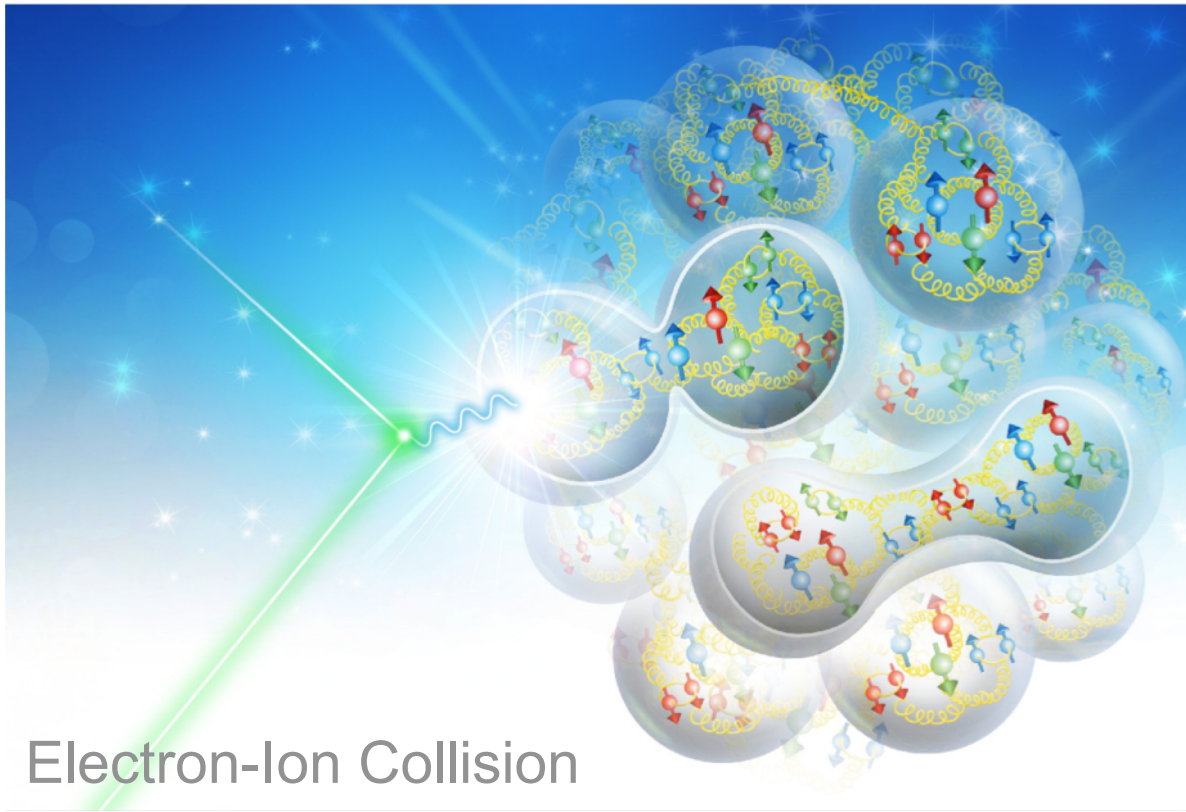
EIC Software Meeting



Markus Diefenthaler

Electron-Ion Collision

Jefferson Lab

Conveners

Andrea Bressan
(INFN, University of Trieste)

Markus Diefenthaler
(EIC^2, Jefferson Lab)

Torre Wenaus
(Brookhaven Lab)

EIC Software Groups (beyond the simulation effort at the labs)

High Energy Physics

CERN ROOT
Possible collaboration

HEP Software Foundation
Started collaboration

MCnet
Started collaboration

SLAC Geant4
Established collaboration

Nuclear Physics

EIC Software
EIC Software Consortium
Community Endorsement ✗
Funding ✓ (EIC Generic Detector R&D)
EICUG Software Working Group
Community Endorsement ✓
Funding ✗

Same software suite Seamless data processing from DAQ to data analysis using AI

EIC Streaming Readout Consortium
Community Endorsement ✗
Funding ✓ (EIC Generic Detector R&D)

Charge for EICUG Software Working Group

The EICUG Software Working Group's initial focus will be on **simulations of physics processes and detector response** to enable quantitative assessment of measurement capabilities and their physics impact. This will be pursued in a manner that is accessible, consistent, and reproducible to the EICUG as a whole.

