Scintillation Screen IP Simulation & Reconstruction

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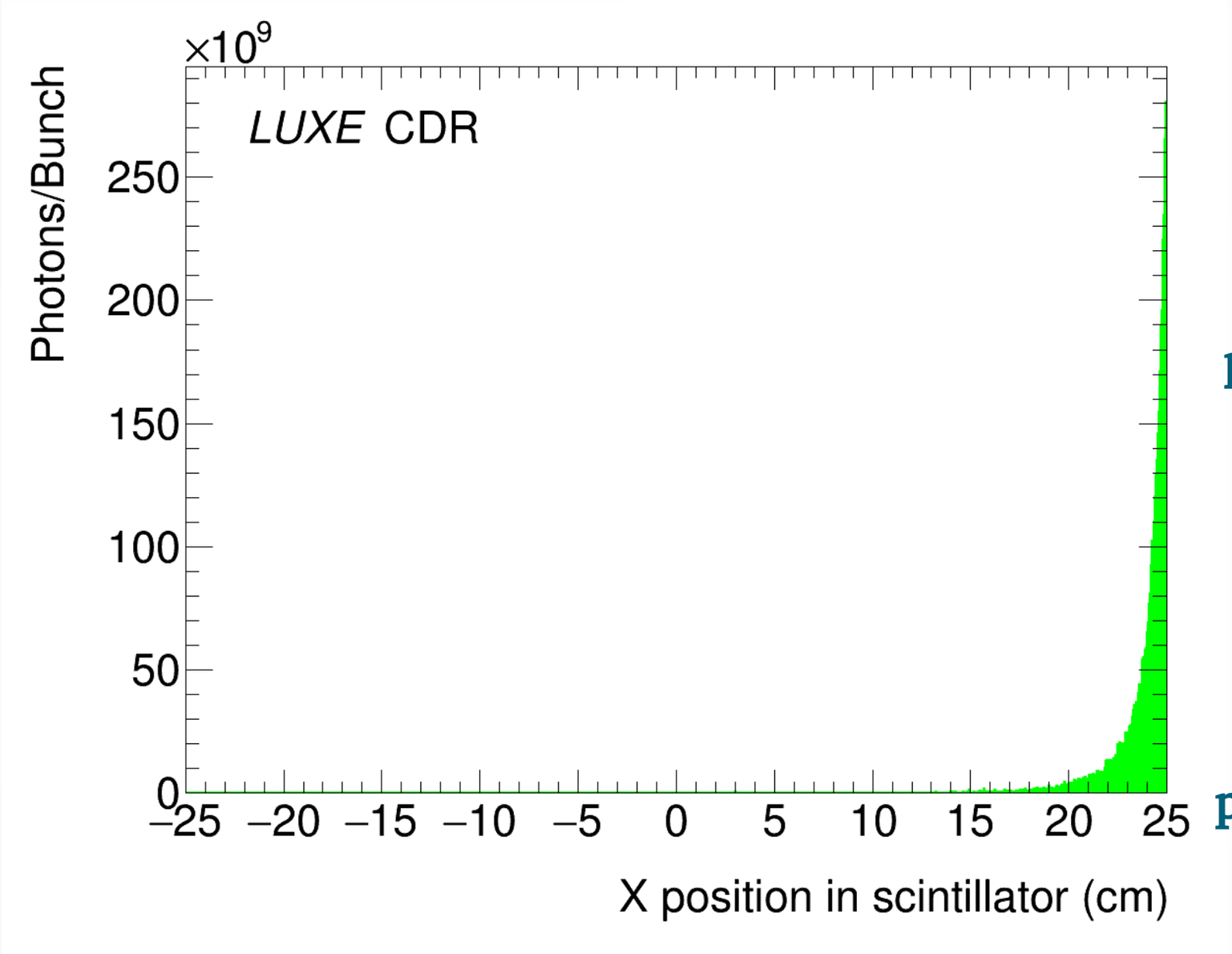
LUXE

DESY.

