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 focusing 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.
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)]

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- 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 …
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 that 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.