



# ECCE Software

Joe Osborn  
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**Brookhaven**<sup>™</sup>  
National Laboratory

# ECCE Core Computing Team



- Cameron Dean (LANL) - Simulations
- Jin Huang (BNL) - Simulations
- Cristiano Fanelli (MIT) - AI and ML
- William Phelps (CNU/JLab) - AI and ML
- David Lawrence (JLab) - Computing and Software
- Joe Osborn - Computing and Software
- Christoph Paus (MIT) - Computing and Software
- More welcome! Please contact us for more information and to join the effort

## Computing Team

Cristiano Fanelli (MIT)  
David Lawrence (JLab)

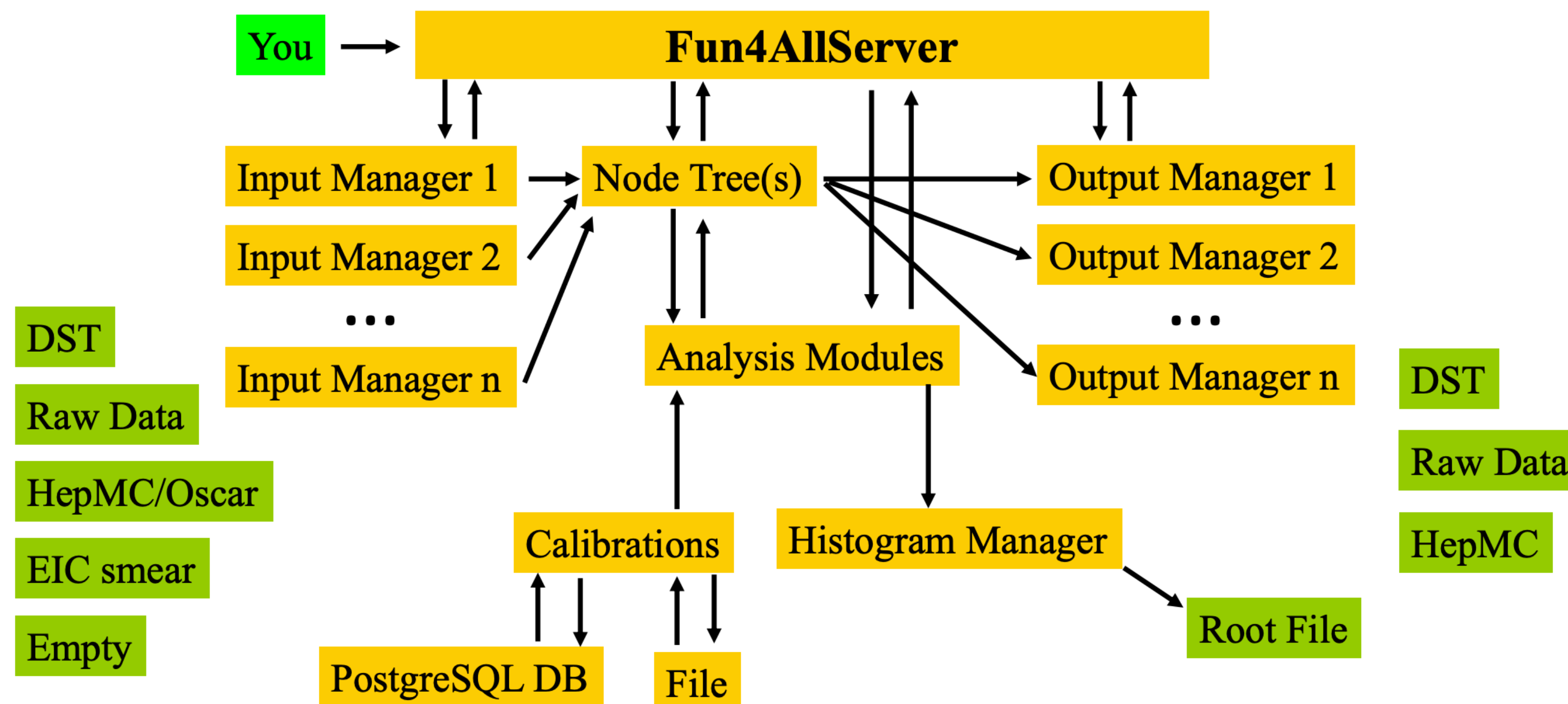
## Computing Working Groups:

- Artificial Intelligence  
William Phelps (CNU/JLab)
- Computing and Software  
Joe Osborn (ORNL)

## Physics Working Groups:

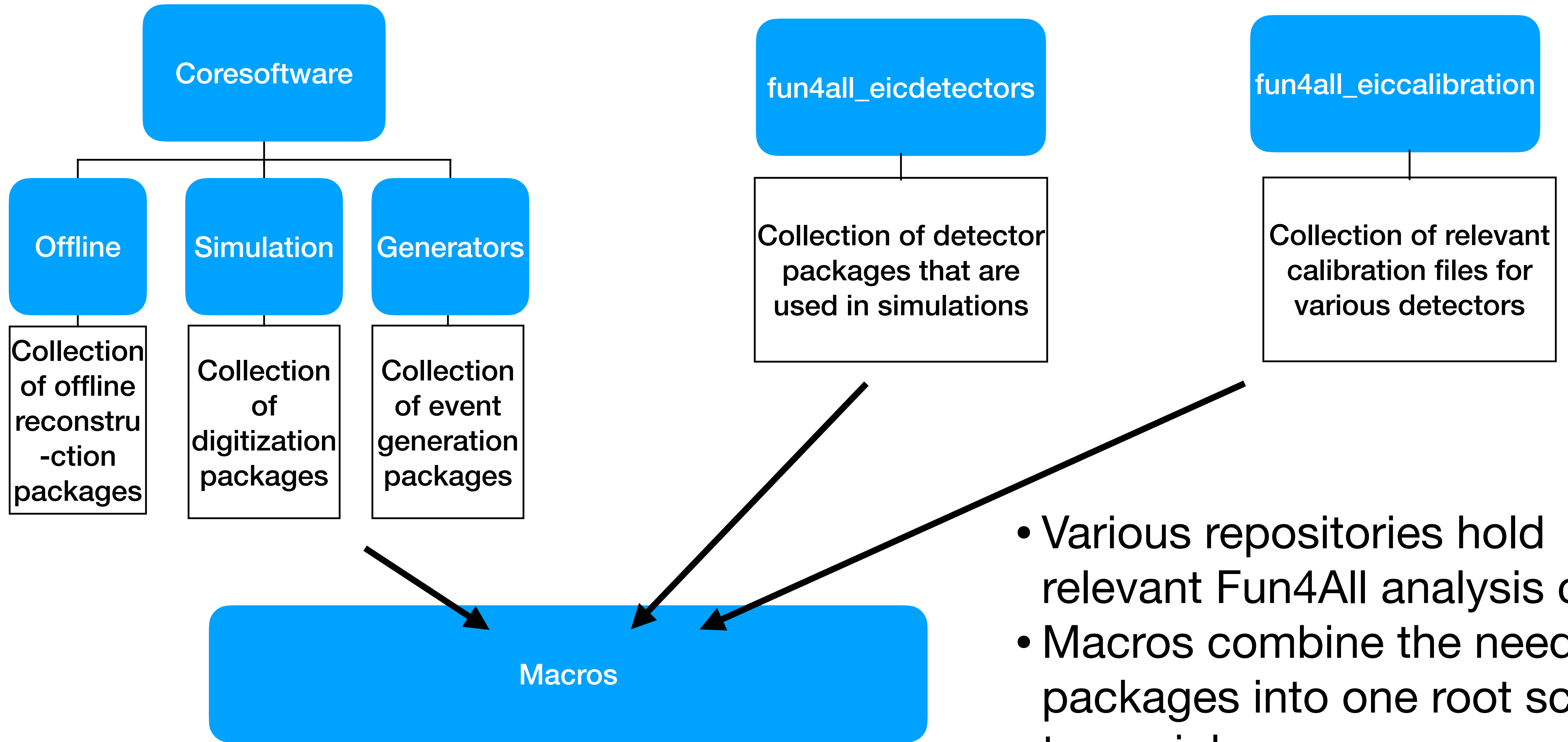
- Simulations  
Cameron Dean (LANL), Jin Huang (BNL)

