

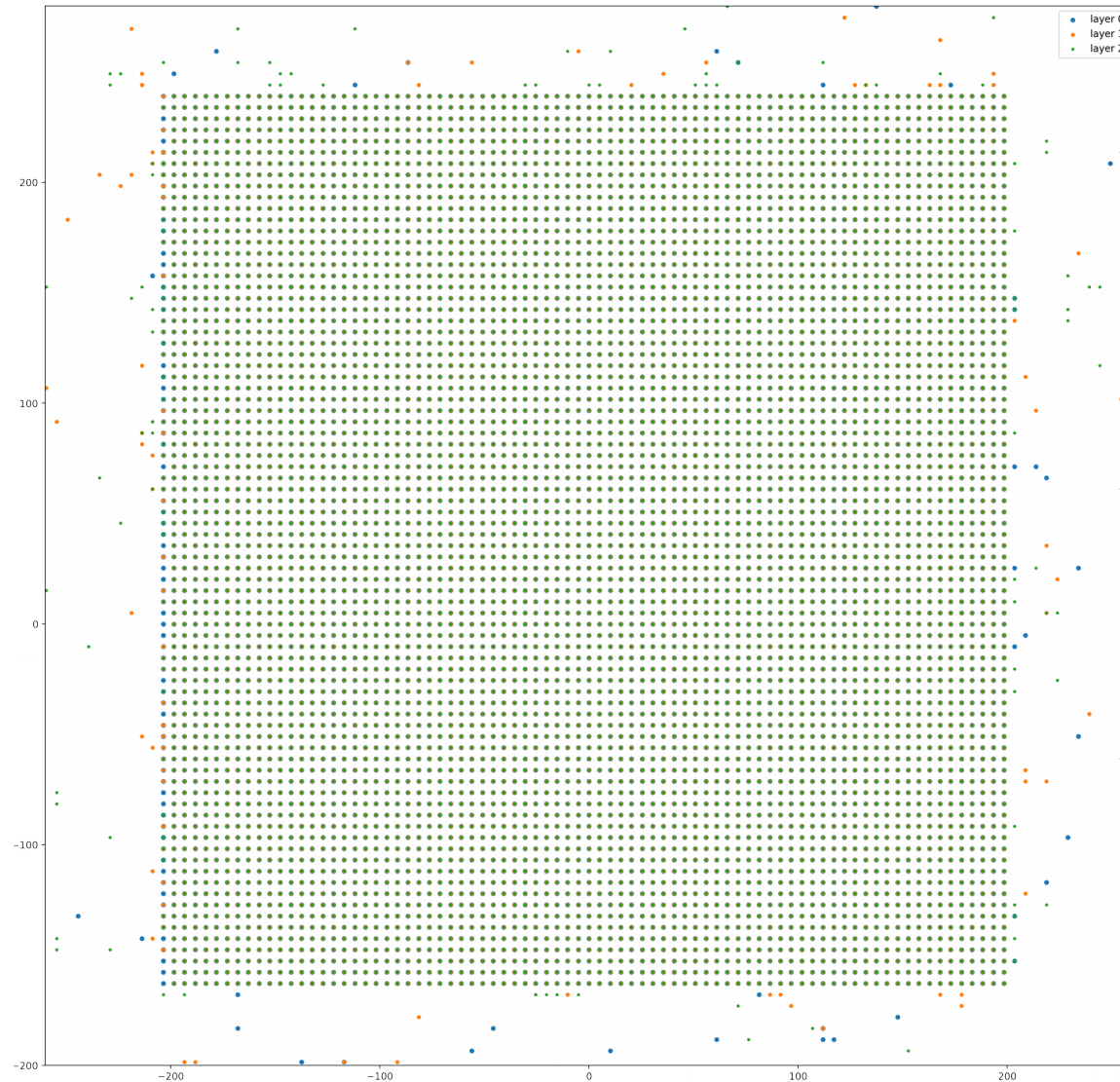
Regular ECAL

16.02.2023

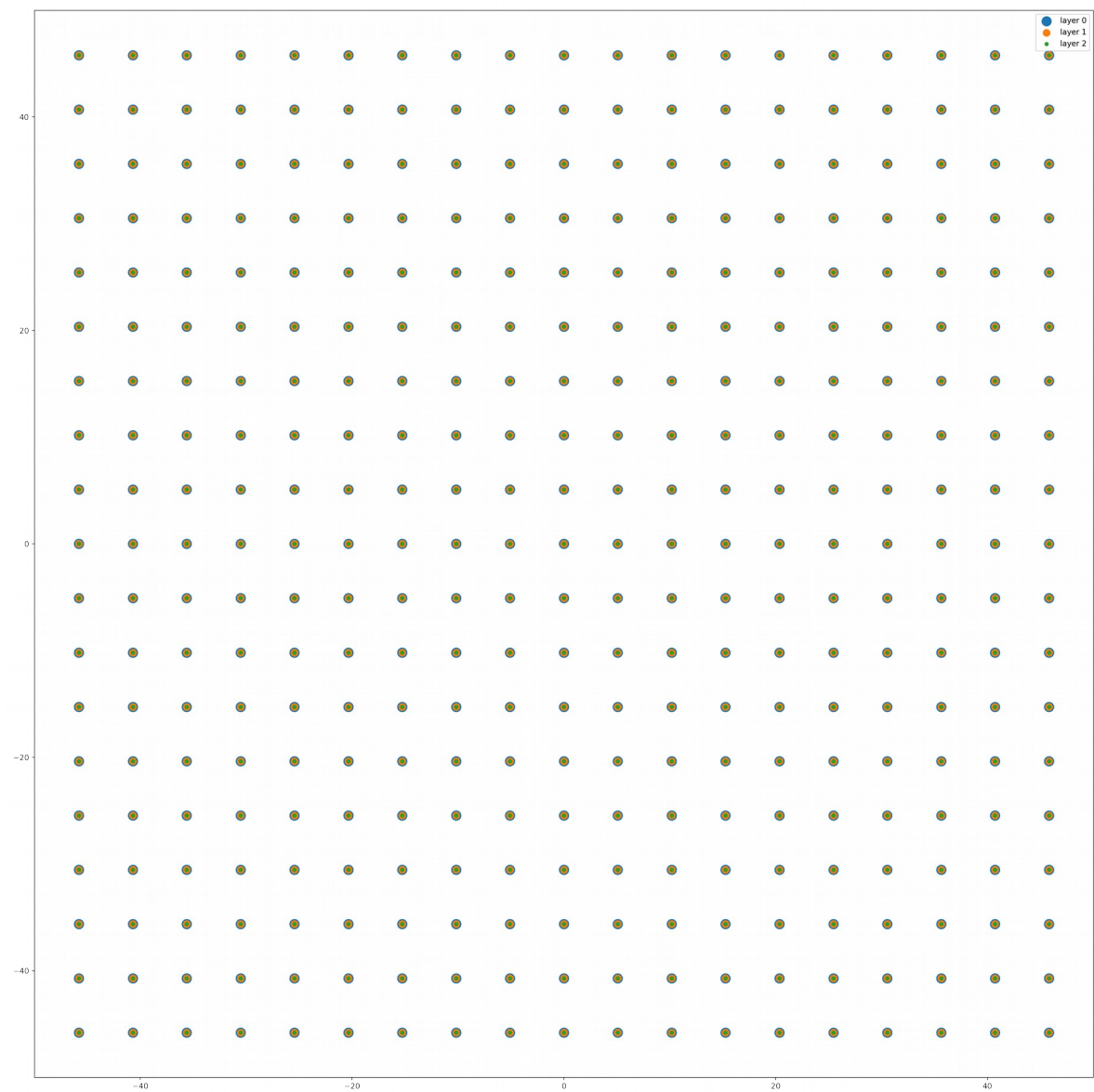
Muon map: Real ILD ECAL



Muon map: Regular ILD ECAL – between layers



Muon map: Regular ILD ECAL – between layers (zoomed)