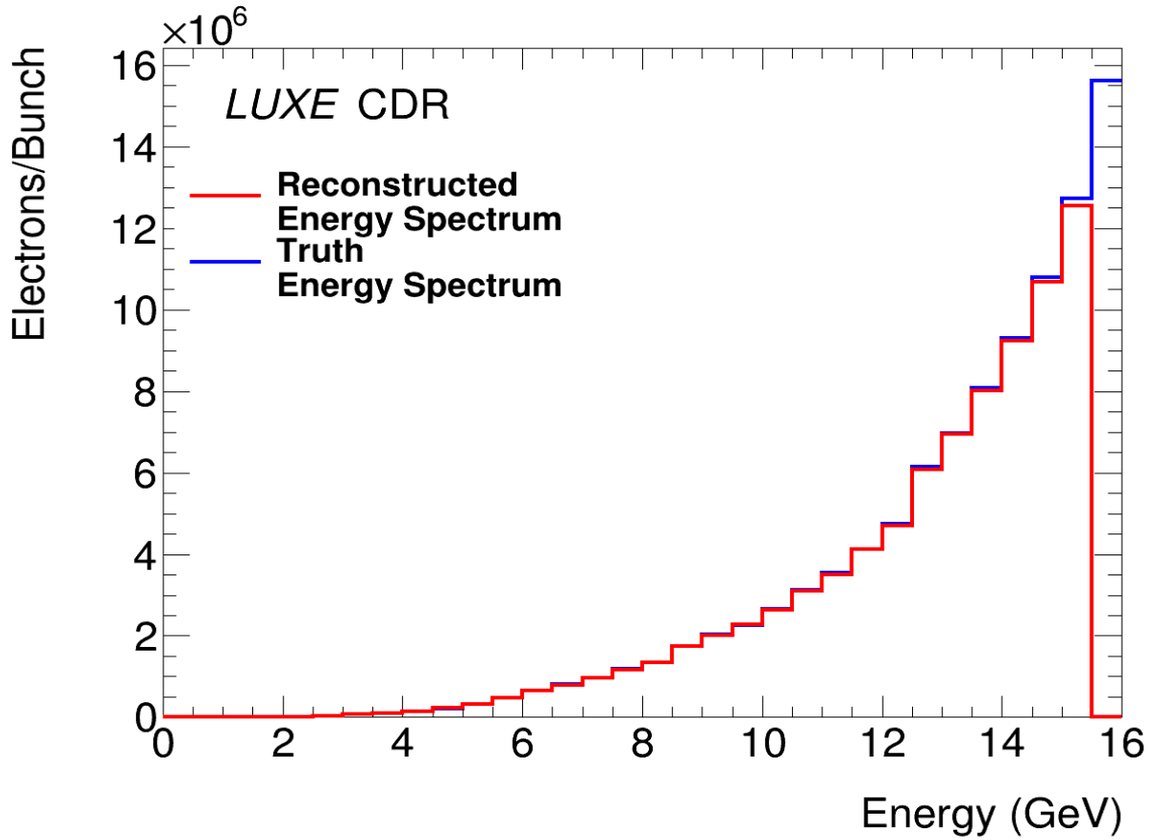


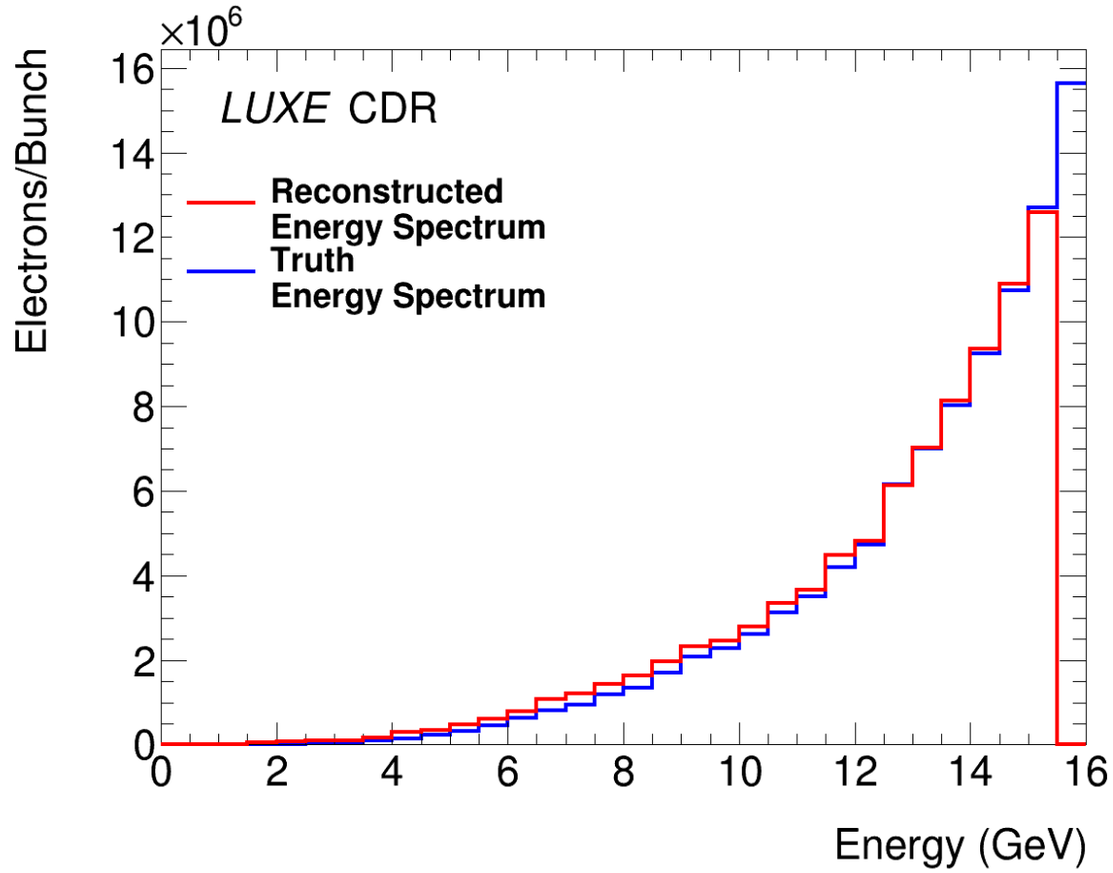
Reminder:

- Producing recon vs truth plots for IP e- measurement Lanex screen

- Involves simulating Scintillation processes in Geant4

- Then taking integral of photon light between x position limits corresponding to desired energy interval

