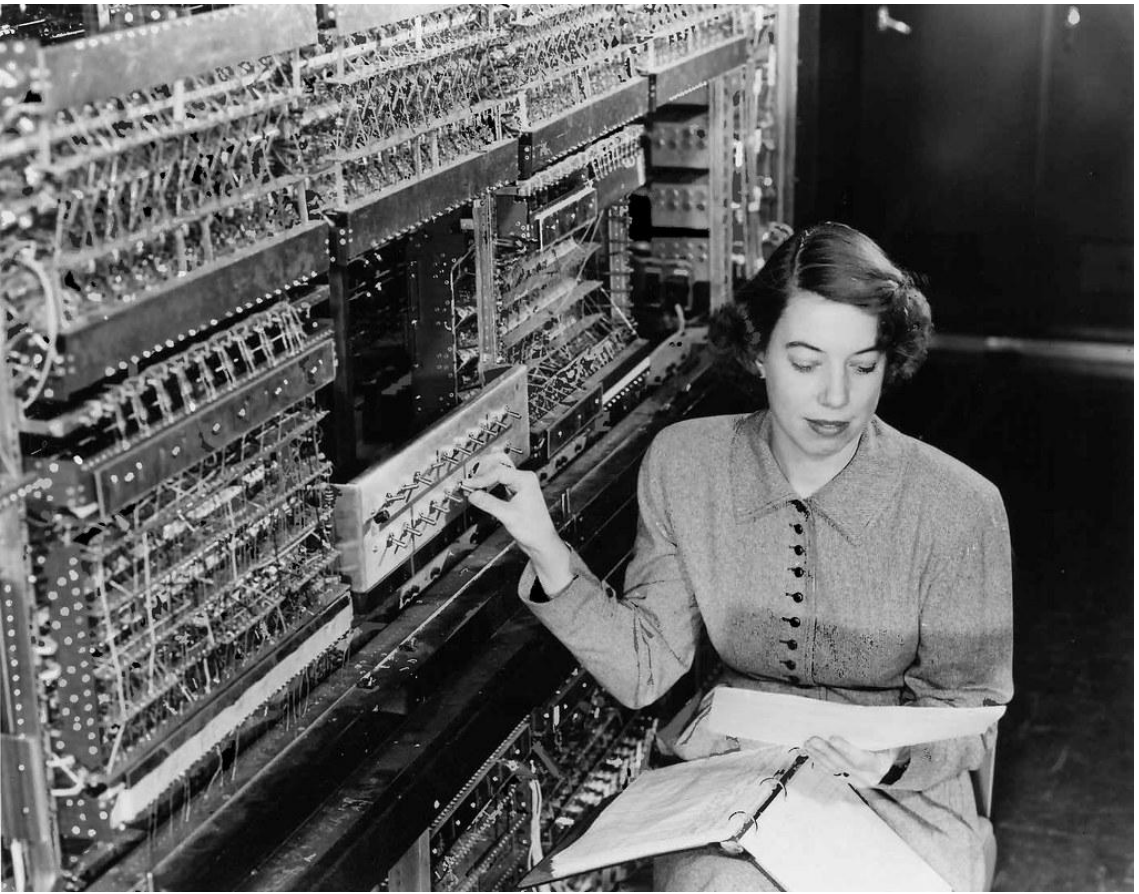


ATHENA

Simulation Status

Bi-weekly Collaboration Meeting,
Thursday 2021-09-02

The Software and Computing WG Conveners:
Andrea Bressan (University of Trieste and INFN) ,
Dmitry Romanov (Jefferson lab) ,
Sylvester Joosten (Argonne National Laboratory) ,
Whitney Armstrong (Argonne National Laboratory) ,
Wouter Deconinck (The University of Manitoba)

Full Simulation Production Status

Since last meeting:

- eSTARlight input file generator status fixed
- Reduced reconstructed output size
- Also copying full simulations to S3 (with hits)