Physics validation: material scan and geometry checks

Regular

| + Material scan between: x_0 = (10.00, 175.00, 10.00) [cm] and x_1 = (10.00, 220.00, 10.00) [cm] : | | | | | | | | | | | | |
|------------------------------------------------------------------------------------------------------|----------------|-----------------|-----------------|-----------------|-----------------------|-------------------------|----------------|------------------|--------------------|------------------------|---------------------------------|--|
| Num. \ Layer \ | Material Name | Atomic Number/Z | Mass/A [g/mole] | Density [g/cm3] | Radiation Length [cm] | Interaction Length [cm] | Thickness [cm] | Path Length [cm] | Integrated X0 [cm] | Integrated Lambda [cm] | Material Endpoint (cm, cm, cm) | |
| 1 | G4_AIR | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 1.571 | 1.57 | 0.000052 | 0.000022 | (10.00, 176.57, 10.00) | |
| 2 | g10 | 11 | 21.318 | 1.7000 | 16.2003 | 54.3032 | 0.090 | 1.66 | 0.005616 | 0.001682 | (10.00, 176.66, 10.00) | |
| 3 | G4_KAPTON | 6 | 12.701 | 1.4200 | 28.5747 | 55.8669 | 0.015 | 1.68 | 0.006142 | 0.001951 | (10.00, 176.68, 10.00) | |
| 4 | G4_Cu | 29 | 63.546 | 8.9600 | 1.4356 | 15.5142 | 0.021 | 1.70 | 0.020793 | 0.003307 | (10.00, 176.70, 10.00) | |
| 5 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.010 | 1.71 | 0.020794 | 0.003307 | (10.00, 176.71, 10.00) | |
| 6 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.563 | 2.27 | 0.020812 | 0.003315 | (10.00, 177.27, 10.00) | |
| 7 | G4_Si | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.020 | 2.29 | 0.022948 | 0.003752 | (10.00, 177.29, 10.00) | |
| 8 | G4_C | 6 | 12.011 | 2.0000 | 21.3485 | 40.1007 | 0.100 | 2.39 | 0.027632 | 0.006246 | (10.00, 177.39, 10.00) | |
| 9 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.030 | 2.42 | 0.027633 | 0.006246 | (10.00, 177.42, 10.00) | |
| 10 | G4_C | 6 | 12.011 | 2.0000 | 21.3485 | 40.1007 | 0.100 | 2.52 | 0.032317 | 0.008740 | (10.00, 177.52, 10.00) | |
| 11 | G4_Si | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.020 | 2.54 | 0.034452 | 0.009177 | (10.00, 177.54, 10.00) | |
| 12 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 2.613 | 5.15 | 0.034538 | 0.009214 | (10.00, 180.15, 10.00) | |
| 13 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.327 | 5.48 | 0.034549 | 0.009218 | (10.00, 180.48, 10.00) | |
| 14 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.108 | 5.59 | 0.038324 | 0.011314 | (10.00, 180.59, 10.00) | |
| 15 | G4_W | 74 | 183.840 | 19.3000 | 0.3504 | 10.3056 | 0.210 | 5.80 | 0.637614 | 0.031691 | (10.00, 180.80, 10.00) | |
| 16 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.086 | 5.88 | 0.640620 | 0.033360 | (10.00, 180.88, 10.00) | |
| 17 | G4_Al | 13 | 26.982 | 2.6990 | 8.8963 | 38.8767 | 0.010 | 5.89 | 0.641744 | 0.033617 | (10.00, 180.89, 10.00) | |
| 18 | G4_Cu | 29 | 63.546 | 8.9600 | 1.4356 | 15.5142 | 0.040 | 5.93 | 0.669607 | 0.036195 | (10.00, 180.93, 10.00) | |
| 19 | G4_AIR | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.050 | 5.98 | 0.669609 | 0.036196 | (10.00, 180.98, 10.00) | |
| 20 | G4_POLYSTYRENE | 6 | 11.159 | 1.0600 | 41.3123 | 68.8720 | 0.150 | 6.13 | 0.673240 | 0.038374 | (10.00, 181.13, 10.00) | |
| 21 | Silicon | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.053 | 6.19 | 0.678845 | 0.039522 | (10.00, 181.19, 10.00) | |
| 22 | GroundOrHVMtx | 26 | 56.590 | 5.1900 | 2.7338 | 24.2845 | 0.010 | 6.20 | 0.682503 | 0.039933 | (10.00, 181.20, 10.00) | |
| 23 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.015 | 6.21 | 0.683027 | 0.040224 | (10.00, 181.21, 10.00) | |
| 24 | G4_W | 74 | 183.840 | 19.3000 | 0.3504 | 10.3056 | 0.210 | 6.42 | 1.282317 | 0.060602 | (10.00, 181.42, 10.00) | |
| 25 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.015 | 6.44 | 1.282841 | 0.060893 | (10.00, 181.44, 10.00) | |
| 26 | GroundOrHVMtx | 26 | 56.590 | 5.1900 | 2.7338 | 24.2845 | 0.010 | 6.45 | 1.286499 | 0.061305 | (10.00, 181.45, 10.00) | |
| 27 | Silicon | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.053 | 6.50 | 1.292104 | 0.062452 | (10.00, 181.50, 10.00) | |

