Physics - Chinese Academy of Sciences
INFN	Istituto Nazionale di Fisica Nucleare
JLab	Thomas Jefferson National Accelerator Facility
LANL	Los Alamos National Laboratory
LBNL and UC Berkeley	Lawrence Berkeley National Laboratory and University of California, Berkeley
NCBJ	National Centre for Nuclear Research
OhioU	Ohio University
ORNL	Oak Ridge National Laboratory
SBU	Stony Brook University
SLAC	SLAC National Accelerator Laboratory
SU	Shandong University

https://indico.bnl.gov/event/8552/contributions/43221/

- **Software Tools for Simulations and Reconstruction**
  - **Monte Carlo Event Generators** see validation
  - **Detector Simulations** Project eAST **Update from Wouter**
  - **Reconstruction** ACTS
  - **Validation** **Update from EIC-India**, test-beam data
- **Middleware and Preservation**
  - **Workflows** Job submission, simple examples provided to proto-collaborations
  - **Data and Analysis Preservation** REANA
- **Interaction with the Software Tools**
  - **Explore User-Centered Design** **Slides 8 – 11**
  - **Discoverable Software** cvmfs/spack
  - **Data Model** Common data format
- **Future Technologies**
  - Artificial Intelligence
  - Heterogeneous computing
  - New languages and tools
  - Collaborative software

Accelerator and Beam Conditions Critical for EIC Simulations

Simulations

https://eic.github.io/resources/simulations.html

Accelerator and Beam Conditions Critical for EIC Simulations

A note summarizes how measurements at the Electron-Ion Collider will be influenced by accelerator and beam effects, including the:

- Beam crossing angle.
- Crabbing rotation.
- Beam energy spread.
- Angular beam divergence.
- Beam vertex spread.

The accelerator and beam effects may have profound consequences on the measurement capabilities of the EIC, as well as the design and layout of the detectors. The effects studied in the note should be included in physics and detector simulations for the EIC. The supplementary material gives example implementations on the generator level as well as for a generator-agnostic approach on how to integrate these effects in physics and detector simulations for the EIC.

Accelerator and Beam Conditions Critical for Physics and Detector Simulations for the Electron-ion Collider (J. Adam, E.-C.Aschenauer, M. Diefenthaler, Y. Furletova, J. Huang, A. Jentsch, B. Page)

It also includes a movie illustrating the electron and proton bunch movement during their interaction. The visualization is for an electron-proton collision at 18x275 GeV and based on the transport model described in the note.

Visualization of the electron and proton bunch movement during their interaction (18x275 GeV) (J. Adam)

Project eAST: Unify the Simulation Effort with the Community

Common effort on **next-generation simulations**:

- building on the work done in the existing simulations,
- a requirement for the common toolkit is that it integrates existing detector simulations in a modular way.

Detector Simulation

- **comprehensive, centrally maintained application**
- **based on Geant4 10.7 / 11**
- **for fast and full simulations**
- **with library of potential detector options**