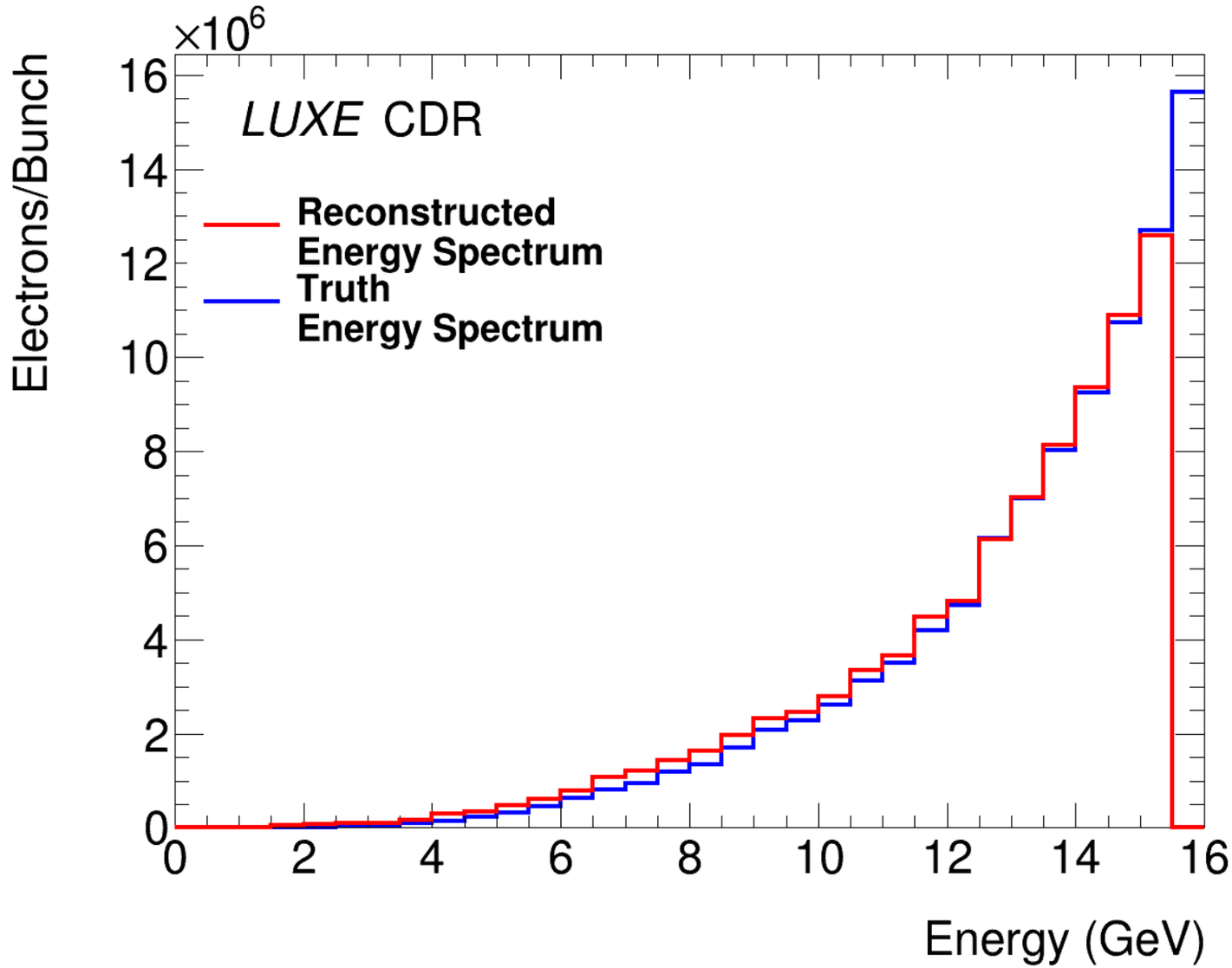




Minimal Scattering from environment
IP Scint. Screen, w_0 = 3μm

Full Scattering
IP Scint. Screen, w_0 = 3μm

- After some difficulties! A good reconstruction is observed. Much better than the Brem. Reconstruction with full scattering. Advantage of electrons approaching a beam window at ~normal angle



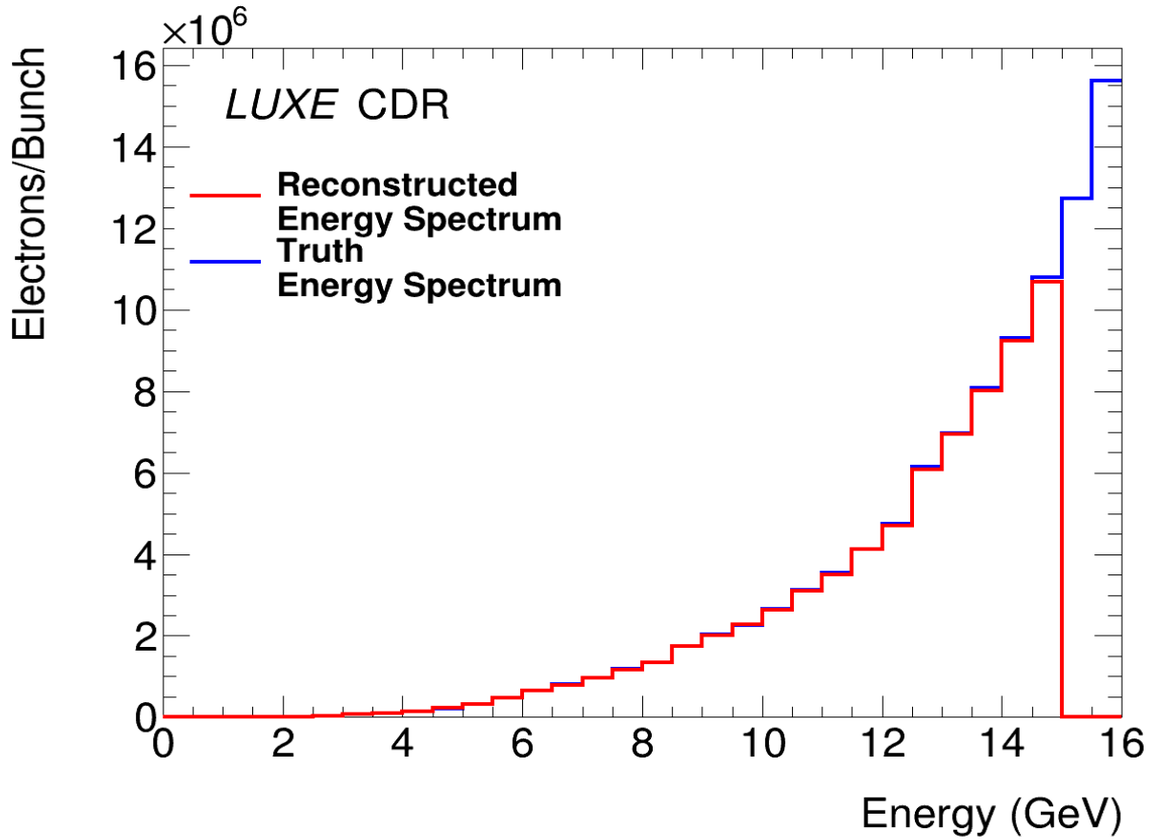
Full Scattering
IP Scint. Screen, w_0 = 3μm