# ECCE Software



- Working in the Fun4All framework
  - Modular, adaptable event processing framework developed and used with PHENIX for ~20 years
- Code available on [Github](#) - utilize daily, weekly builds and tagged production releases

# Software Framework



- Various repositories hold relevant Fun4All analysis code
- Macros combine the needed packages into one root script to run job



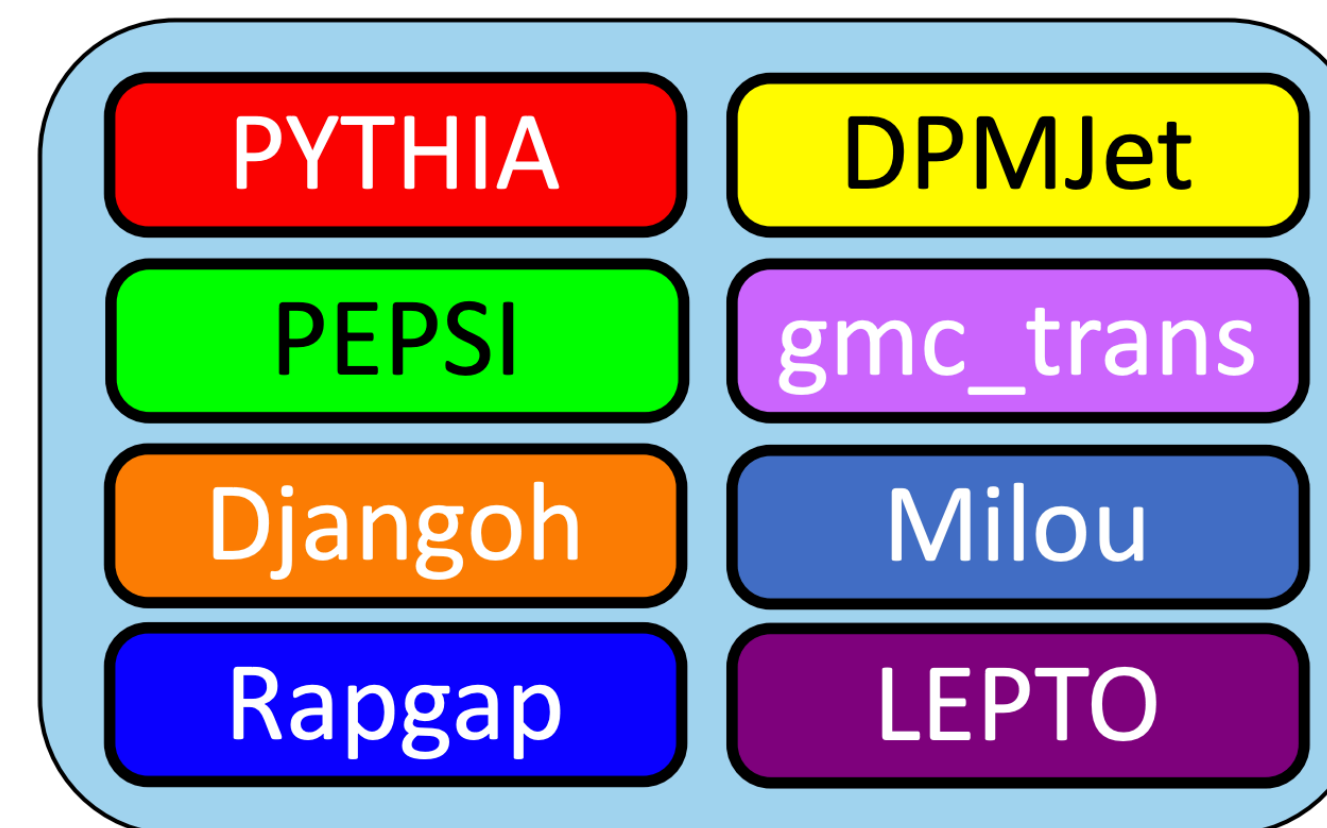
# Macros

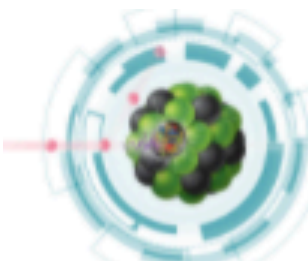
- Default macro can run a wide variety of event generators, detector configurations, etc.
- Can pick and choose what to run for your needs - just create the relevant module and register it with Fun4All
- Example - add a clustering algorithm for the EEMC

```
RawClusterBuilderTemplate *ClusterBuilder = new RawClusterBuilderTemplate("EEMCRawClusterBuilderTemplate");  
  
