

Simulation for the SiW ECAL Test Beam 2021

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Overview

- First set of samples for the Tungsten (soon MIP) runs at TB2021 conditions.
- Work kept in our [GitHub repo](#).
- (Digitization not discussed here but developed tools are available.)

Material for simulation - From upstream beam direction

| Material | Thickness [mm] | Notes |
|--------------------|----------------|---|
| Polyethylene + air | 2 + 61.8 | Only first layer. CHO (0.89 g/cm^3) |
| Tungsten | 0, 2.1 or 4.2 | Variable air/Tungsten (19.1 g/cm^3) box |
| Carbon Frame | 1.5 | |
| Kapton | 0.1 | |
| Glue | 0.1 | Using air |
| Wafer | 0.32 or 0.5 | |
| Glue | 0.1 | Using air |
| Copper | 0.1 | |
| PCB | 1.7 | D. Jeans: Si O C H Br (1.7 g/cm^3) |
| Chip | 1.2 | Inhomogeneous layer to be modeled |
| Air | Variable | 15 mm between consecutive grooves |

(Thanks to Alexandre, Vincent and Adrián.)

Generation

- W runs: 1, 1.4, 1.8, 2.2, 2.6, 3.0, 3.4, 3.8, 4.2, 4.6, 5.2, 5.6, 6 [GeV]
- Beam spread: measure 1st layer data
- 100k (20*5k) events per energy
- TBD:
 - MIP (no W) @ 3 GeV (ongoing)
 - Angle runs
 - Rerun with improvements (prev. slide)

Sample macro

```
/gps/verbose 1
/gps/particle e-
/gps/direction 0 0 1
/gps/pos/type Beam
/gps/pos/shape Circle
/gps/pos/centre -40 -40 0 mm
/gps/pos/sigma_x 7 mm
/gps/pos/sigma_y 7 mm
/gps/ang/rot1 0 0 1
/gps/ang/rot2 0 1 0

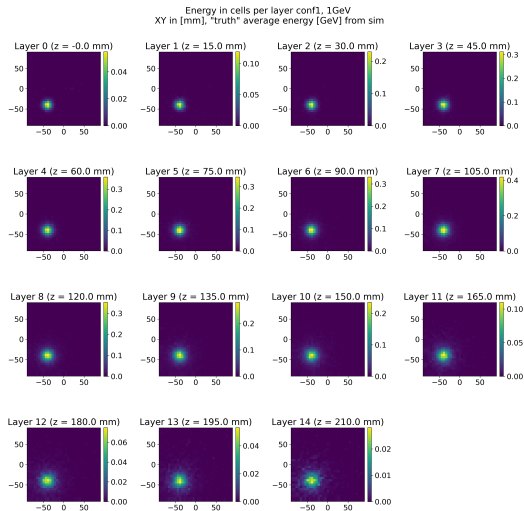
/gps/ene/type Mono
/gps/ene/mono [Energy] GeV
/run/beamOn [Nevt]
```

Sample ddsim script

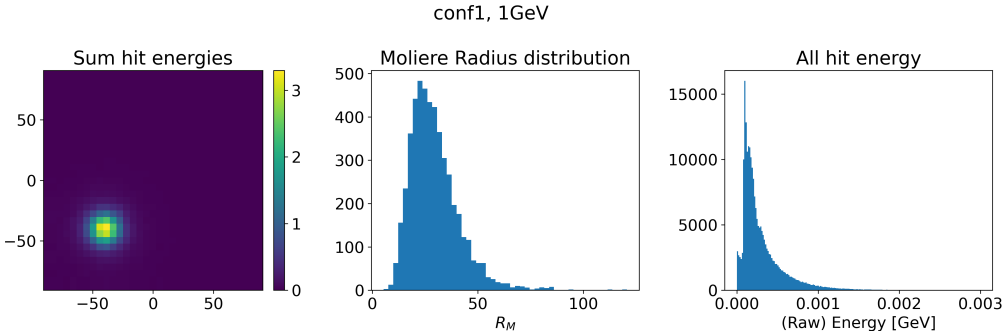
```
from DDSim.DD4hepSimulation import DD4hepSimulation
from g4units import GeV, mm, MeV

SIM = DD4hepSimulation()
SIM.runType = "run"
SIM.skipNEvents = 0
SIM.outputFile = "${local}/data/ECAL_${label}.slcio"
SIM.compactFile = "${geometry_folder}/ECAL_CONF${conf}.xml"
SIM.dumpSteeringFile = "${local}/steer/dumpSteering.xml"
SIM.field.eps_min = 1*mm
SIM.part.minimalKineticEnergy = 0.3*MeV
SIM.physicsList = "${physlist}"
SIM.enableDetailedShowerMode=True
```

Average hits, per layer - conf1, 1 GeV



Average hits, sum all layers - conf1, 1 GeV



Multiple peaks in (unconverted) energy → different wafer thicknesses?

Ongoing work

Generation

- Simulated conf 1 so far look as expected, but more control plots/thorough comparison to come
- MIP run @ 3 GeV (ongoing) angles (to be launched).
- Improvements in input material layers
- Store/share in eos eventually?
- (Visualization)

Code/analysis work:

- Put this through digitization framework.
- Adapt 2017 analysis tools for shower profiles, modelling.

Runs summary

From elog 2221 (Vincent)

Summary of runs taken with W in the "good region":
1 ms spill, 10 ms readout

| Energy | run | time | Stat (?) | Collim. | Rates | Comment |
|---------|--------|-----------------------------|--|------------------------|--------------------------|---------------------------------|
| 6.0 GeV | 050176 | 2h (9h planned) | 553524 cycles | 9~10 mm | 5 Hz, 72 cycles/s | accidentally set to finite time |
| 6.0 GeV | 050182 | 10h 18m | 2943381 cycles | 10~13 mm | 80 cycles/s | |
| 4.6 GeV | 050177 | 2h | | 5 mm | | |
| 4.2 GeV | 050175 | 2h | 256657 cycles | 3.4 mm | 30 Hz, 21 cycles/s | |
| 3.8 GeV | 050173 | 2h 1m | 177421 cycles | 4.7 mm | 80 Hz, 24 cycles/s | |
| 3.4 GeV | 050172 | 2h | 178147 cycles | 3 mm | 60 Hz, 20 cycles/s | |
| 3.0 GeV | 050169 | 2h 0m | 224210 cycles | 3 mm | 50 Hz | |
| 2.6 GeV | 050166 | 2h 0m | 137000 cycles | 4 mm | 150 Hz | |
| 2.2 GeV | 050166 | 2h3 mins | 199473 cycles | 3 mm | 100 Hz beam, 26 cycles/s | |
| 1.8 GeV | 050165 | 2h2mins | 165k hits in 1st slab | 3 mm | 100 Hz beam | |
| 5.2 GeV | 050164 | 8h03m | 464000 evts in teh beam spot ~ 16Hz of events | 10.5 (8.5 on the west) | ?? | |
| 1.4 GeV | 050163 | 1h7mins | | 3.1 ~ 3.7 | ?? | |
| 1.0 GeV | 050162 | 1h20mins | 161,102 entries in the 1st layer --> 107,401 evts/hr | 3.1 ~ 3.7 | ?? | test run ? |
| 4.0 GeV | 050161 | | | 4.8 (west at 3.6) | ?? | Noise run |
| 5.6 GeV | 050157 | 8h effective + 1h30 no beam | | 10 mm | 30 cycles / s | Last 1h30 without beam |