It will embody simulations of all processes that make up the EIC science case as articulated in the white paper, eventually integrating new processes under request and with the help of interested communities within the EICUG. The Software working group is to **engage with new major initiatives that aim to further develop the EIC science case**, including for example the upcoming INT program(s), and is anticipated to play key roles also in the preparations for the EIC project(s) and its critical decisions. The working group will build on the considerable progress made within the EIC Software Consortium (eRD20) and other efforts. The evaluation or development of experiment-specific technologies, e.g. mass storage, clusters or other, are outside the initial scope of this working group until the actual experiment collaborations are formed.

The working group will be open to all members of the EICUG to work on EICUG related software tasks. It will communicate via a new **mailing list** and organize **regular online and in-person meetings** that enable broad and active participation from within the EICUG as a whole.

User requests

Ongoing EIC project
Software ✓
Documentation ✓
Requests none

EIC User Group
Common Software ✗
Common Documentation ✗
Requests software, documentation

EIC Generic Detector R&D projects
Software ✓
Documentation ✗ - ✓
Requests common software

Example projects
- ANL: TOPSiDE LDRD
- BNL: eRHIC preCDR
- JLAB: JLEIC preCDR

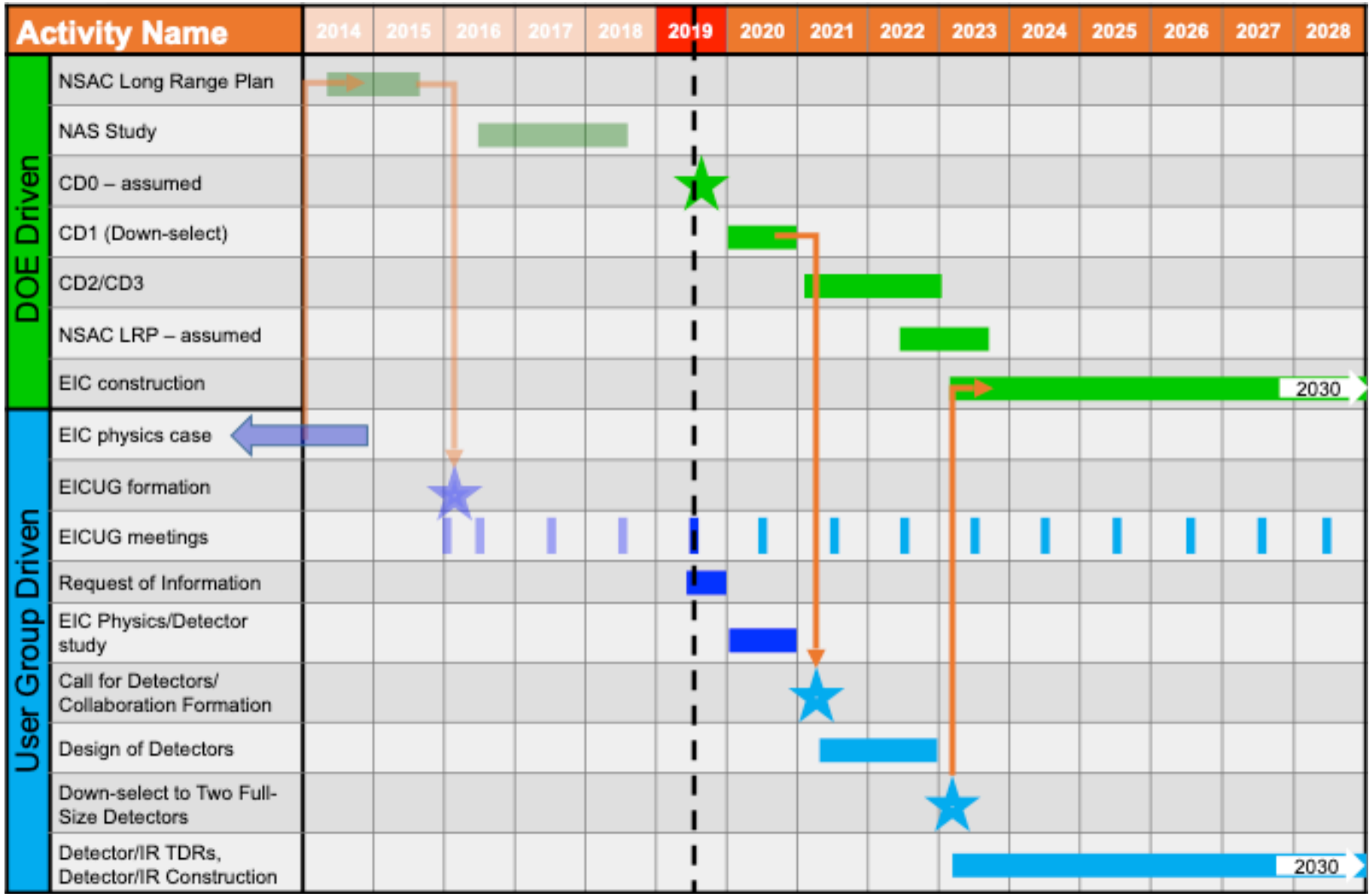
Focus on (pre)**CDRs and site selection as part of CD1** using existing lab software