ClusterBuilder->Detector("EEMC");  
ClusterBuilder->Verbosity(verbosity);  
se->registerSubsystem(ClusterBuilder);
```

# Available Tools

- Wide range of event generators through EIC-smear interface and Fun4All
  - HIJING, PYTHIA, Sartre, single particle...
- Dedicated detector geometry examples
- Available analysis modules
  - Event evaluator, Track/Cluster evaluator....
- All documented through [Doxygen](#) and [Github](#)



 **ECCE @ EIC Software**  
Reference for ECCE @ EIC simulation and reconstruction software on GitHub

Home page	Related Pages	Modules	Namespaces	Classes	Files	External L
File List		File Members				
		▶ CaloTruthEval.h				
		EventEvaluator.cc				
		▶ EventEvaluator.h				
		JetEvalStack.cc				
		▶ JetEvalStack.h				
		JetEvaluator.cc				
		▶ JetEvaluator.h				
		JetRecoEval.cc				
		▶ JetRecoEval.h				
		JetTruthEval.cc				
		▶ JetTruthEval.h				

```

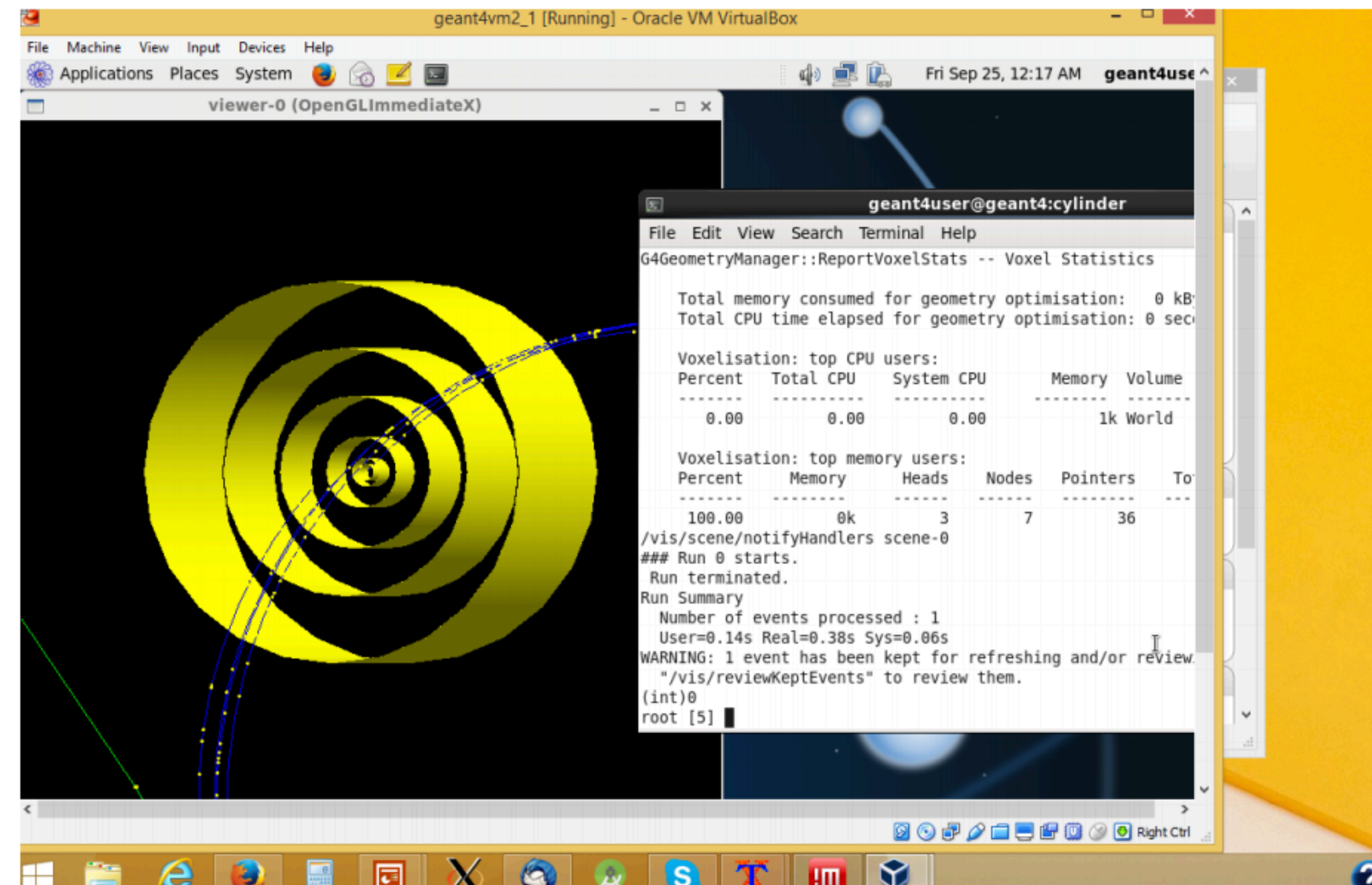
1193     if (_do_TRACKS)
1194     {
1195         _nTracks = 0;
1196         _nProjections = 0;
1197         // Loop over track maps, identify each
1198         // Although this configuration is fixed
1199         // It will only store them if they're a
1200         std::vector<std::pair<std::string, Track
1201             {"TrackMap", TrackSource_t::all},
1202             {"TrackMapInner", TrackSource_t::in
1203         bool foundAtLeastOneTrackSource = false;
1204         for (const auto& trackMapInfo : trackMap
1205         {
1206             SvtxTrackMap* trackmap = findNode::get
1207             if (trackmap)
1208             {
1209                 foundAtLeastOneTrackSource = true;
1210                 int nTracksInASource = 0;
1211                 if (Verbosity() > 0)

