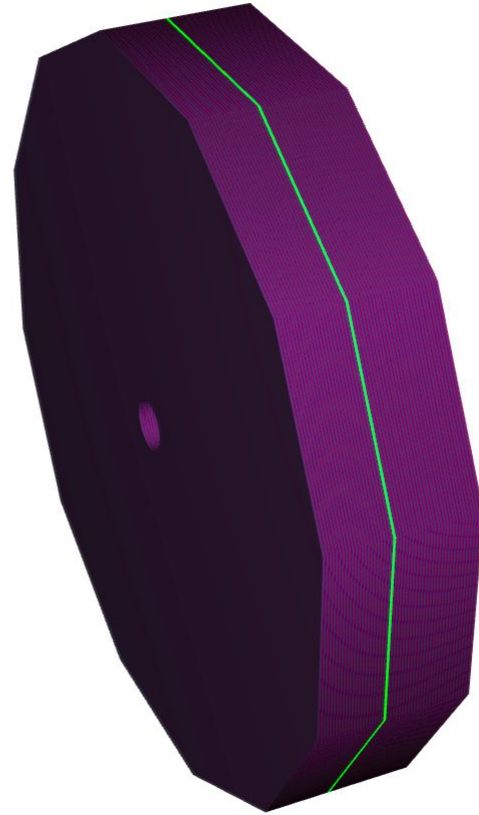


# Status of HCAL Model and reconstruction Within DD4HEP

Miguel Arratia (UCR),  
June 1st 2021



# Near-term steps:

1) **Implement Fe/Sc HCAL in DD4Hep**

2) **Test calorimetry clustering in DD4Hep**

DD4Hep has already various reconstruction algorithms, available “off the shelf”. Existing ones in DD4HEP are 2D and 3D algorithms (Island, Topological clustering) etc.