Real

| + Material scan between: x_0 = (10.00, 175.00, 10.00) [cm] and x_1 = (10.00, 220.00, 10.00) [cm] : | | | | | | | | | | | | |
|------------------------------------------------------------------------------------------------------|----------------|-----------------|-----------------|-----------------|-----------------------|-------------------------|----------------|------------------|--------------------|------------------------|---------------------------------|--|
| Num. \ Layer | Material Name | Atomic Number/Z | Mass/A [g/mole] | Density [g/cm3] | Radiation Length [cm] | Interaction Length [cm] | Thickness [cm] | Path Length [cm] | Integrated X0 [cm] | Integrated Lambda [cm] | Material Endpoint (cm, cm, cm) | |
| 1 | G4_AIR | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 1.571 | 1.57 | 0.000052 | 0.000022 | (10.00, 176.57, 10.00) | |
| 2 | g10 | 11 | 21.318 | 1.7000 | 16.2003 | 54.3032 | 0.090 | 1.66 | 0.005616 | 0.001682 | (10.00, 176.66, 10.00) | |
| 3 | G4_KAPTON | 6 | 12.701 | 1.4200 | 28.5747 | 55.8669 | 0.015 | 1.68 | 0.006142 | 0.001951 | (10.00, 176.68, 10.00) | |
| 4 | G4_Cu | 29 | 63.546 | 8.9600 | 1.4356 | 15.5142 | 0.021 | 1.70 | 0.020793 | 0.003307 | (10.00, 176.70, 10.00) | |
| 5 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.010 | 1.71 | 0.020794 | 0.003307 | (10.00, 176.71, 10.00) | |
| 6 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.563 | 2.27 | 0.020812 | 0.003315 | (10.00, 177.27, 10.00) | |
| 7 | G4_Si | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.020 | 2.29 | 0.022948 | 0.003752 | (10.00, 177.29, 10.00) | |
| 8 | G4_C | 6 | 12.011 | 2.0000 | 21.3485 | 40.1007 | 0.100 | 2.39 | 0.027632 | 0.006246 | (10.00, 177.39, 10.00) | |
| 9 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.030 | 2.42 | 0.027633 | 0.006246 | (10.00, 177.42, 10.00) | |
| 10 | G4_C | 6 | 12.011 | 2.0000 | 21.3485 | 40.1007 | 0.100 | 2.52 | 0.032317 | 0.008740 | (10.00, 177.52, 10.00) | |
| 11 | G4_Si | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.020 | 2.54 | 0.034452 | 0.009177 | (10.00, 177.54, 10.00) | |
| 12 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 2.613 | 5.15 | 0.034538 | 0.009214 | (10.00, 180.15, 10.00) | |
| 13 | Air | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.327 | 5.48 | 0.034549 | 0.009218 | (10.00, 180.48, 10.00) | |
| 14 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.108 | 5.59 | 0.038324 | 0.011314 | (10.00, 180.59, 10.00) | |
| 15 | G4_W | 74 | 183.840 | 19.3000 | 0.3504 | 10.3056 | 0.210 | 5.80 | 0.637614 | 0.031691 | (10.00, 180.80, 10.00) | |
| 16 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.086 | 5.88 | 0.640620 | 0.033360 | (10.00, 180.88, 10.00) | |
| 17 | G4_Al | 13 | 26.982 | 2.6990 | 8.8963 | 38.8767 | 0.010 | 5.89 | 0.641744 | 0.033617 | (10.00, 180.89, 10.00) | |
| 18 | G4_Cu | 29 | 63.546 | 8.9600 | 1.4356 | 15.5142 | 0.040 | 5.93 | 0.669607 | 0.036195 | (10.00, 180.93, 10.00) | |
| 19 | G4_AIR | 7 | 14.801 | 0.0012 | 30392.0349 | 71025.9556 | 0.050 | 5.98 | 0.669609 | 0.036196 | (10.00, 180.98, 10.00) | |
| 20 | G4_POLYSTYRENE | 6 | 11.159 | 1.0600 | 41.3123 | 68.8720 | 0.150 | 6.13 | 0.673240 | 0.038374 | (10.00, 181.13, 10.00) | |
| 21 | Silicon | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.053 | 6.19 | 0.678845 | 0.039522 | (10.00, 181.19, 10.00) | |
| 22 | GroundOrHVMix | 26 | 56.590 | 5.1900 | 2.7338 | 24.2845 | 0.010 | 6.20 | 0.682503 | 0.039933 | (10.00, 181.20, 10.00) | |
| 23 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.015 | 6.21 | 0.683027 | 0.040224 | (10.00, 181.21, 10.00) | |
| 24 | G4_W | 74 | 183.840 | 19.3000 | 0.3504 | 10.3056 | 0.210 | 6.42 | 1.282317 | 0.060602 | (10.00, 181.42, 10.00) | |
| 25 | CarbonFiber | 6 | 11.956 | 1.4667 | 28.6083 | 51.5382 | 0.015 | 6.44 | 1.282841 | 0.060893 | (10.00, 181.44, 10.00) | |
| 26 | GroundOrHVMix | 26 | 56.590 | 5.1900 | 2.7338 | 24.2845 | 0.010 | 6.45 | 1.286499 | 0.061305 | (10.00, 181.45, 10.00) | |
| 27 | Silicon | 14 | 28.085 | 2.3300 | 9.3661 | 45.7533 | 0.053 | 6.50 | 1.292104 | 0.062452 | (10.00, 181.50, 10.00) | |