Focus on preparation of EIC collaborations
- further develop EIC Science
- examine detector requirements
- work on detector designs
- work on detector concepts

requires simulations of physics processes and detector response

Request from Thomas Ullrich, manager of the R&D program:
- in most cases only GEANT simulations are needed:
  - no need for sophisticated framework
  - no need for elaborate tracking
- a simple *lite setup* with a well defined geometry description standard might get them a long way as long if it is EIC wide and easy to use

Timeline


Activity Name
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
DOE Driven
NSAC Long Range Plan
NAS Study
CD0 – assumed
CD1 (Down-select)
CD2/CD3
NSAC LRP – assumed
EIC construction
2030
User Group Driven
EIC physics case
EICUG formation
EICUG meetings
Request of Information
EIC Physics/Detector study
Call for Detectors/ Collaboration Formation
Design of Detectors
Down-select to Two Full-Size Detectors
Detector/IR TDRs, Detector/IR Construction
2030

Memo on “EIC Physics and Detector Conceptual Development"

PDF

To: The Electron-Ion Collider Users’ Group members
From: The EICUG Steering Committee
Date: September 20, 2019
Subject: EIC Physics and Detector Conceptual Development

As discussed at the annual meeting in Paris in July, we are in the process of organizing a 12-18 months intensive study of the EIC physics and detector concepts by the members of the EIC users’ group. This study seeks to build on the 2014 EIC White Paper and the EIC Detector Requirements and R&D Handbook and will be complementary to the ongoing effort at laboratories and universities worldwide. The study is open to all EICUG members, and we would particularly encourage participation by colleagues from universities.

We are proposing that two groups to be formed: one to quantify physics measurements for existing or new physics topics focusing on implication for detector requirements, and a second to study detector concepts based on these requirements. Each of these groups will further be divided into a number of subgroups. Each subgroup will work on their topic in a collaborative effort over about a year and write a summary of about 15 pages in length. These studies should use, in so far as possible, the current accelerator and detector concepts and simulations should be carried out using the EICUG developed software tools. The summaries from each subgroup would be collected, edited, and published in one volume for each group, in the style of the CERN Yellow Reports.

We envision a 2-day kick-off meeting in late 2019 or early 2020, regular workshops about every 4 months and a meeting in spring 2021 to finalize the reports. We are in the process of putting in place an organizational structure that will be presented at the upcoming meetings of the Institutional Board and User Group.

As you are aware, the Department of Energy is moving forward on the official launch of the EIC project, and serious consideration of site selection has begun. It is possible that the EICUG study of physics and detectors over the next 12-18 months may evolve into proto-collaboration formation. We are prepared to shepherd this transition in the most effective way, if required.

All suggestions and advice are welcome.

Sincerely,

EICUG Steering Committee

EICUG 12-18 months intensive study of the EIC physics and detector concepts

Working group 1 Quantify physics measurements for existing or new physics topics focusing on implication for detector requirements.

Working group 2 Study detector concepts based on these requirements.

These studies should use, in so far as possible, the current accelerator and detector concepts and **simulations should be carried out using the EICUG developed software tools**.

High-priority tasks

“These studies should use, in so far as possible, the current accelerator and detector concepts and simulations should be carried out using the EICUG developed software tools. We envision a 2-day kick-off meeting in late 2019 or early 2020.”

Key questions

- What will be software we will present at the 2-day kick-off meeting?
- How do we share responsibility?
- What support will be able to provide for the 12-18 months study? Where do we plan further tutorials?
- How do we ensure updates of the current accelerator and detector concepts?