```



# ECCE Containers

- Distribute Singularity container nightly for software access anywhere, no account required
- Containers are used to run jobs on the Open Science Grid, your home computer, HPC (e.g. CADES at ORNL)
- Install virtualbox and you can be up and running, [tutorials](#) and instructions available

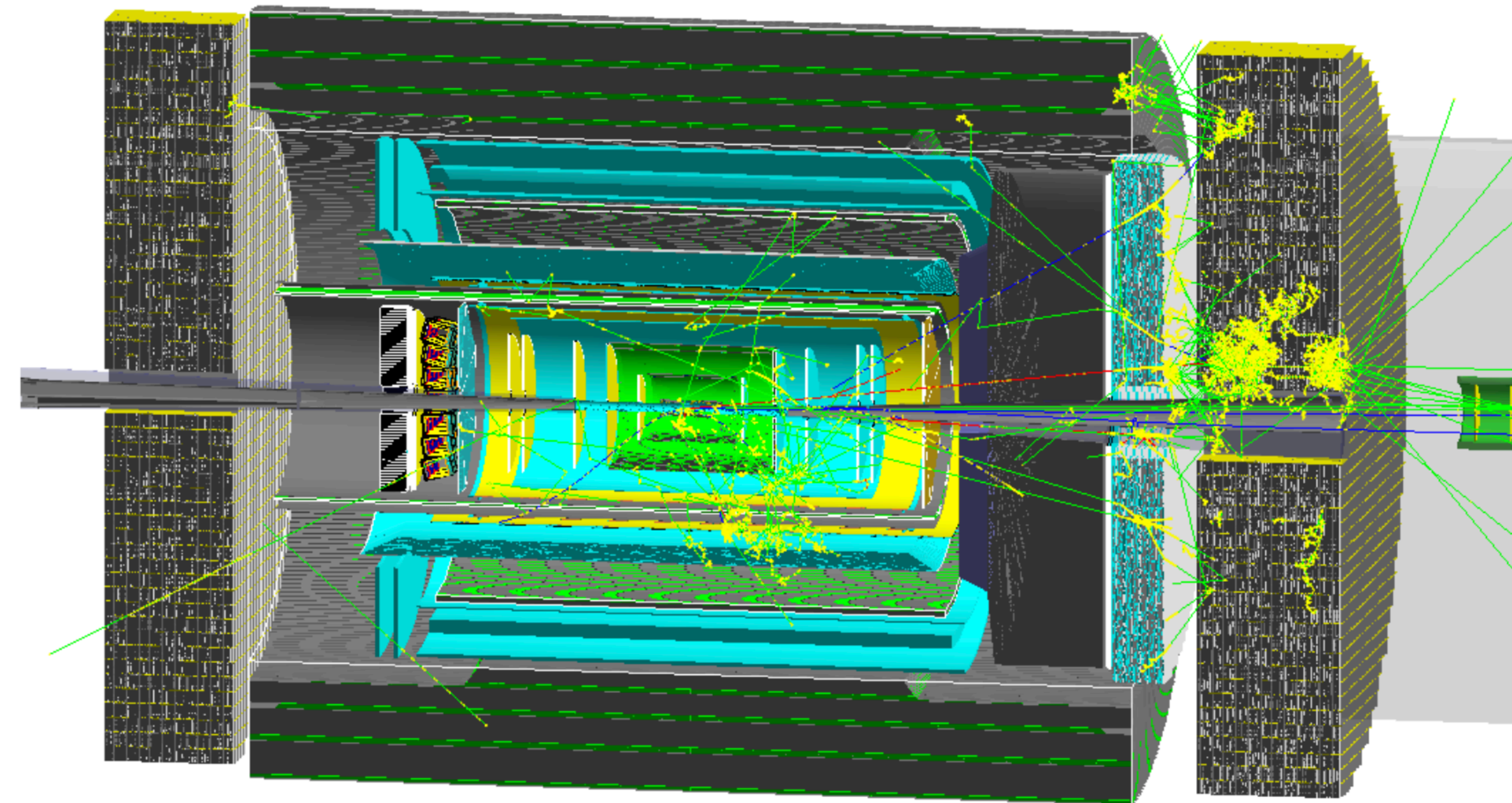




# ECCE Detector Geometry



- ECCE “June 2021” concept detector geometry fully implemented into Geant4
- Changes for second and final simulation campaign ongoing (“July 2021” concept)
- Detectors can be easily added/removed/tested within the Fun4All framework