# Barrel HCAL

20 mm Fe and 5 mm plastic scintillator layers; 10x10 cm<sup>2</sup> cells

Read a ROOT file

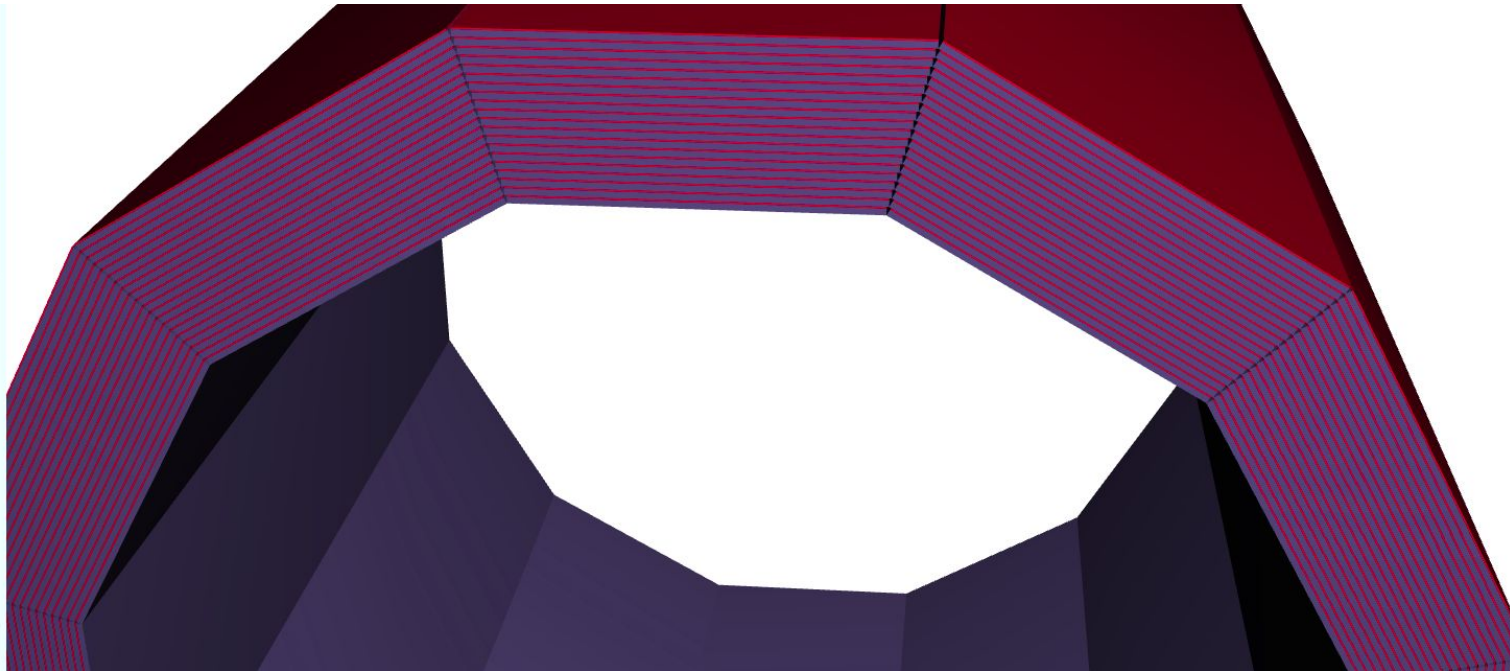
[SROOT](#) version 6.1.0 15/04/2021

detector\_geometry.root

Load  simple

[open all](#) | [close all](#) | [clear](#)

- box\_volume\_243
- box\_volume\_244
- box\_volume\_245
- box\_volume\_246
- box\_volume\_247
- box\_volume\_248
- box\_volume\_249
- ...more...
- ⊕ HcalBarrel\_27
- ⊖ HcalEndcapP\_28
  - ⊖ endcap\_0
    - ⊖ layer0\_0
      - slice1\_0
      - slice2\_1



# Forward HCAL

51 layers (6 lambda), 20 mm Fe and 3 mm plastic scintillator layers; 10x10 cm<sup>2</sup> cells

Read a ROOT file

JSROOT version 6.1.0 15/04/2021

detector\_geometry.root

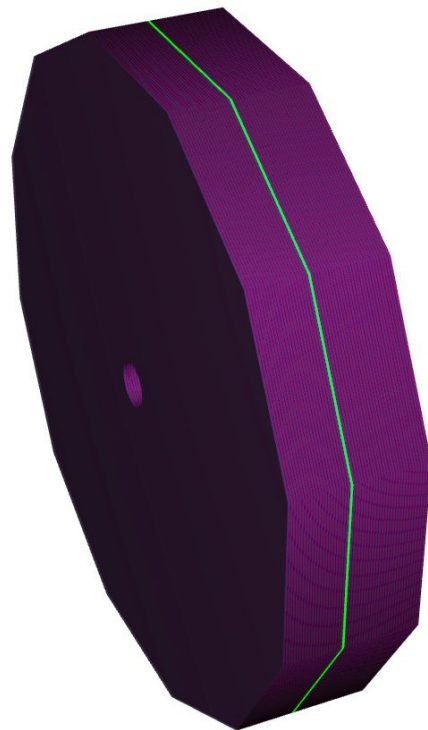
[Read docu](#) how to open files from other servers.

Load Reset simple

[open all](#) | [close all](#) | [clear](#)

- Materials
- Media
- world\_volume
  - B0PF\_BeamlineMagnet\_asser
  - B0APF\_BeamlineMagnet\_asse
  - Q1APF\_BeamlineMagnet\_ass
  - Q1BPF\_BeamlineMagnet\_ass
  - Q2PF\_BeamlineMagnet\_asser
  - B1PF\_BeamlineMagnet\_asser
  - B1APF\_BeamlineMagnet\_asse
  - B2PF\_BeamlineMagnet\_asser
  - QPFC1\_BeamlineMagnet\_ass
  - QPFC2\_BeamlineMagnet\_ass
  - QPFC3\_BeamlineMagnet\_ass
  - QPFC4\_BeamlineMagnet\_ass
  - QPFR1\_BeamlineMagnet\_ass
  - BPFR1\_BeamlineMagnet\_ass
  - QPFR2\_BeamlineMagnet\_ass
  - BeamPipe\_assembly\_15
  - SolenoidCoilBarrel\_assembly\_
  - SolenoidCoilEnds\_17
  - HcalBarrel\_18
  - HcalEndcapP\_19
    - endcap\_0
  - HcalEndcapN\_20