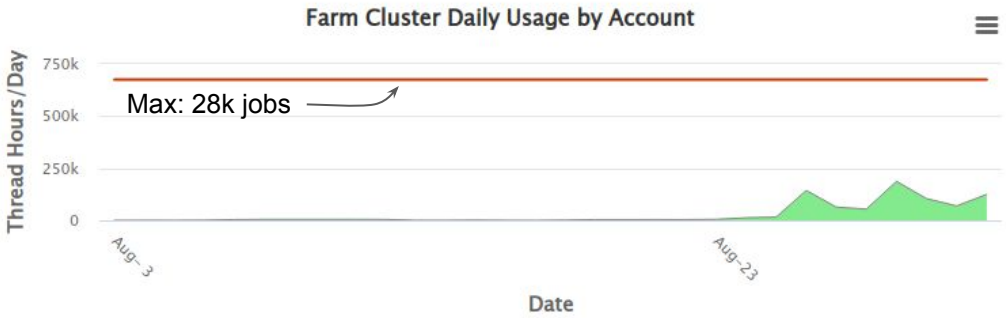
Current dev focus: debugging and resiliency

- Debugging:
  - G4Cerenkov track splitting
  - Include RICH materials in ACTS
  - Event weights and “A” records
- Resiliency: Automatic flagging/resubmit
  - Timeouts on stuck tracks (MRICH)
  - Automatic timing estimates in CI
- Efficiency: Multithreaded simulations
  - Memory use now > 2 GB / core which leaves cores budgeted at 2 GB unused

Questions? → #software-helpdesk

Data on S3 and XRootD (synced upon generation):

- https://dtn01.sdcc.bnl.gov:9000/~~minio~~/eictest/ATHENA/RECO
- `mc mirror S3/eictest/ATHENA/RECO RECO`
- `TFile::Open(“s3https://dtn01.sdcc.bnl.gov:9000/eictest/ATHENA/RECO”)`
- `TFile::Open(“root://sci-xrootd.jlab.org//osgpool/eic/ATHENA/RECO/…”)` (do not use the /osgpool directory directly)
- Geometries: master, acadia-v1.0-alpha



Geometry Update

Geometry versions

Acadia-v1.0-alpha

- This is the tag in all the simulations up to now
- Mostly N0.0-B0.0-P0.0 central detector configuration
  - ❌ Misses proper ScFi calorimeter in positive endcap
  - ❌ Not enough space between RICH and solenoid
  - ❌ Barrel geometry not fully optimized for acceptance
  - ❌ Material stand-in for DIRC, ❌ does not match BECAL
- IP version 0.4.0
  - ❌ FF transport not yet validated

Acadia-v1.0

- Upcoming tag for next round
- Very close to N0.0-B0.0-P0.0 central detector configuration
  - 🚧 Add ScFi in positive endcap
  - ❌ Not enough space between RICH and solenoid
  - ✅ Better barrel geometry
  - ❌ Material stand-in for DIRC, ✅ matches BECAL
- Next IP version (will be 0.5.0)
  - ✅ Validated (usable!) FF region

