

Tracking Status in Fun4All

Joe Osborn
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Running Simulations

- Can run simulations either via a BNL account or with Singularity on your local computer
- Jobs are run as ROOT macros
- Detector specifications steered by relevant macro (e.g. Barrel, FST, track reconstruction)
- See e.g. last tracking meeting which contained a presentation of optimization studies in Fun4All: <https://indico.bnl.gov/event/15659/>
- Many workshops/resources online for help. See e.g.:
 - <https://indico.bnl.gov/event/11112/>
 - <https://indico.bnl.gov/event/7254/>
 - <https://ecce-eic.github.io/>

Running Simulations

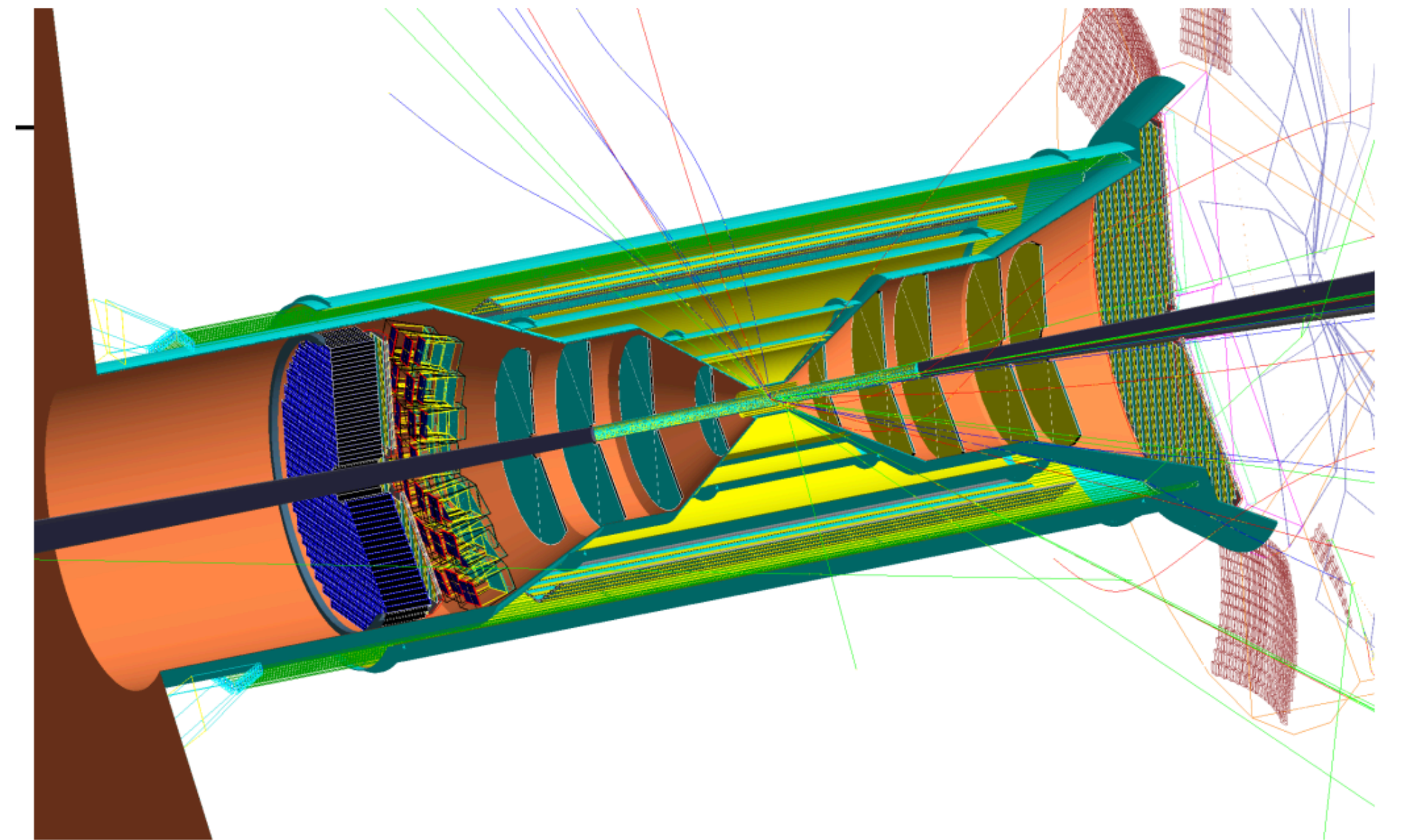
- With a BNL account:
 - Suggest using NoMachine to get an already setup VM to use:
<https://www.sdcc.bnl.gov/information/services/how-use-nx-sdcc>
- On singularity or with a local VM
 - See <https://github.com/eic/Singularity>
 - Or/and <https://github.com/eic/Singularity/blob/master/VirtualBox.md>
- Contact Jin Huang or myself for help with troubleshooting