# Data Distribution

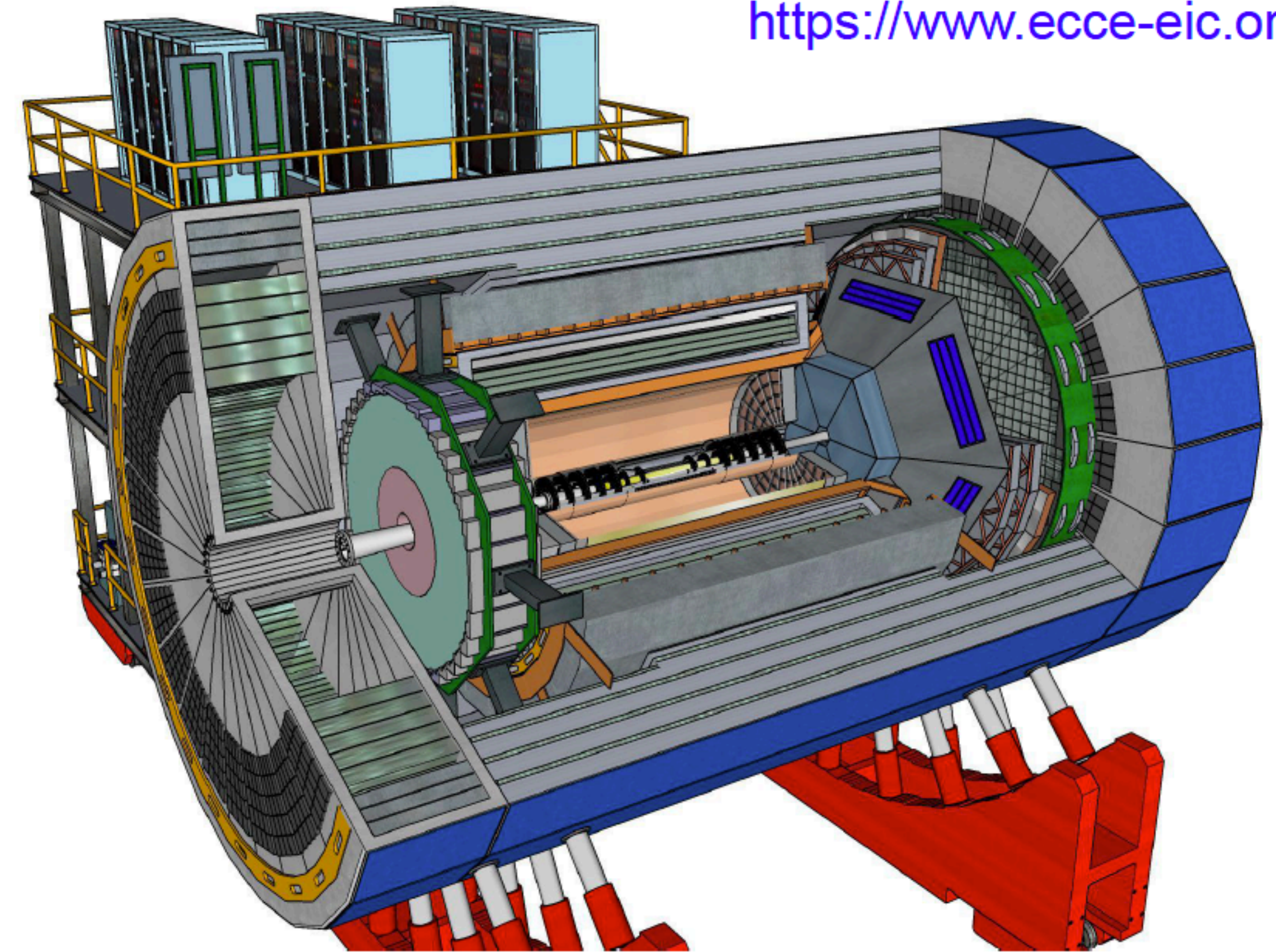
- First simulation campaign with June 2021 concept almost finished
  - ~150M events on disk, ready to analyze
- Data is distributed through S3 at BNL and XRootD at JLab
- No account needed, can run terminal commands to download data (e.g. ntuples, please ask us about DSTs) directly to your computer
- [Wiki](#) page has information about how to access data and what production data is already available.
- [Tutorial](#) available to start from scratch to analysis in ~20 minutes



# Machine Learning and AI

- Dedicated ML/AI working group within ECCE that is highly active
- Detector design with AI/ML
  - Tracking detectors
  - DIRC for PID
  - Calorimetry with e.g. clustering
- Ongoing developments with
  - e.g. track finding, pattern recognition

<https://www.ecce-eic.org>



See dedicated ML/AI talks this week for more information



# Workshops, Tutorials, Documentation

- Three simulation [workshops](#) with many recorded tutorials
  - Analysis modules, accessing data, building a detector...
- Other tutorials and documentation available on our [website](#) and GitHub [repository](#)
- Weekly office hours with computing experts for additional help, see e.g. [here](#)
- Mattermost and Discourse channels available for discussion with developers and other users



# Conclusions

- ECCE software stack has many available tools ready to use for Monte Carlo generation, full simulation, and analysis
- ~150M events from first ECCE simulation campaign are available for analysis, in both DST and final ntuple analysis format
- Tutorials, recorded workshops, and documentation available to help you get started. Containerization allows for deployment of software on any computer
- Please let computing team know if you have questions! Available on email, mattermost, [discourse](#), etc. Please contact me or others for more info