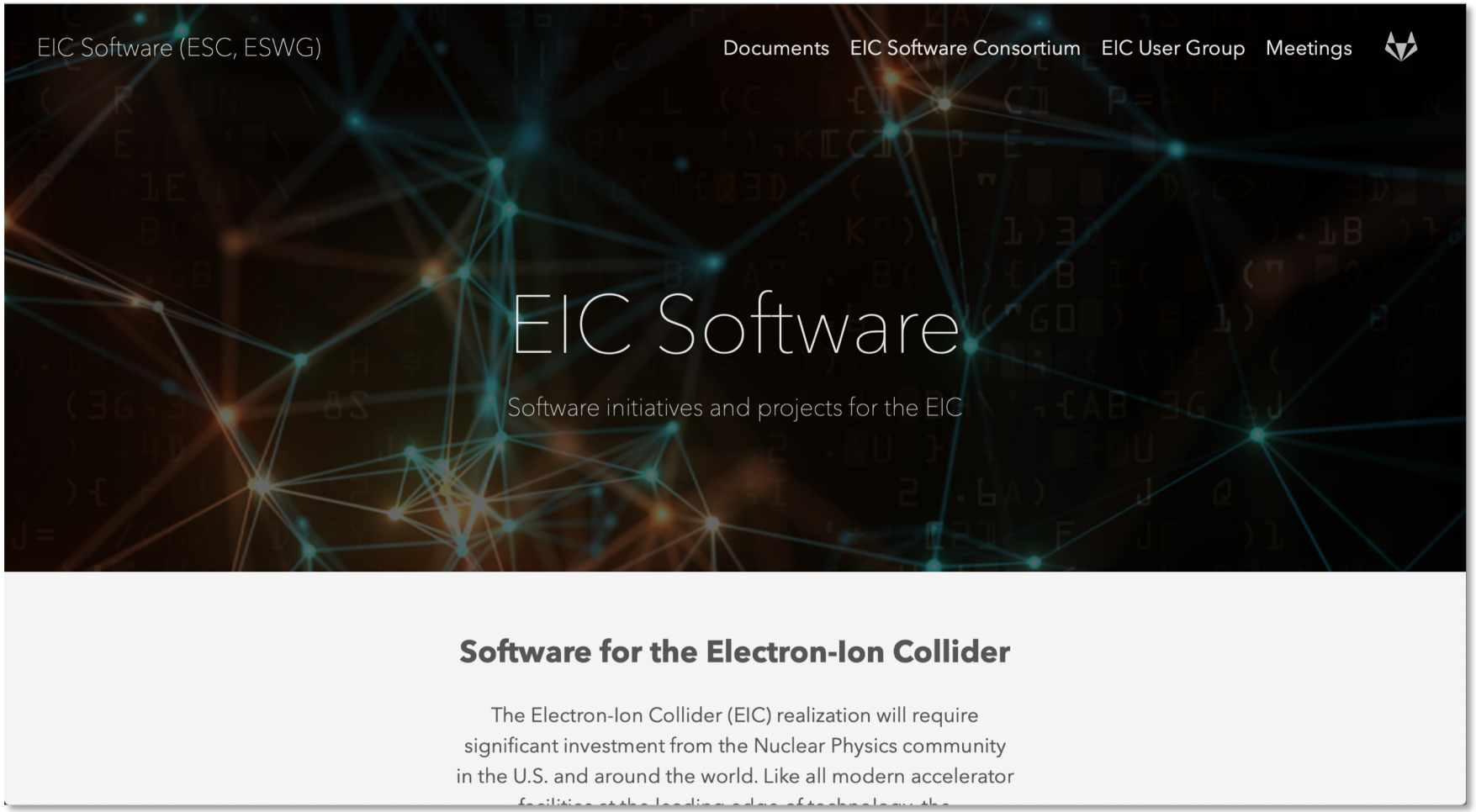
EIC Software for wider community

Workflow environment for EICUG

to use (tools, documentation, support) **and**

to grow with user input (direction, documentation, tools)

Single point of entry



EIC Software website
URL https://eic.gitlab.io

Introduction
- EIC Software Consortium
- EICUG Software Working Group

Meeting schedule

Documents
- container guidelines
- quick start tutorial

Repository

JupyterLab environment

- **collaborative workspace** to create and share Jupyter Notebooks
- **web-based interactive analysis environment** accessible, consistent, reproducible analyses
- **fully extensible and modular** build a collection of analyses and analysis tools
- **bridge to modern data science**, e.g.,
  - *Nature* **563**, 145-146 (2018): "Why Jupyter is data scientists' computational notebook of choice"
  - more than three million Jupyter Notebooks publicly available on GitHub

07/23 EIC Software Tutorial

Dmitry Romanov (JLAB) introduced EIC simulations in JupyterLab environment.