Physics validation: material scan and geometry checks

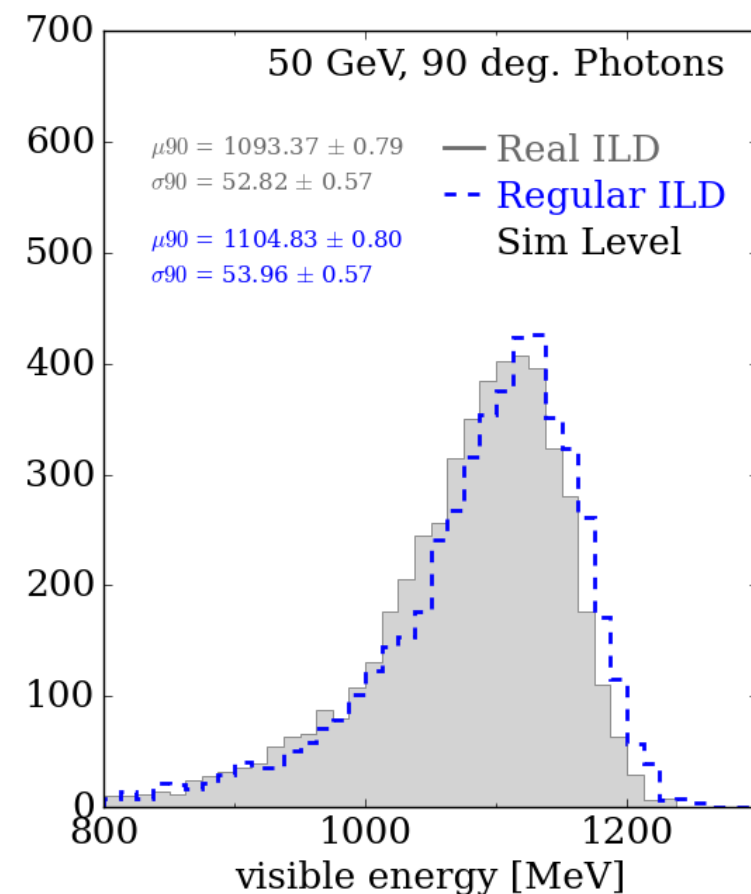