- Serious relative overestimate for lower energies, likely some migration from higher energies

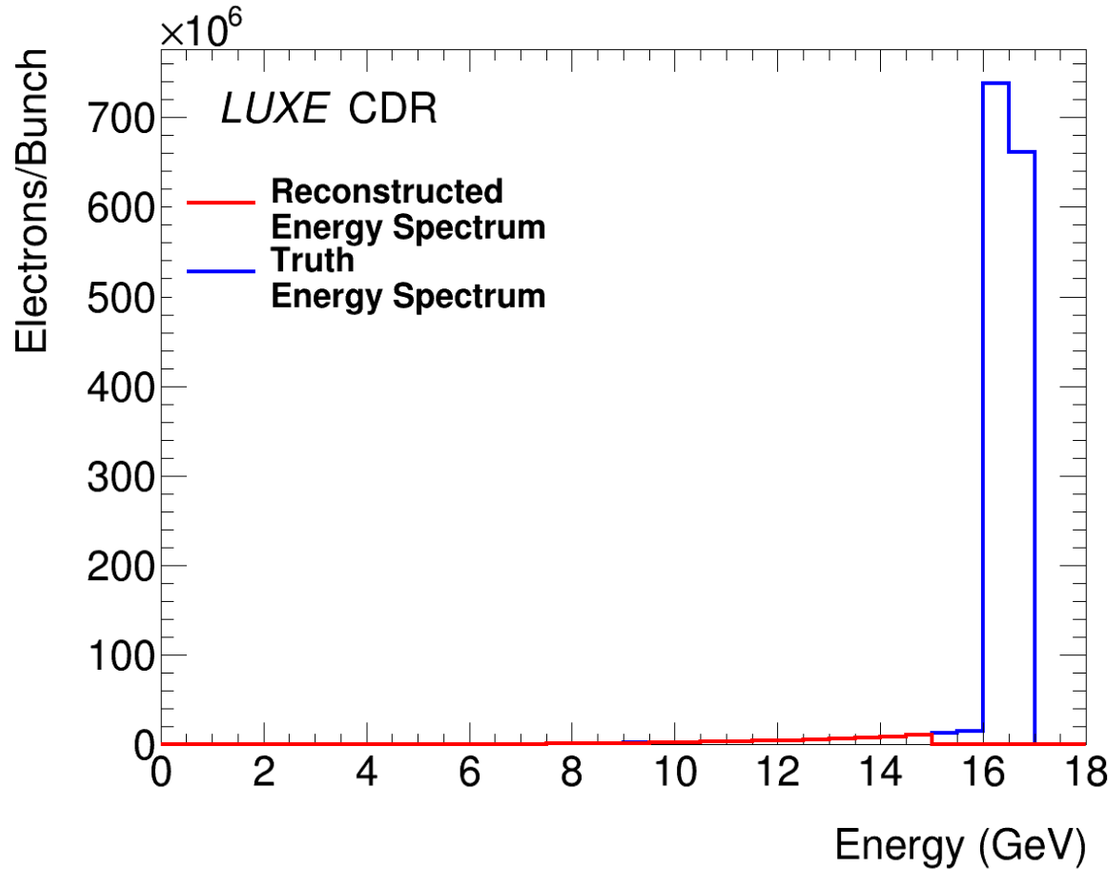
- sub-optimal statistics, ~850*2000 macroparticles were used (1.7M). For Brem. managed to use 1/10 of bunch (150M). Excited to use Tom Blackburn's production to improve on this

- As seen in light profile, very steep gradients are present. Even a small angular dispersion of scattered secondaries can then affect low-E integral

- Currently 5 cm of air from beam-window to screen – could be useful to evaluate 0 cm i.e. screen taped to window