StreamerInfo

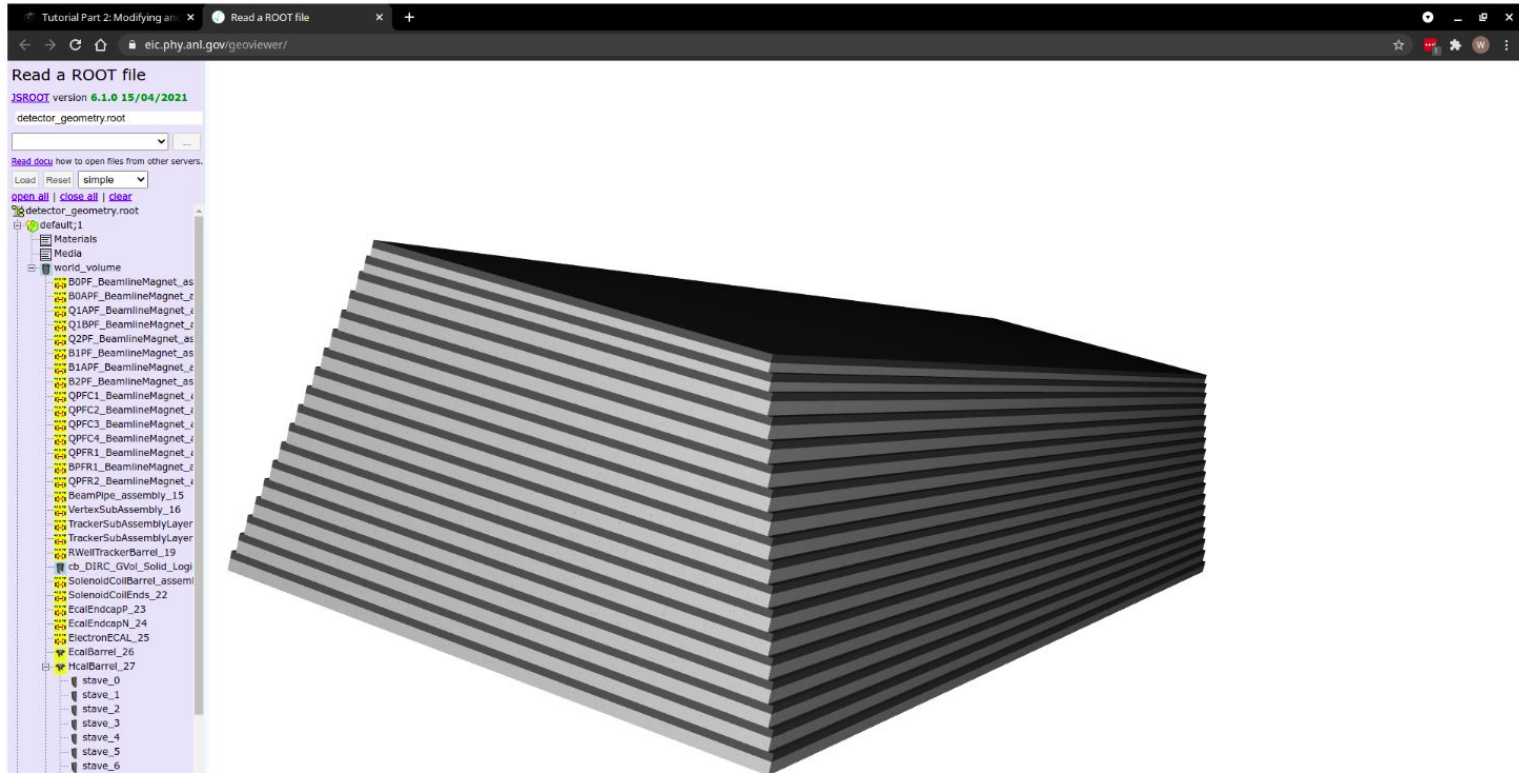


# Wouter is also implementing KLM-type HCAL for barrel: (RPC based, and/or scintillator strips)



image.png

Wouter Deconinck (he/him) May 28th at 5:47 AM



Wednesday, May 26th

# intall athena

```
git clone https://eicweb.phy.anl.gov/EIC/detectors/athena.git
cd athena
mkdir build && cd build
cmake .. -DCMAKE_INSTALL_PREFIX=../../development
make install
cd ../../
```

# intall beamline

```
git clone https://eicweb.phy.anl.gov/EIC/detectors/ip6.git
cd ip6
mkdir build && cd build
cmake .. -DCMAKE_INSTALL_PREFIX=../../development
make install
cd ../../
```

# copy beamline compact files to detector

```
cp -r ip6/ip6 athena/
```

# install juggler

```
git clone https://eicweb.phy.anl.gov/EIC/juggler.git
cd juggler/
mkdir build && cd build
cmake .. -DCMAKE_INSTALL_PREFIX=../../development -DCMAKE_CXX_STANDARD=20
make install
cd ../../
```

# set environment needed by benchmark

```
export DETECTOR_PATH=$PWD/athena
export JUGGLER_DETECTOR=athena
export JUGGLER_INSTALL_PREFIX=$PWD/development
```

# run benchmark (particle generation, simulation, reconstruction, analysis)

# comment out all the trackers in athena.xml (vertex\_tracker, central\_tracker, rwell\_tracker\_barrel) first, because the latest commit has an issue with a service in juggler due to ACTS. This will be fixed soon.

```
git clone https://eicweb.phy.anl.gov/EIC/benchmarks/reconstruction_benchmarks.git
cd reconstruction_benchmarks/
bash benchmarks/sampling_ecal/run_emcal_barrel.sh -t emcal_barrel_electrons -p "electron" -n 100
```