Office Hours

- Office hours exist for both Fun4All and DD4Hep stacks
- See here for a schedule:
<https://indico.bnl.gov/category/416/>
- OH will allow you to get dedicated time with the software experts to help solve whatever you are stuck on. Bring any question!
- No question/problem is worth being unnecessarily stuck on for a long period of time

Geometry

- Baseline tracking in ECCE proposal implemented in Fun4All geometry
- Consists of:
 - 5 MAPS based silicon layers (3 vertex, 2 sagitta)
 - 5 (4) forward (backward) silicon disks
 - 3 barrel microRWell layers
 - 1 AC-LGAD TOF layer



Fun4All Macros

- Main Fun4All macro which steers a job:
https://github.com/ECCE-EIC/macros/blob/master/detectors/EICDetector/Fun4All_G4_EICDetector.C
- Tracking macros that determine detector configuration:
e.g. https://github.com/ECCE-EIC/macros/blob/master/common/G4_Barrel_EIC.C
- Contains the “instructions” which calls the source code to do something

Fun4All Macros

- Main Fun4All macro which steers a job:
https://github.com/ECCE-EIC/macros/blob/master/detectors/EICDetector/Fun4All_G4_EICDetector.C
 - Event generation
 - Detector simulation
 - Reconstruction
- The main steering macro can be intimidating at first, but each “instruction” is just controlled by a true/false flag

```
// Use Pythia 8
// Input::PYTHIA8 = true;

// Use Pythia 6
// Input::PYTHIA6 = true;

// Use Sartre
// Input::SARTRE = true;

// Simple multi particle generator in eta/phi/pt ranges
Input::SIMPLE = true;
// Input::SIMPLE_NUMBER = 2; // if you need 2 of them
// Input::SIMPLE_VERBOSITY = 1;

// Particle gun (same particles in always the same direction)
// Input::GUN = true;
// Input::GUN_NUMBER = 3; // if you need 3 of them
// Input::GUN_VERBOSITY = 0;
```


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```
Enable::RWELL = true;
// barrel tracker
Enable::TrackingService = true;
// Enable::TrackingService_VERBOSITY = INT_MAX - 10;
Enable::BARREL = true;
// fst
Enable::FST = true;

//AC-LGAD TOFs
Enable::FTTL = true;
Enable::ETTL = true;
Enable::CTTL = true;

//mRPC TOFs
Enable::BTOF = false;
Enable::ETOOF = false;
Enable::HTOF = false;
Enable::ETOOF_GAS = Enable::ETOOF && true;
Enable::HTOF_GAS = Enable::HTOF && true;
```


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```
if (Enable::TRACKING) Tracking_Reco();  
  
if (Enable::DIRC_REC0) DIRCReco();  
  
if (Enable::mRICH_REC0 ) mRICHReco();  
  
if (Enable::RICH_REC0) RICHReco();
```

