

Why we urgently need a

- **common (EIC-wide)**
- **easy to use***
- **capable**

detector simulation software

EIC Software Meeting on Detector and
Physics Simulations

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

EIC Detector R&D Program

- Started 2011 BNL, in association with JLab and the DOE Office of NP
- Funded on the level of \$1M/year
- Typical 10-11 projects supported per FY
- Bigger consortia for Calorimetry, Tracking, PID
- 187 participants from 46 institutions (13 non-US)

Although initially called *generic* R&D the pressure is on and the program has to become more targeted and focussing on the most urgent needs. With CD-0 in sight and DOE having an aggressive CD schedule in mind there's not much time to lose.

Detector R&D and Simulations (Case 1)

- For almost all proposed detector R&D the **Committee has and does request extensive simulations showing the concept is sound** before substantial money is released for hardware/prototyping/test beams etc.
 - ▶ Geant simulations are mature and sophisticated enough to allow one to test the validity of the proposed concept and establish the detector performance to good accuracy
 - ▶ In most cases **only GEANT** simulations are needed
 - no need for sophisticated framework
 - no need for elaborate tracking software
 - ▶ The key issue in all cases is the **detector description**
 - geometry
 - materials

Detector R&D and Simulations (Case 2)

- Optimization
 - ▶ No detector concept is perfect from the start
 - ▶ Multi-parameter problems
 - ◎ Example Si-vertex detectors: # disks/layers, position of disks/layers, pixel size etc.
 - ◎ Tracking/RICH: composition of gases, voltages, readout layers (GEM), etc
 - ▶ It is impossible to build and test prototypes for all possible configurations - phase space is too big. Often simulations are the only way to find the right parameter set
- Simulations are mandatory here

Need for Simulations

- In June 2016 a “computing” proposal was submitted

Generic R&D Proposal submitted on June 15th 2016 for FY17:

Developing Analysis Tools and Techniques for the EIC

Proponents: Whitney Armstrong (ANL), Elke-Caroline Aschenauer (BNL), Franco Bradamante (INFN Trieste), Andrea Bressan (INFN Trieste), Andrea Dotti (SLAC), Sergei Chekanov (ANL), **Markus Diefenthaler (Jefferson Lab, co-PI)**, **Alexander Kiselev (BNL, co-PI)**, Anna Martin (INFN Trieste), Christopher Pinkenburg (BNL), Stefan Prestel (SLAC)

Contact: Markus Diefenthaler (mdiefent@jlab.org)

- ▶ The Committee did not like the idea of “analysis tools” at that early stage but realized the urgent need for a comprehensive common simulation package and used the opportunity ...

Ups and Downs

Committee Report July 2016:

“[...] The consortium also proposes to work towards a common geometry and detector interface and a unified track reconstruction. [...] All tools would be organized within a software repositories dedicated to the EIC that would be embedded in an EIC-wide community website. [...]

The committee recommends that it be funded in full. [...]”

Committee Report January 2019:

*“The feedback from the user community indicates **that there is a keen desire to have access to reliable and easy simulation and reconstruction frameworks**. It seems that there remains a threshold for users to quickly engage in Monte Carlo simulations to carry out an end-to-end evaluation of various detector designs and study the EIC physics performance for different detector configurations.[...]*

*The effort on providing **common interfaces** is strongly supported”*

⇒ We are not there yet

Why “common” is important

- Example 1
 - ▶ eRD16 & 18 are optimizing Si-vertex barrel and forward tracker in MC simulation based on EicRoot based on the “BNL detector” design
 - ▶ It will be quite an effort to even test if the optimized geometry even fits in the “JLab detector design”
- Example 2
 - ▶ The inverse case is the forward GEM-based TRD R&D project by eRD22
 - ▶ How much effort would it take eRD22 to move all simulations to the “BNL setup” (EicRoot)?

Why “easy accessible and usable”?

- Many R&D groups are also involved in other projects that have a mature simulation setup (e.g. CMS, PANDA, COMPASS)
- If the EIC does not provide a common and easy simulation setup the chances are high groups will either use what they are used to or even go to vanilla Geant4
- This makes the situation even worse
- Note that other groups (e.g. ILC) have solved this successfully. Changing one detector to another is simply a matter of one switch. This makes it easy for groups working on certain sub-detectors to see how it fits and performs in whatever setup is available

Keep Context in Mind

- Users within the R&D community are **not** looking for a full flashed-out framework at this time
- 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
- It is understood that a complete geometry/material package has to fulfill many tasks: simulations, reconstruction, all with condition DB interface, but this is something the collaborations will have to work out later. If the EIC User Group finds a workable solution now, chances are high that it will be picked up by the actual collaborations later.