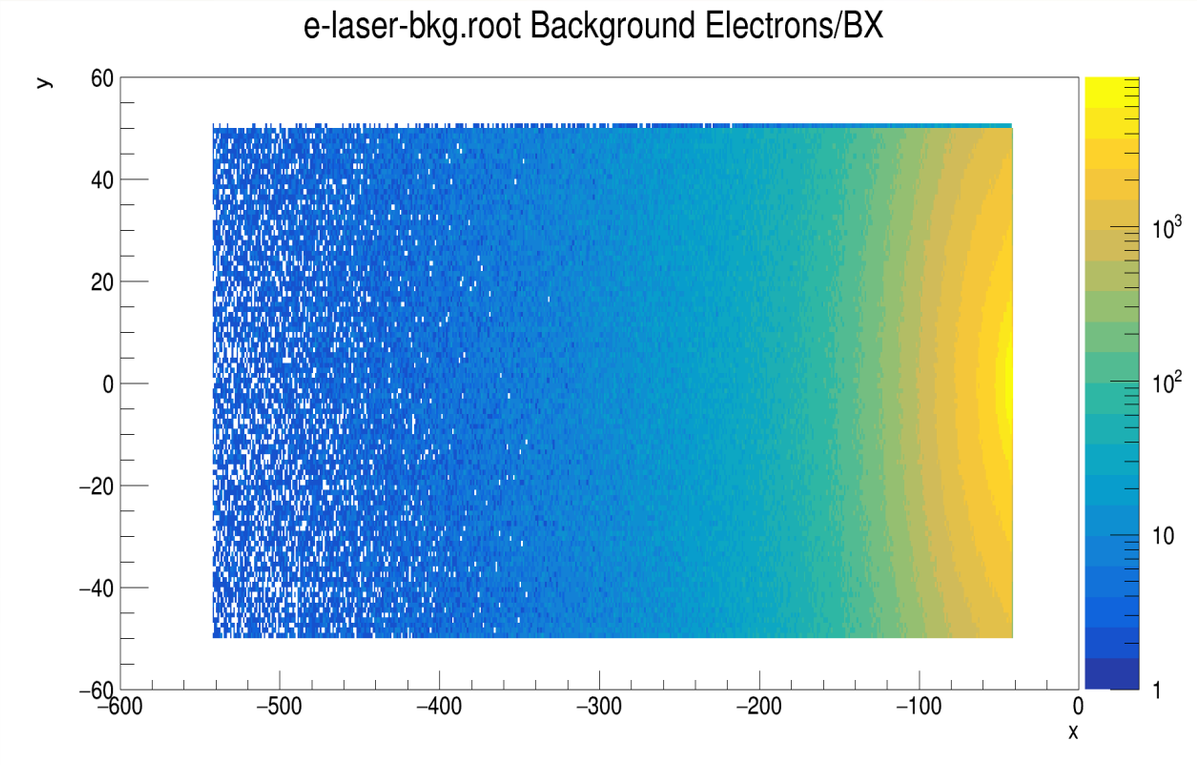


Minimal Scattering from environment
IP Scint. Screen, w_0 = 3μm

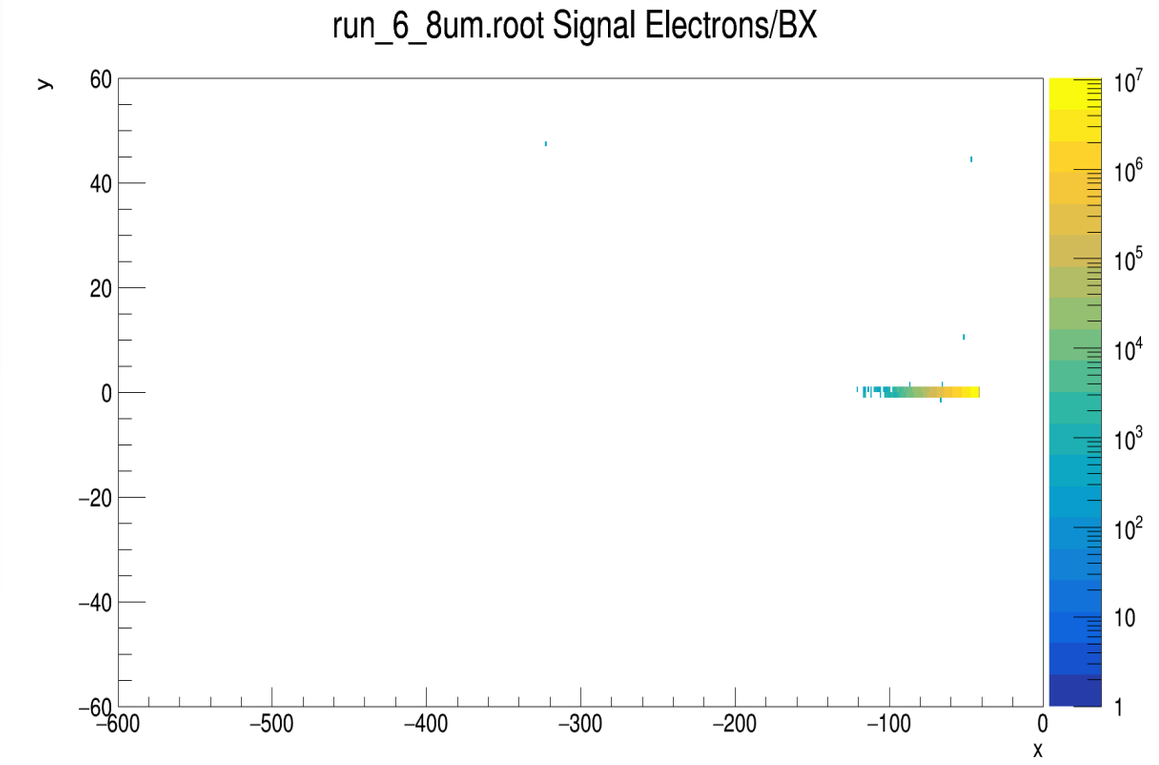


Minimal Scattering
IP Scint. Screen, w_0 = 3μm

- energy of 15.5 GeV corresponds to 0.15mm from screen edge, which both in simulation and real life may be fraught. So maybe we round down to 15 GeV