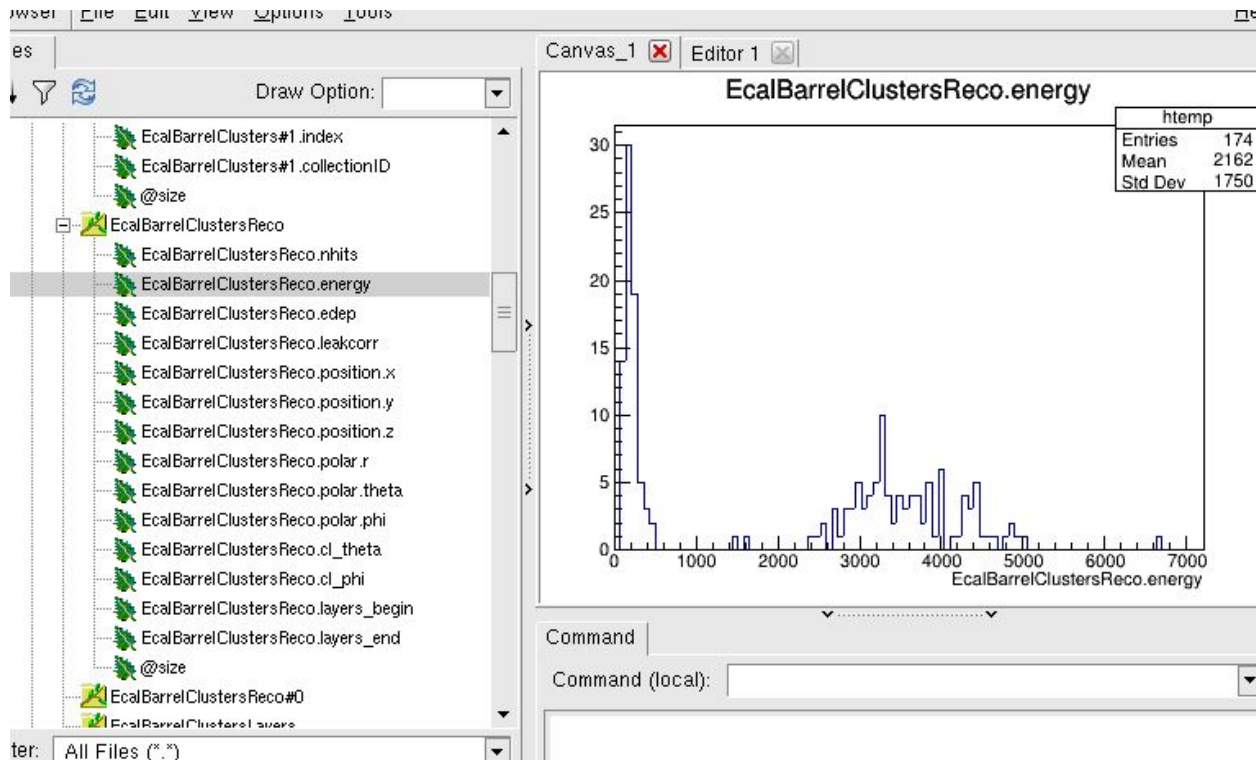
C Peng 1:18 PM

@Miguel Arratia

# development directory

Steps to get to  
Reconstruction  
benchmarks for  
calorimeter (ECAL)  
Reconstruction  
(from scratch)

# I can attest it works fine:



We now need to adapt this code to run over HCAL hits rather than ECAL hits.

We will start with 2D clustering



the env vars...

```
#!/bin/bash
#SBATCH --account=rrg-wdconinc
#SBATCH --time=00:15:00
#SBATCH --mem-per-cpu=2G
#SBATCH --cpus-per-task=8

export PROJECT=$HOME/projects/rrg-wdconinc
export EICSHELL=$PROJECT/wdconinc/containers/eic_container/eic-shell
export DETECTOR_PATH=$PROJECT/wdconinc/EIC/detectors/athena/
export DETECTOR_BENCHMARKS=$PROJECT/wdconinc/EIC/benchmarks/detector_benchmarks

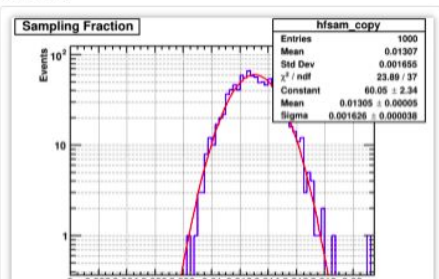
export E_START=5
export E_END=5
export JUGGLER_N_EVENTS=1000
export JUGGLER_DETECTOR=athena

cd $DETECTOR_BENCHMARKS
mkdir -p data results sim_output
cat << EOF | $EICSHELL bash --rcfile /etc/profile -l
source /opt/detector/setup.sh
$DETECTOR_BENCHMARKS/benchmarks/barrel_ecal/run_emcal_barrel_particles.sh
electron
root -b -q
'$DETECTOR_BENCHMARKS/benchmarks/barrel_ecal/scripts/emcal_barrel_particles_anal
ysis.cxx+("electron")'
EOF
```