Track Reconstruction

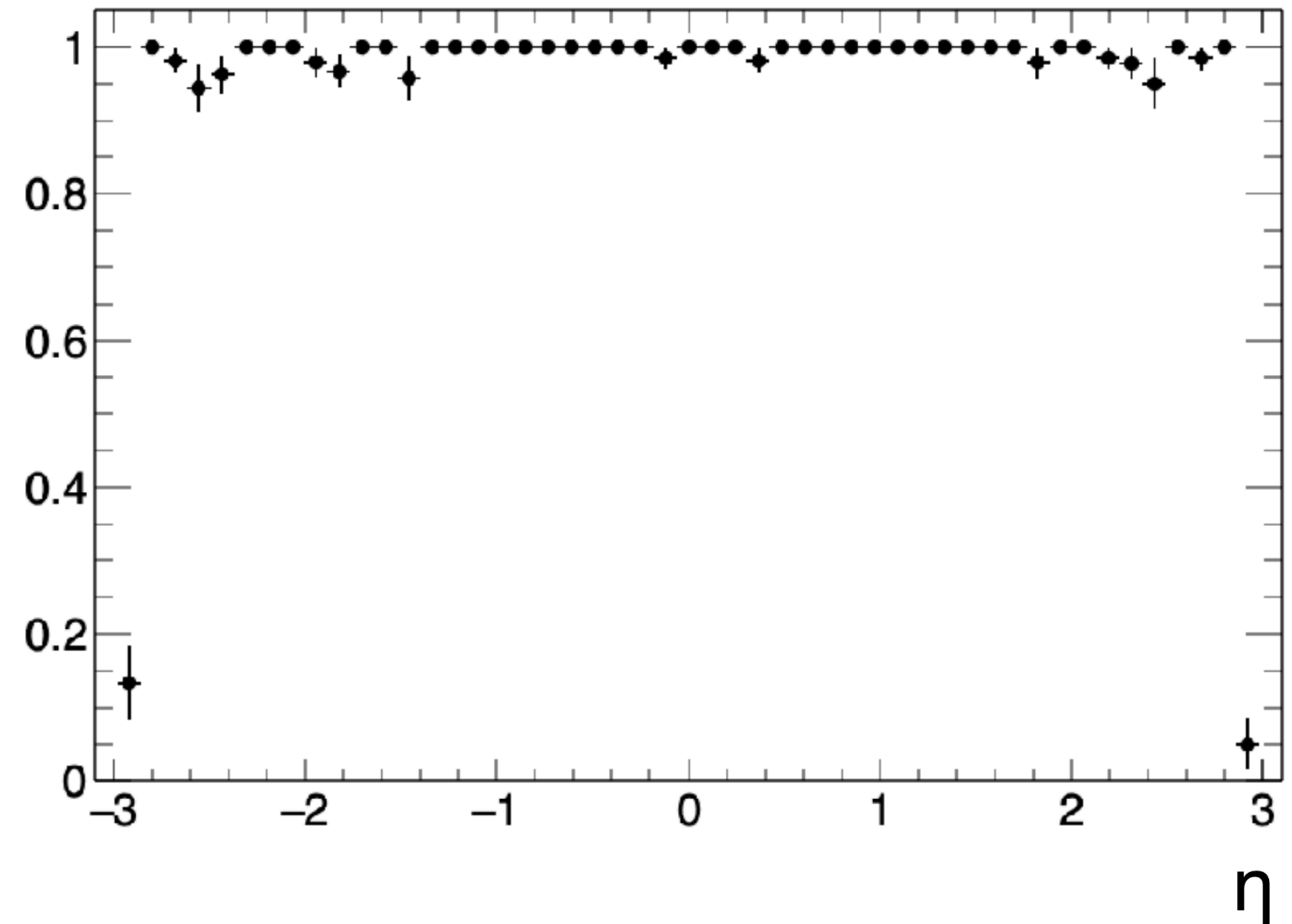
- Track reconstruction is currently performed with truth seeding
- Take truth hits, smear them based on position resolution
- Fit track with Genfit track fitter, which uses Geant material description
- Fun4All spent a considerable amount of time implementing Genfit and, as ACTS development continued, switched to ACTS for computational speed and reliability in sPHENIX

Track Reconstruction

- For sPHENIX, a lot of development work has gone into integrating A Common Tracking Software (ACTS) into the software framework
 - See CSBS 5, 23 (2021) or [2103.06703](#)
 - Will use several ACTS tools for the first time in production - beta testing
 - e.g. fitting, seeding, propagation, amongst other ACTS tools explored
- ACTS tools available within generic Fun4All for development

Seeding

- Very preliminary studies performed by Sebastian Tapia (ISU) and myself with ACTS seeder
- No time to optimize/tune etc. but got a very preliminary version running that produced seeds that could be matched to truth tracks in single particles



Track Reconstruction

- Have a well developed truth evaluation chain that allows benchmarking reconstruction methods with corresponding truth methods in Fun4All
 - e.g. truth seeding, truth track association, etc.
- Integrated KFParticle for heavy flavor and secondary resonance decay reconstruction into framework
- Integrated vertexing packages e.g. RAVE, ACTS, and an in house written simple vertex finder
- Other reco tools available, e.g. track->calo projections

Conclusions

- Tracking geometry implemented in Fun4All and geometry parameters can be changed at the macro level - no compilation necessary
- Simulations can be run anywhere with Singularity container
- My personal opinion - we will use ACTS moving forward for reconstruction. We have already developed expertise in the community and should continue to do so in any framework
- Come to office hours if you are stuck with something (for Fun4All or DD4Hep stack!)