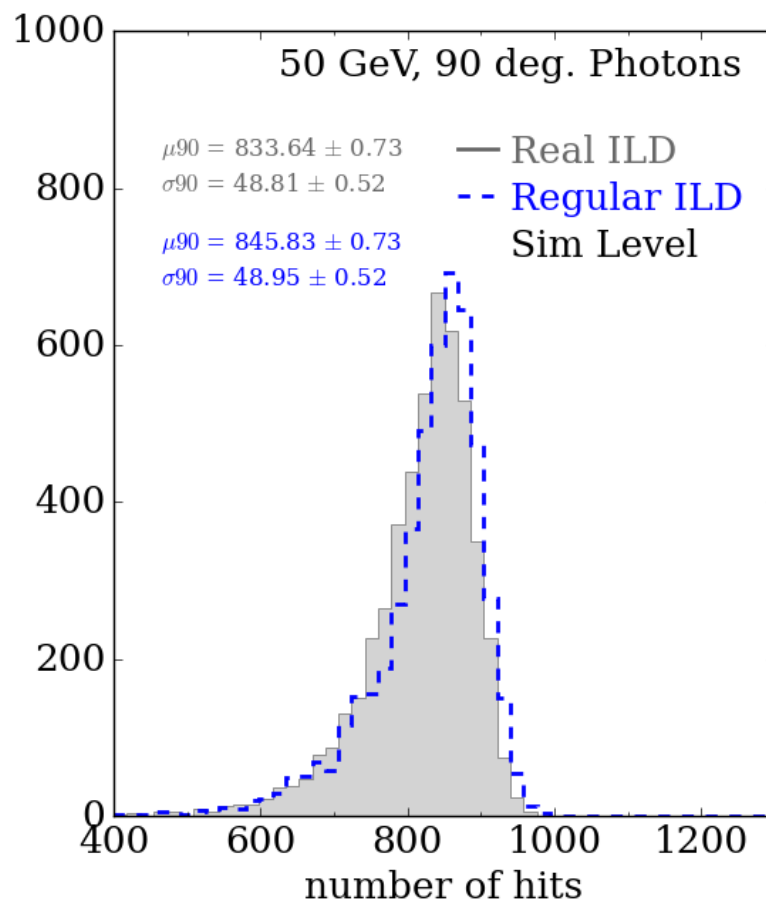
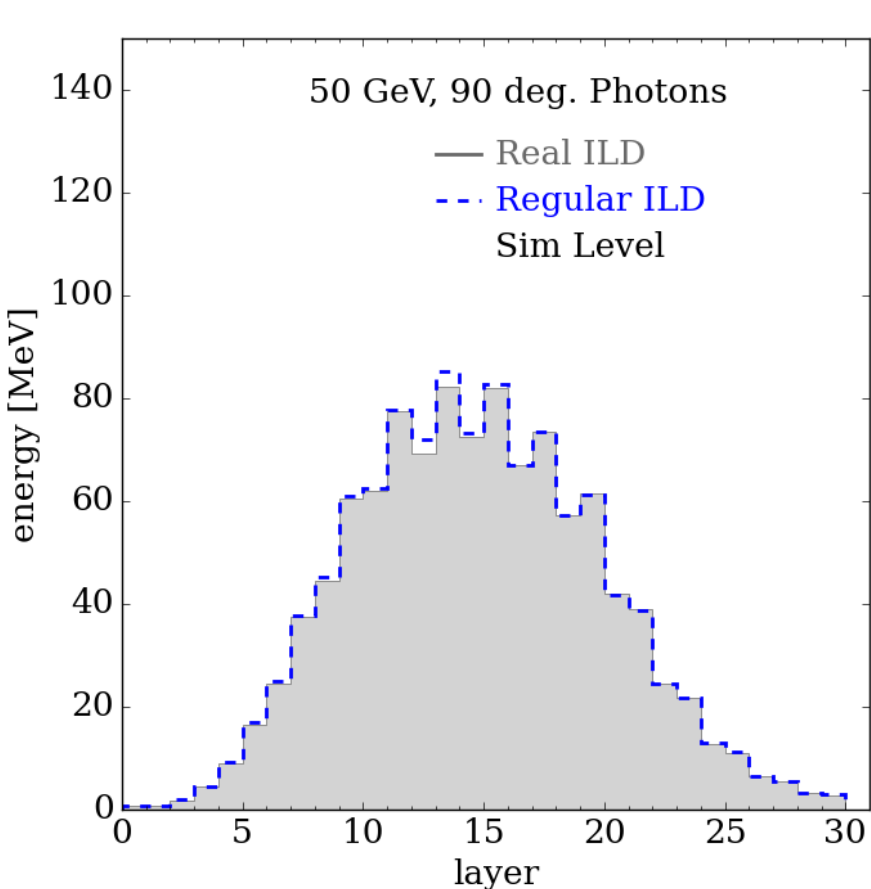
Regular