It writes in those directories, not a scratch dir, so it doesn't like concurrency. Check output with

```
display
EIC/benchmarks/detector_benchmarks/results/emcal_barrel_electron_fsm.png
```

image.png ▾



**Wouter Deconinck (he/him)** 18 hours ago

Not the nicest, but this does the job on a cluster farm with

## Another working example for calorimeter analysis.



# Status

- 1) **Implement Fe/Sc HCAL in DD4Hep**

Status: Mostly done.

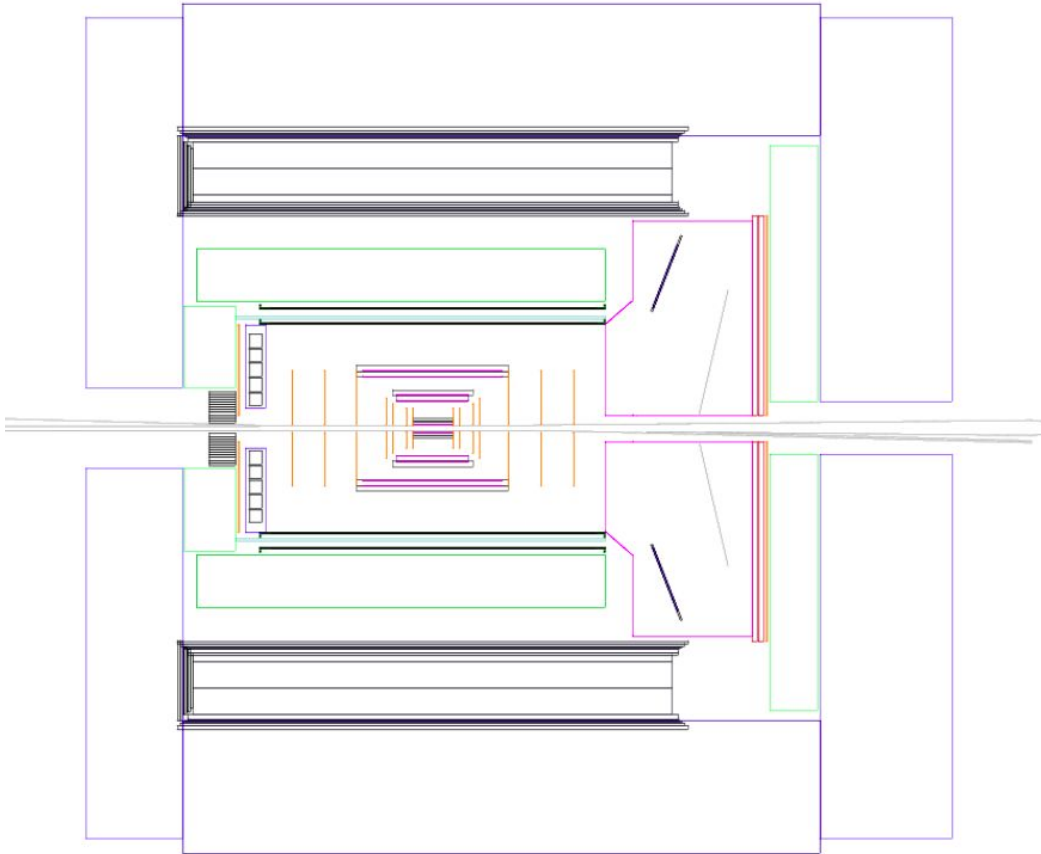
- 2) **Test calorimetry clustering in DD4Hep**

Status: Tried EMCAL 2D and 3D clustering. Works fine.

- 3) **Adapt clustering code examples to get HCAL clusters (2D at first)**

Work in progress

# Impact on coils for hadronic reconstruction ??



Wouter already implemented latest model sent by Elke last week.

Should be able to study impact of coils soon.

Is there space for “EMCAL extension” or “inner HCAL”?