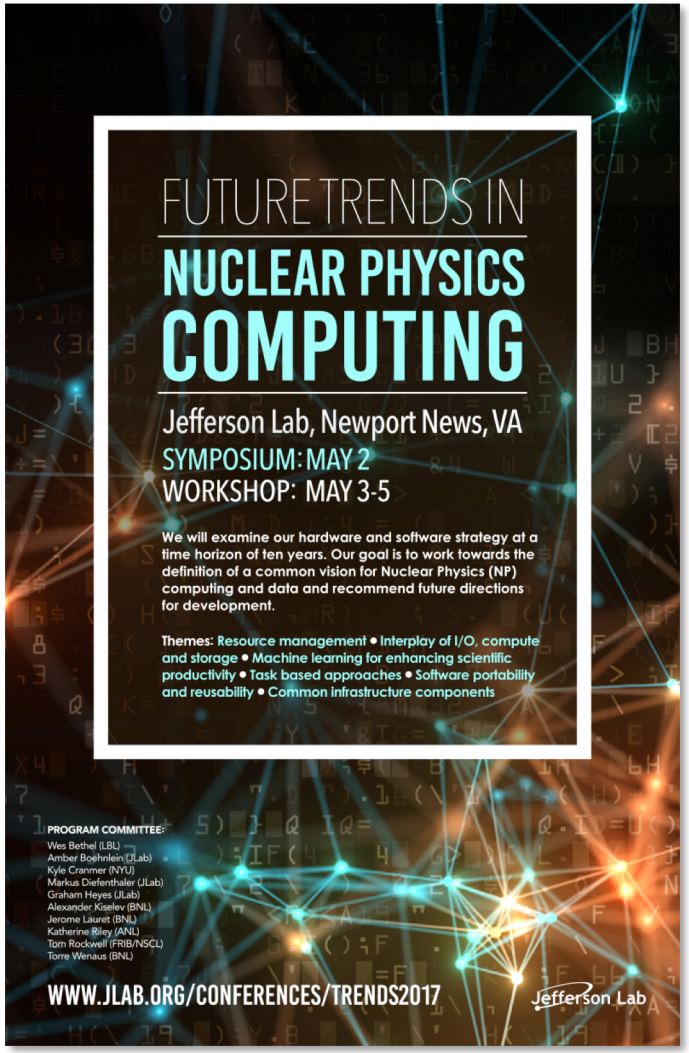
Requirements

- ability to **reuse existing simulation work** ✓
- ease of **switching detector options** ✓
- ease of switching between **detailed and coarse** detector descriptions (work in progress)
- ease of **leveraging new and rapidly evolving** technologies:
  - AI/ML (to be tested)
  - heterogeneous architectures (work in progress)

Project Leader

- Makoto Asai (SLAC), Geant4 project leader and deep technical expert for >20yrs.

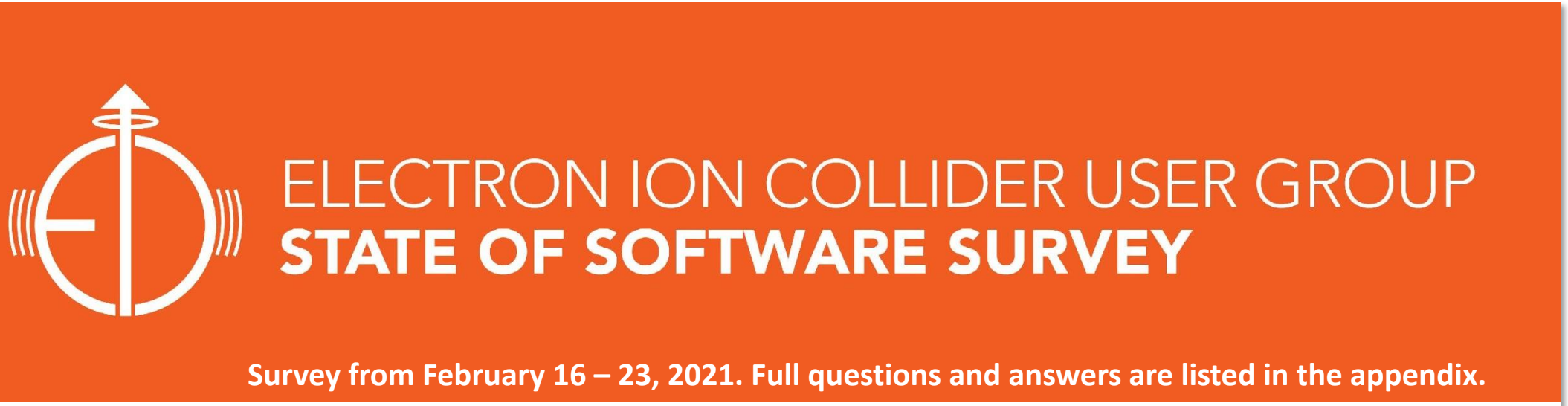
Explore User-Centered Design



- **Software and computing are an integral part of our research**

- **Goal** All scientists of all levels worldwide should be enabled to participate in EIC simulations and analyses actively.
- **User-Centered Design** To achieve this goal, we must develop simulation and analysis software using modern and advanced technologies while *hiding* that complexity.

Initial Step: State of Software Survey



The Software Working Group collected information on the community's specific software tools and practices during the Yellow Report Initiative. This *software census* will be essential to better understand and quantify software usage throughout the EIC community.