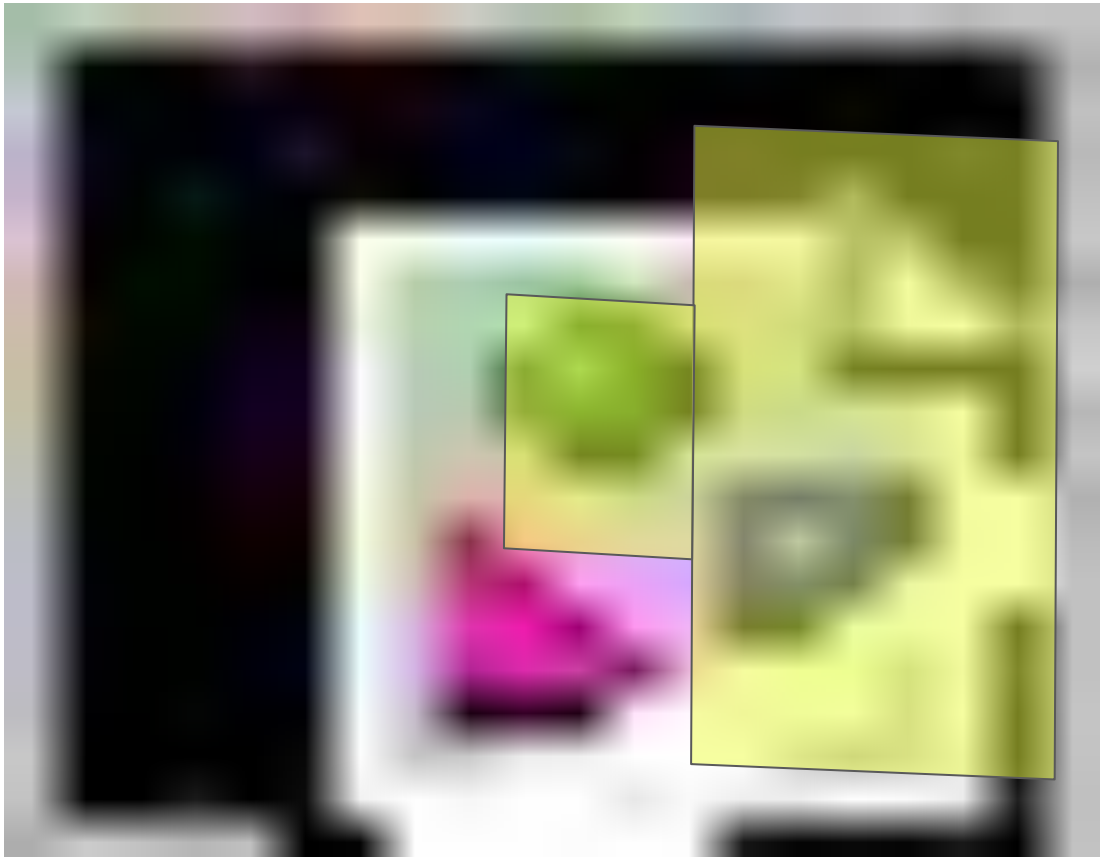
BigBend-v1.0

- Baseline+ configuration (work ongoing)
- Implements N1.0-B1.0-P1.0
  - 🚧 Different (hybrid) central tracking setup
  - 🚧 Different imaging layer setup in BECAL
  - 🚧 Shorter RICH snout
  - ❌ Still not enough space between RICH and solenoid!
- Same IP version as Acadia-v1.0

Acadia-v1.0 (N0.0-B0.0-P0.0)

Central tracking (negative half) 0cm to -137cm (Δ: 137 cm) rmin: beampipe, rmax: 95cm
Backward PID: -137 to -177cm (Δ: 40cm) rmin: beampipe, rmax: 95cm
Backward tracking -177cm to -185cm (Δ: 8cm) rmin: beampipe, rmax: 95cm
Backward ECAL -185cm to -245cm (Δ: 60cm) (40cm glass blocks + 20cm for readout) rmin: beampipe, rmax: 95cm
Empty space -245m to -285cm (Δ: 40cm) 30cm for DIRC expansion 10cm service gap
HCAL -285cm to -390cm (Δ: 105cm) (60cm more available in negative direction)

Acadia-v1.0 (N0.0-B0.0-P0.0)



Central tracking (positive half) 0cm to 155cm (Δ: 155 cm) rmin: beampipe, rmax: 95cm
Forward PID: 155cm to 335cm (Δ: 180cm) vessel: rmin: beampipe, rmax 200cm snout: rmin: bmpp, rmax 92.5 → 122.5cm Snout length: 50cm. **13cm gap between vessel and solenoid cryostat**
Forward tracking (needs more space for upgrades!): 335cm to 340cm (Δ: 5cm) rmin: beampipe, rmax: dRICH rmax
Empty space 10cm service gap
Forward ECAL 350cm to 380cm (Δ: 30cm) rmin: beampipe, rmax: solenoid rmax
HCAL 380cm to 500m (Δ: 120cm)

Acadia-v1.0 (N0.0-B0.0-P0.0)

Central tracking
-137cm to 155cm (Δ: 155 cm)
rmin: beampipe, rmax: 95cm
(same radial parameters for backward region)

Barrel PID (DIRC, 16 sectors):
-275cm to -155cm (Δ: 430cm)
rmin: 95cm, rmax 103cm (Δr: 8cm)
space for expansion volume behind BECAL
Space for 10cm service gap in front of HCAL

Barrel ECAL (including support)
-245cm to -159cm (Δ: 404cm)
rmin: 112cm, rmax: 159cm (Δr: 47cm)