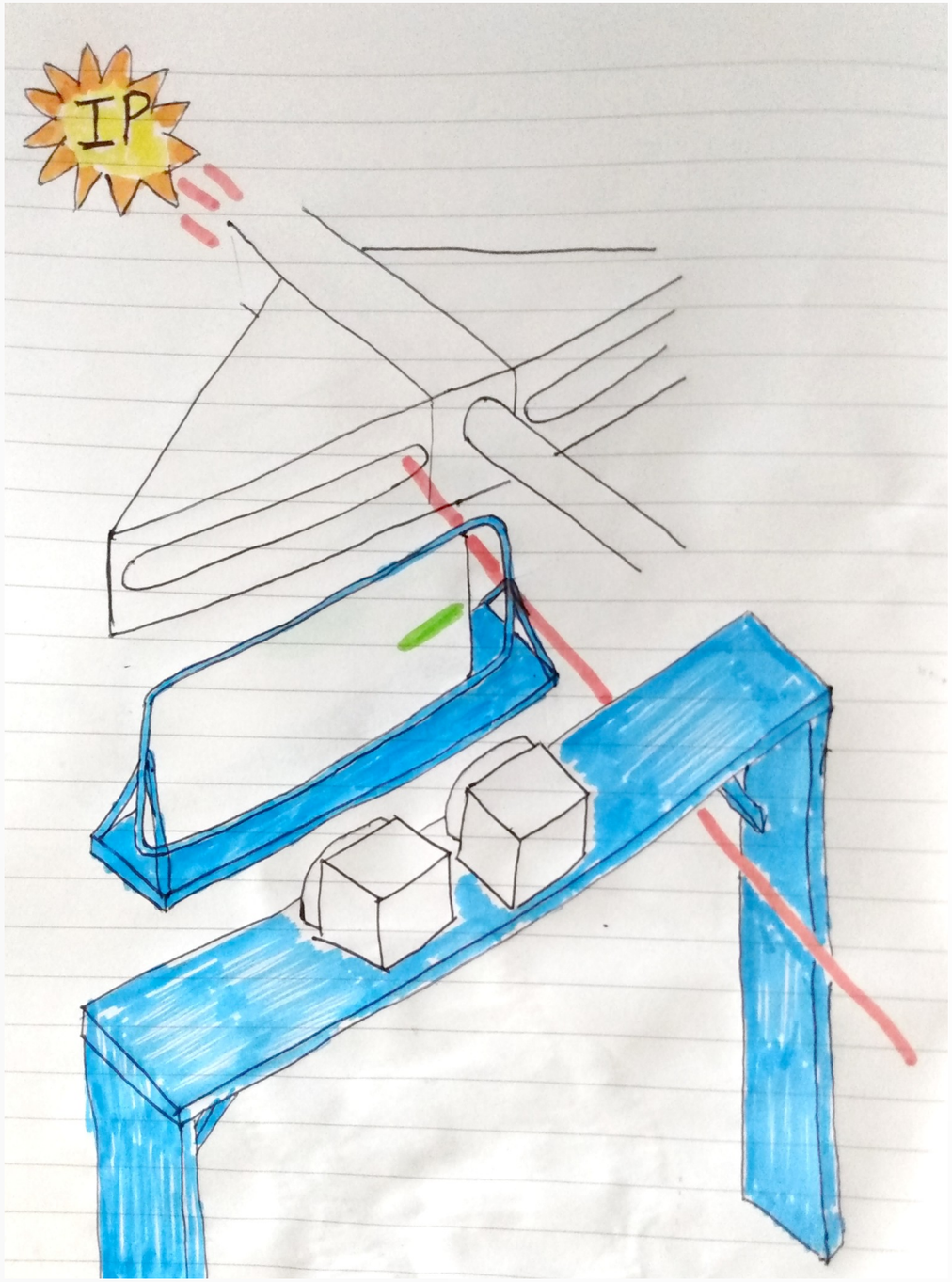
Minimal Scattering from environment
IP Scint. Screen, w_0 = 3μm



Full Scattering
IP Scint. Screen, w_0 = 3μm

- Tried already a rudimentary background subtraction – taking some integral of some small area above/below central signal band, and subtracting