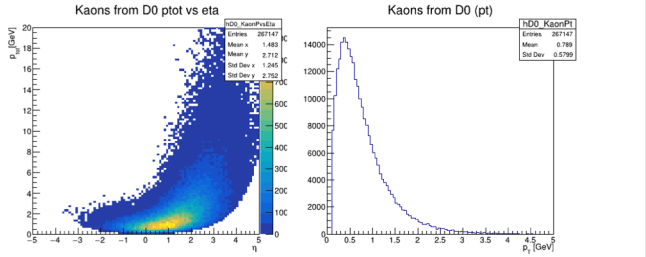
Quickstart https://eic.gitlab.io/documents/quickstart/

Jupyter Notebooks

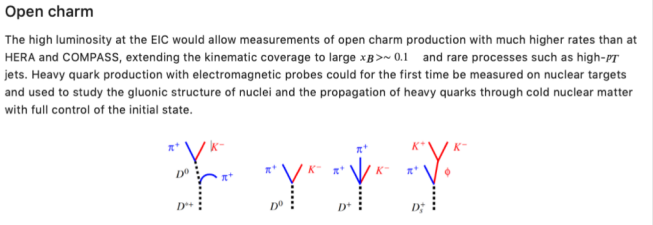
- **writing analysis code**

```
[4]: jana.plugin('hepmc_reader') \
     .plugin('jana', nevents=10000, output='hepmc_sm.root') \
     .plugin('eic_smear', detector='jleic') \
     .plugin('open_charm')

[4]: eJana configured
     plugins: hepmc_reader,eic_smear,open_charm

[5]: jana.source('../data/herwig6_20k.hepmc')

[5]: eJana configured
     plugins: hepmc_reader,eic_smear,open_charm
     sources:
     ../data/herwig6_20k.hepmc

[6]: jana.run()

     Total events processed: 10001 (~ 10.0 kevt)
```

- **visualization of results**



- **narrative of the analysis**



Software design

Escaping complexity scaling trap

- provide interfaces to internal layers
- interaction between layers must be clear

Modularity each layer must be replaceable

simple	JupyterLab web interface
moderate	analysis scripts, python
complex	eJANA, plugins, C++
expert	JANA, eic-smear, ROOT, Geant4