Survey results summarized by Wouter Deconinck (Manitoba), Markus Diefenthaler (JLab), Rebecca Duckett (JLab), Sylvester Joosten (ANL), and Kolja Kauder (BNL).

Download Report

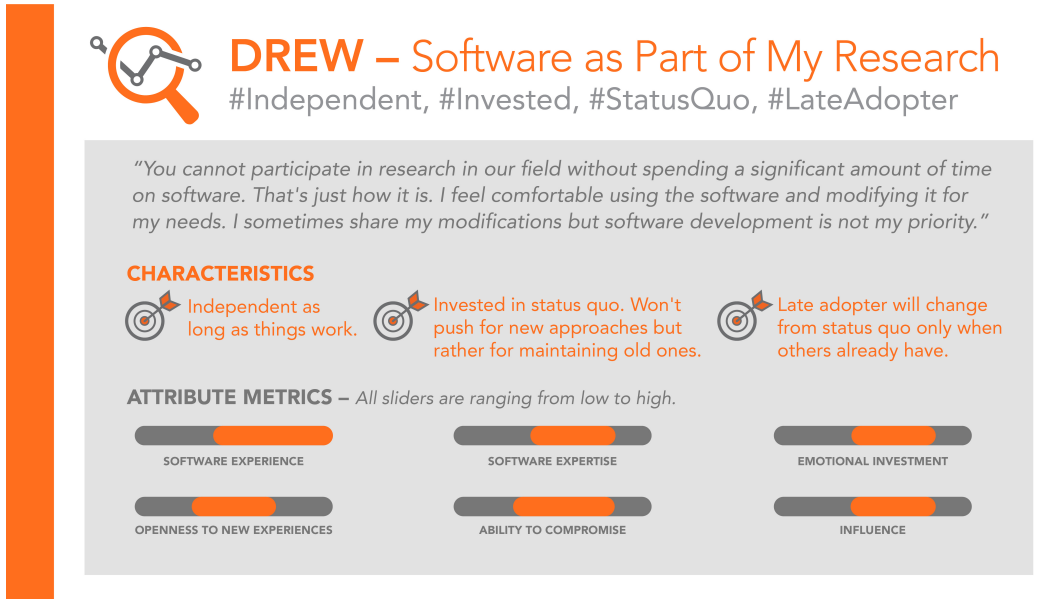
Developing User Stories

Project with BNL and JLab Communication Offices and User Experience Consultant T. Wiggins

Focus Group Discussions → **User Stories**
Input to software developers as to which users they are writing software for.

- **Focus Group: Students**
- **Focus Group: Junior Postdocs**
- **Focus Group: Senior Postdocs**
- **Focus Group: Professors**
- **Focus Group: Industry**

→

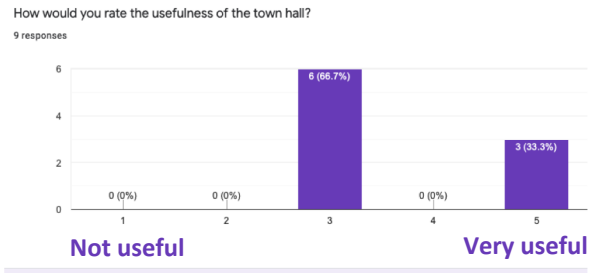


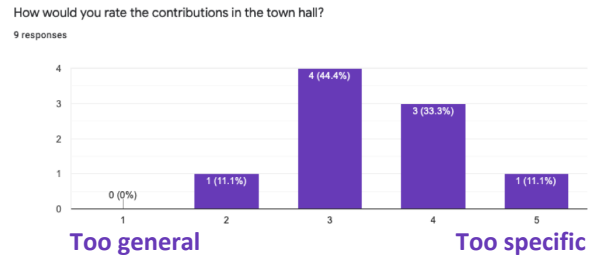
Extremly valueable feedback, including many suggestions and ideas. →

More detailed user profiles with a (partial) focus on software

- *"Important outreach to put a human face on the exciting science we work so hard to do!"* (John Lajoie)
- Rachel Montgomery (University of Glasgow)
- Vaibhavi Gawas (IIT Madras)
- Prabhakar Palni (Goa University)
- Alex Jentsch (BNL)

Software Town Hall





EIC Science and Software

All scientists of all levels worldwide should be enabled to participate actively in the science of the Electron-Ion Collider (EIC). To achieve this goal, we need to understand the requirements of the community on the data analysis software and workflows first and foremost.