- Statistics not helping the case with this

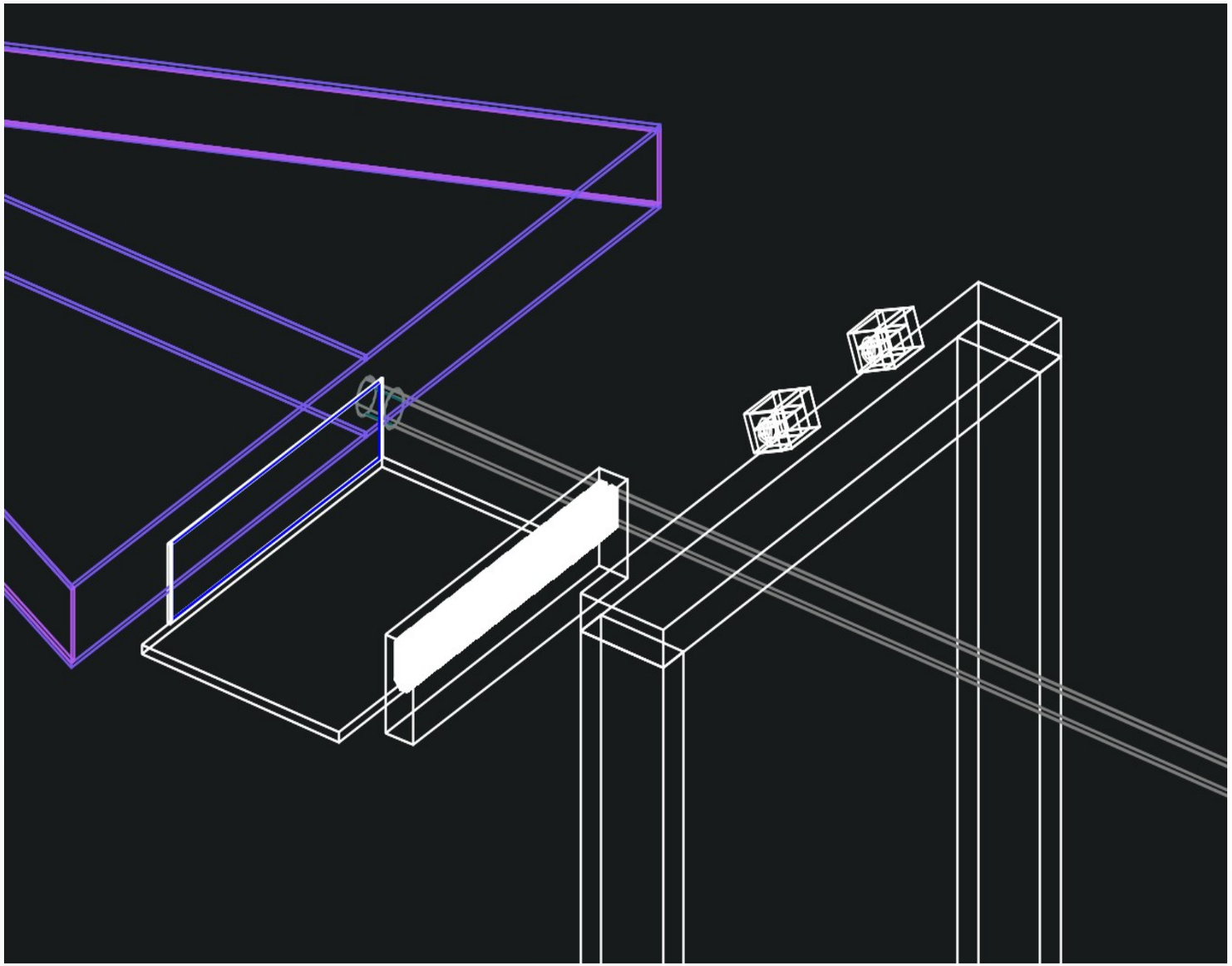


- So moving on to improving reco, will perform simulation with greater statistics with more time

- Produce a 'Laser-off' e-beam simulation campaign with scintillation physics turned on

- Will also construct a couple 'camera' volumes, few cm Pb shielding and Al stand and monitor the radiation intercepting the camera volume

- Calculating the deflection of e-beam (16.5 GeV, B=1T) reveals only 2.5cm of space for inside leg of camera stand at z=z_screen + 1.0m → but we can place this leg on the outside