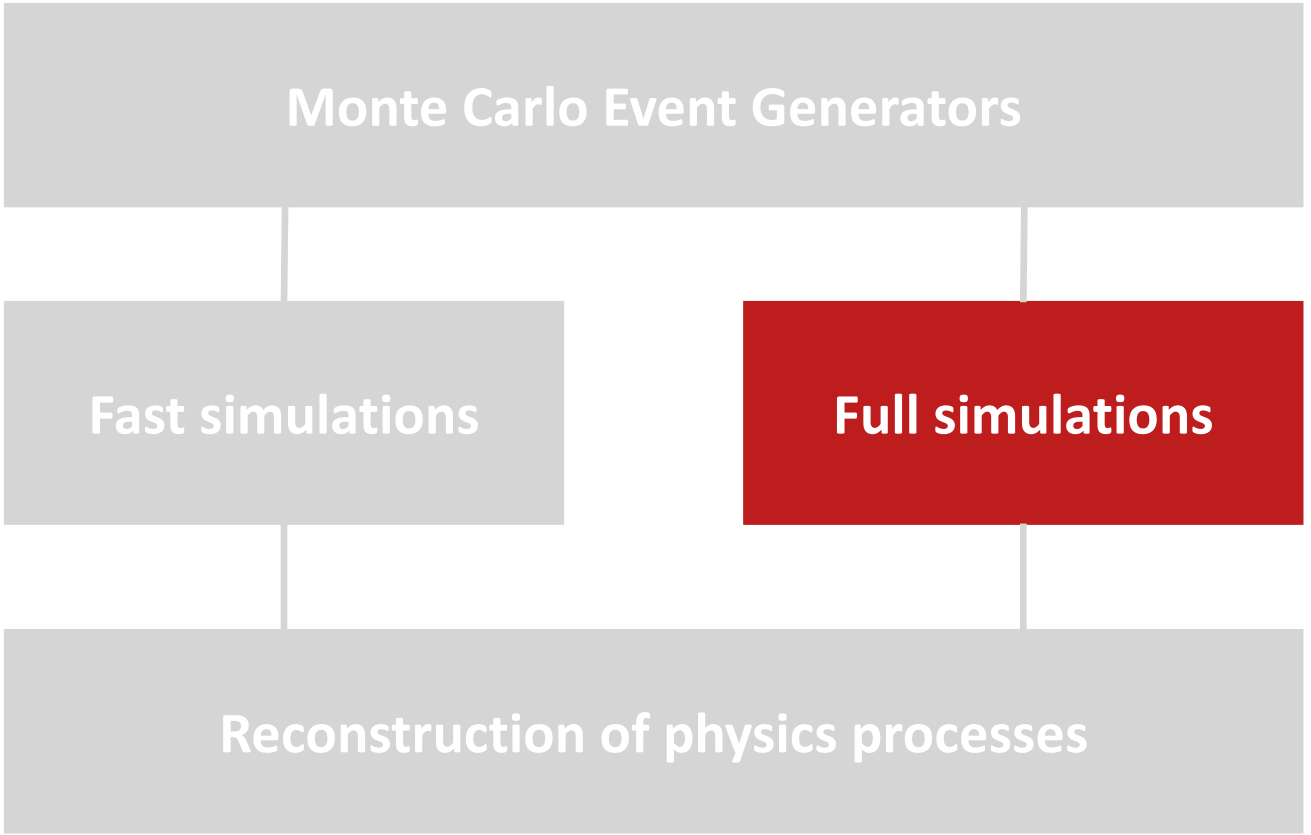
Possible JupyterLab environment for EicROOT, fun4all, etc.

Simulations of physics processes and detector responses

Simulation of physics processes

Simulation of detector responses

Physics analysis



Addressing user requests (slide 4)

EIC Software Meeting on Detector and Physics Simulations

Wednesday 10 Jul 2019, 09:00 → 15:00 US/Eastern

2-160 (BNL Physics)

Andrea Bressan (Trieste), Markus Diefenthaler (Jefferson Lab), Torre Wenaus (BNL)

35 participants

Why we urgently need a
- common (EIC-wide)
- easy to use*
- capable

detector simulation software

EIC Software Meeting on Detector and Physics Simulations

Wednesday Jul 10, 2019, BNL

Thomas Ullrich (BNL)

* for a grad-student/postdoc with moderately good computing skills

EIC User Group
- preparation of EIC collaborations
- request for common software tools and documentation

Request from EIC Generic Detector R&D program:
- in most cases only GEANT simulations are needed:
  - no need for sophisticated framework
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Common Geant4 infrastructure

Goals

- meet requirements by EIC community fully
- meet requirements by EIC community by end of 2019

Approach

- common repository for detector R&D for tEIC
- common detector description in Geant4 (C++)
- common detector naming convention for EIC
- common definition of parameters and their management
- common API/class design for sensitive detector stepping action
- possible common hits output structure
- concise document and template on how to implement and integrate subdetector in the detector concepts for the EIC

Common Geant4 infrastructure compatible with existing simulations tools, e.g., eJANA or fun4all.

Existing tools will be able to **use common Geant4 infrastructure** without loosing any functionality.

Existing prototypes for common Geant4 infrastructure: EIC Software Sandbox, (Alexander Kiselev), g4e (Yulia Furletova et al.), Geant4 in fun4all

EIC Software Meeting

Andrea Bressan (INFN, University of Trieste)
Markus Diefenthaler (EIC^2, Jefferson Lab)
Torre Wenaus (Brookhaven Lab)
eicug-software@eicug.org

Agenda

- **Common Geant4 infrastructure**
  - How do we ensure updates of the current accelerator and detector concepts?
  - Technical Forum at 4:00 p.m.
- **What will be software we will present at the 2-day kick-off meeting?**
  - What are our goals for EPIC? Eic-smear etc.?
  - How do we share responsibility?
  - What support will be able to provide?
- **AOB**

Jefferson Lab