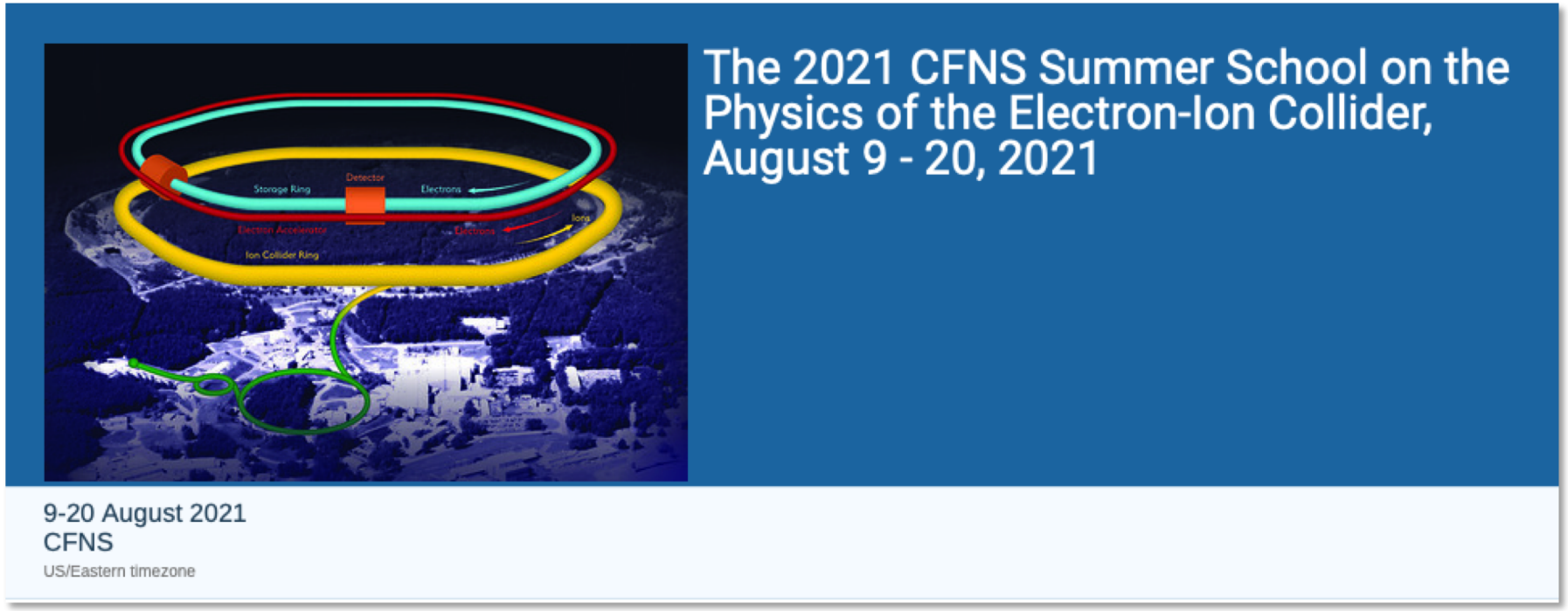
Software Town Hall

The idea of the event is to allow anyone in the EIC community a chance to share past experiences or suggest requirements for EIC Software in an open environment.