| | | | | | | | | | | |
|--------------------|----|--------|--------|--------|---------|--------|-------|-----------|----------|-------------------------|
| 0 Average Material | 30 | 68.624 | 6.2869 | 1.4123 | 24.7797 | 45.000 | 45.00 | 31.863327 | 1.815999 | (10.00, 220.00, 10.00) |
|--------------------|----|--------|--------|--------|---------|--------|-------|-----------|----------|-------------------------|

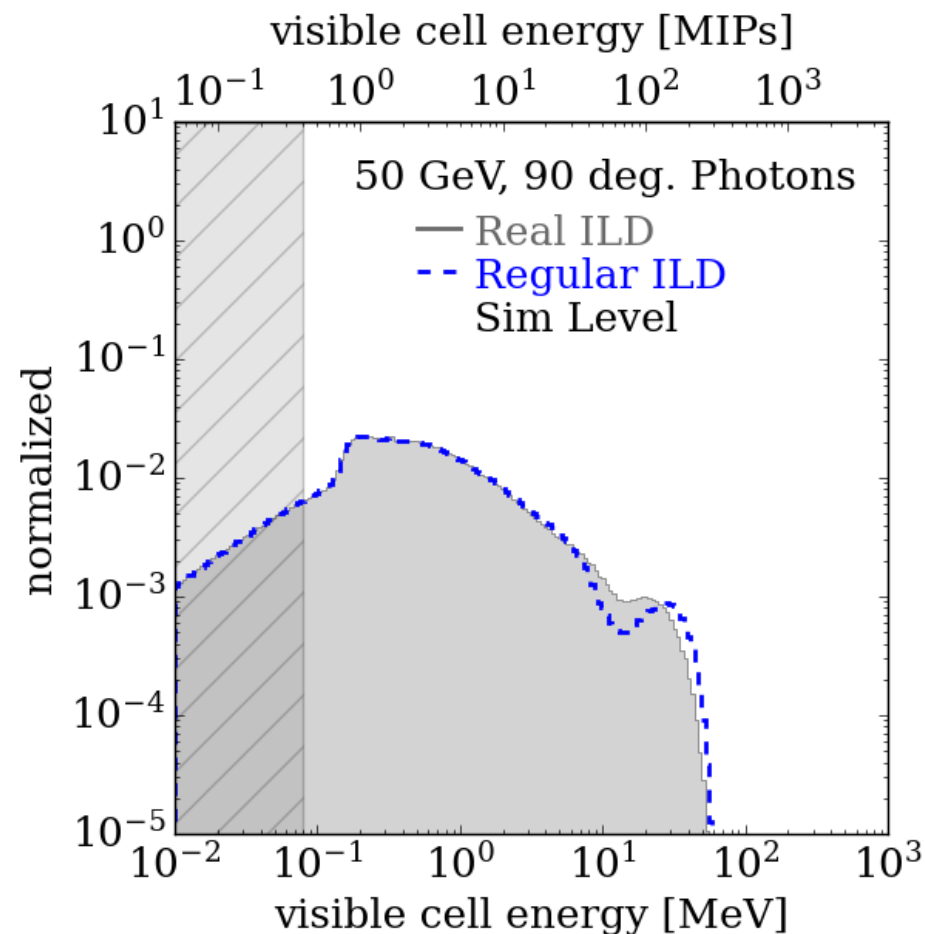
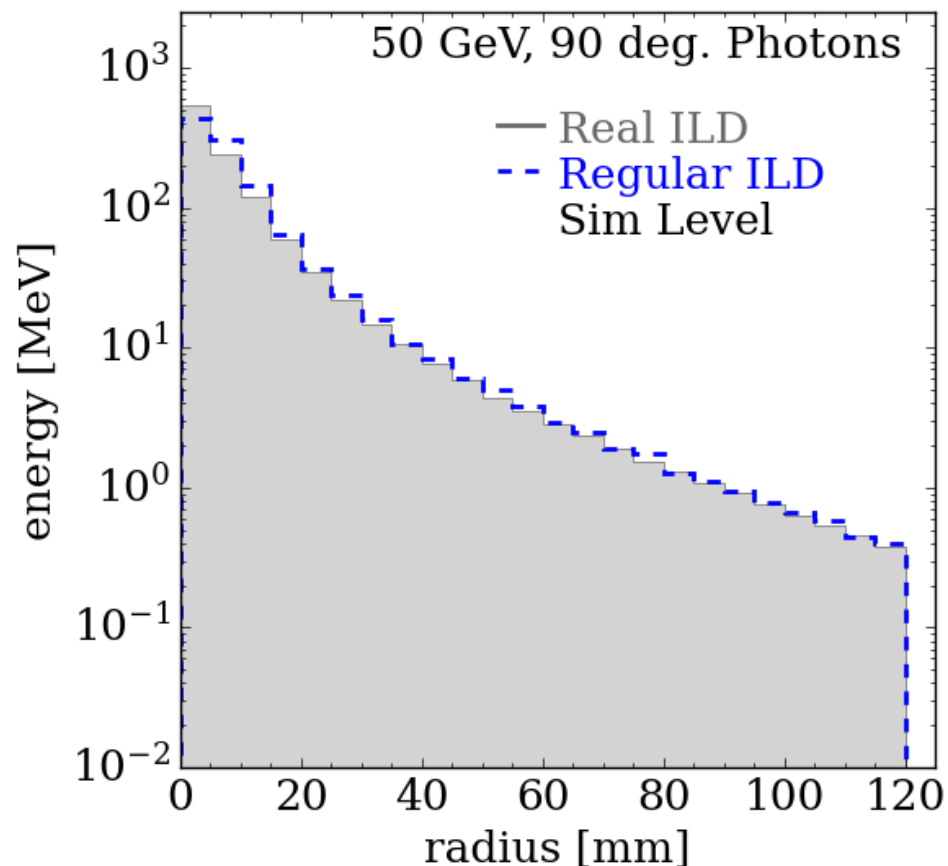
Real

| | QTY | UNIT PRICE | TOTAL PRICE | AMOUNT PAID | BALANCE DUE | CASH ON HAND | ACCOUNTS RECEIVABLE | INVENTORY | EQUITY | LIABILITY |
|--------------------|-----|------------|-------------|-------------|-------------|--------------|---------------------|-----------|----------|-------------------------|
| 0 Average Material | 30 | 68.624 | 6.2869 | 1.4123 | 24.7797 | 45.000 | 45.00 | 31.863327 | 1.815999 | (10.00, 220.00, 10.00) |

Effects on physics distributions: 50 GeV, 90 degree photons



Effects on physics distributions: 50 GeV, 90 degree photons



Conclusion

- No free lunch
- Using a regular geometry gives more hits (as expected- no wafers etc)
- Lack of staggering between layers can alter distributions to some extent
- *Potentially* reduced when going back into the real geometry (to be studied)