Solenoid
-192 to 192cm (Δ: 384cm)
rmin: 160cm, rmax: 224cm (Δr: 64cm)

Barrel HCAL
-224cm to 324cm (Δr: 100cm)

Reconstruction Update

Reconstruction Status

✅ **Calorimetry**
- ✅ Algorithms
  - ✅ Simple Clustering, Island Clustering (2D), 2+1D Clustering, Topological Clustering (3D)
  - ✅ Hybrid cluster merging
- ✅ Clustering benchmarks

🚧 **PID**
- 🚧 Algorithms
  - ✅ Fuzzy-K ring clustering
  - 🚧 MRICH, DIRC, DRICH reconstruction
  - ✅ Truth PID
- ❌ PID benchmarks

🚧 **Far Forward & Far Backward**
- ❌ Integrate B0 with tracker, low Q2 tagger
- 🚧 Matrix transform for Roman Pot & OMD
- ✅ Simple FastMC reconstruction for FF
- 🚧 Use registered hits for FastMC

🚧 **Tracking**
- 🚧 Algorithms
  - ✅ Decent performance in barrel region
  - 🚧 Improve tracking efficiency in endcaps
  - 🚧 Tracking benchmarks
  - 🚧 Incorporate B0 in ACTS
  - ❌ Setup realistic vertex reconstruction
- 🚧 Tracking Benchmarks
  - ✅ Basic benchmarks working
  - ❌ Tracking with realistic background

🚧 **Global**
- Event builder (produces ReconstructedParticle)
  - ✅ Dummy event builder to test reco chain
  - ✅ Simple tracking + truth PID event builder
  - 🚧 Fast parametrized reconstruction for missing algorithms (e.g. dRICH) based on registered hits.
- ✅ Stable data model
- ✅ Cleanup/consolidate reconstruction flow

Ways to get involved/incomplete task list

Reconstruction (C++, Gaudi, ACTS, Python)

- Simple electron PID (medium/expert)
- Advanced electron PID (expert)
- Jet reconstruction (expert)
- Event subcomponent matching (medium/expert)
- RICH reconstruction (medium/expert)
- MRICH reconstruction (medium/expert)
- DIRC reconstruction (medium/expert)
- Holistic calorimeter reconstruction (expert)
- Track propagation and simple vertexing (medium/expert)
- Vertexing (medium/expert)
- Optimize tracking (medium/expert)
- Kinematic reconstruction (easy/medium)
- Far-forward reconstruction (easy/medium)
- Far-backward reconstruction (easy/medium)
- ML-accelerated algorithms (medium/expert)

Reconstruction Benchmarks (ROOT, Python, ...)

- Validate/optimize digitization algorithms (easy)
- Clustering performance (medium)
- Subsystem performance (easy/medium)
- Overall reconstruction performance (medium)
- Study reconstructed acceptance (easy)

Geometry/full simulation (XML, C++, DD4hep, GEANT)

- Detector color scheme (easy)
- Automatic marketing/publication figures (easy/medium)
- Optimize parametrization of subsystems (medium)
- Implement additional technology options (easy/medium/expert)
- Add extra support & service material (easy/medium)

Detector Benchmarks (ROOT, Python)

- Validate hit multiplicities in subsystems (easy)
- Energy calibrations for calorimeters (easy/medium)
- Validate optics in DRICH (medium/expert)
- Study raw acceptance (easy)
- Validate detector material budget (easy/medium)
- Render results on dashboard webpage (all benchmarks)

Physics Benchmarks (ROOT, Python)

- Integrate analyses from PWGs into CI framework (easy)
- Validation figures on kinematic variables (easy)
- Collect and integrate available event samples (easy)

Tutorials and office hours

1. Have organized dedicated tutorial/Q&A sessions aimed at various PWGs
2. **#software-helpdesk office hours every week: Mo-We-Fr at 2:00pm EDT** https://zoom.us/j/93744567735.
3. Will keep close contact with PWGs to support swift development of analyses

Documentation portal:
doc.athena-eic.org

Full simulation tutorials

eic-ip6-software-l@lists.bnl.gov
#software-helpdesk on Slack