Organizers

W. Deconinck, A. Deshpande, M. Diefenthaler, O. Evdokimov, T. Hemmick, D. Higinbotham, and K. Kauder.

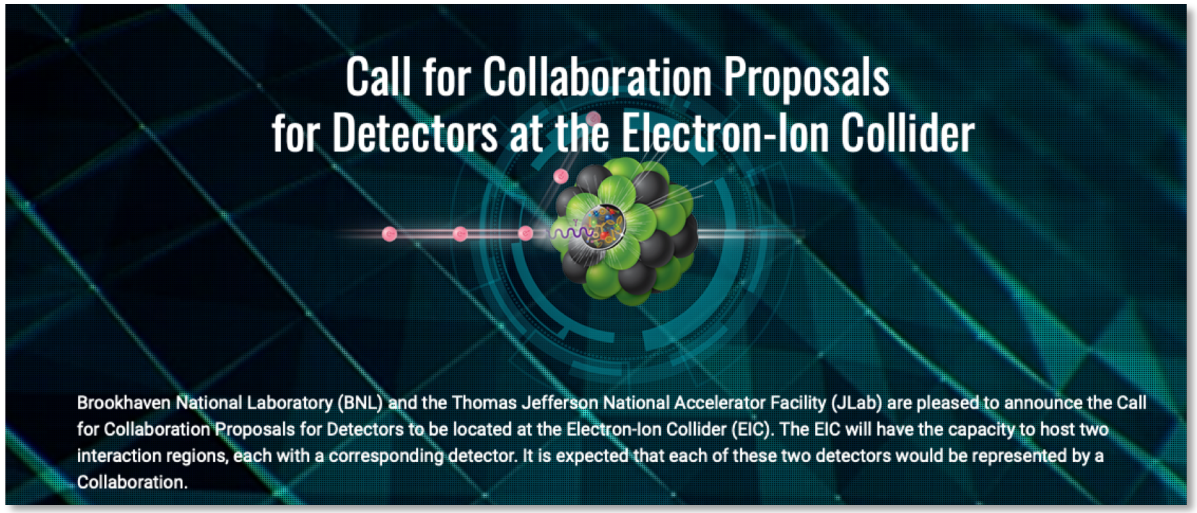
Teaching Together

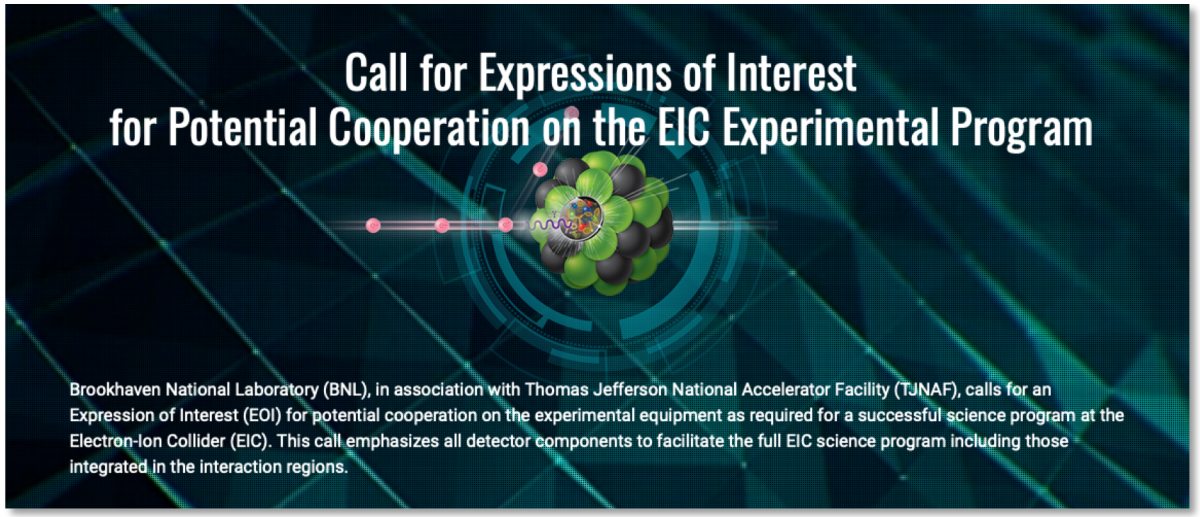


Software Tutorials on August 19 and 20

- by W. Deconinck, M. Diefenthaler, S. Joosten, J. Osborn.
- **Teach students**
  - how to do an EIC analysis for both ATHENA and ECCE, and by doing so
  - how to contribute to the ongoing physics and detector studies.

Summary





Support of Collaboration Proposals

get work done in the short term

Realize Software EoI

sustainable effort

Weekly Meetings https://indico.bnl.gov/category/301/

Mailing List eicug-software@eicug.org

Get involved