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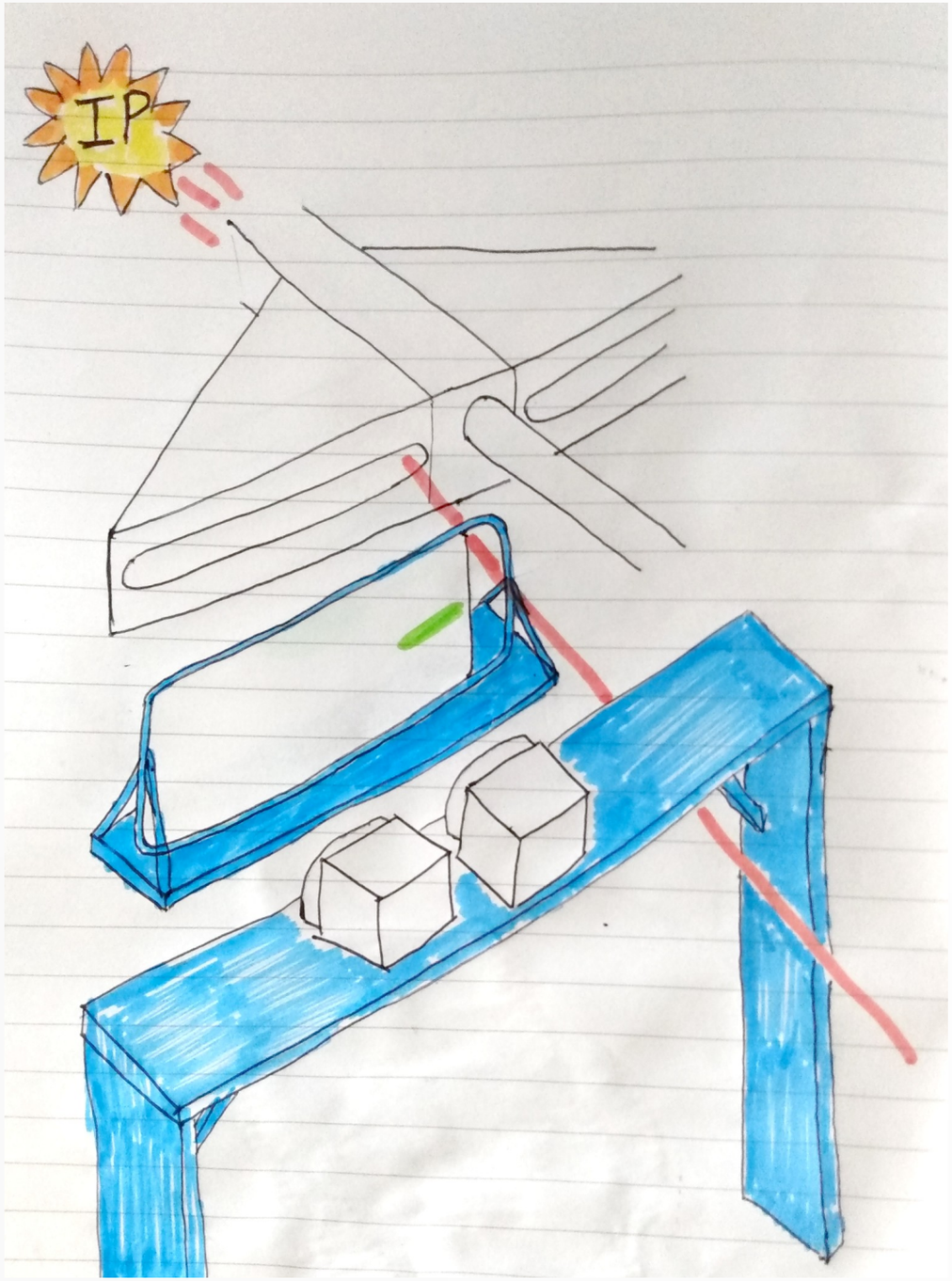
- Calculating the deflection of e-beam (16.5 GeV, B=1T) reveals only 2.5cm of space for inside leg of camera stand at z=z_screen + 1.0m → but we can place this leg on the outside (positron side)

- The inner leg should be placed at region of low electron flux → choose for now at 1 GeV or 0.91m from beamline

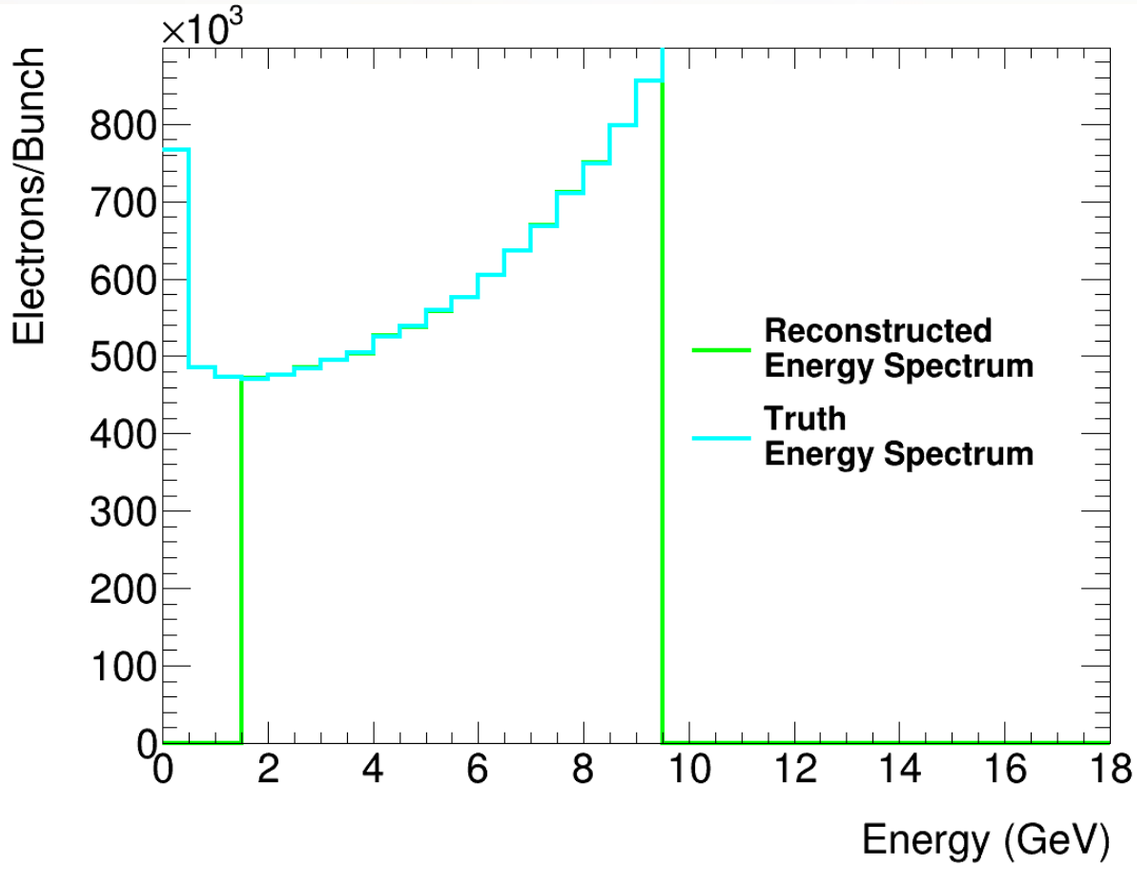
Backup



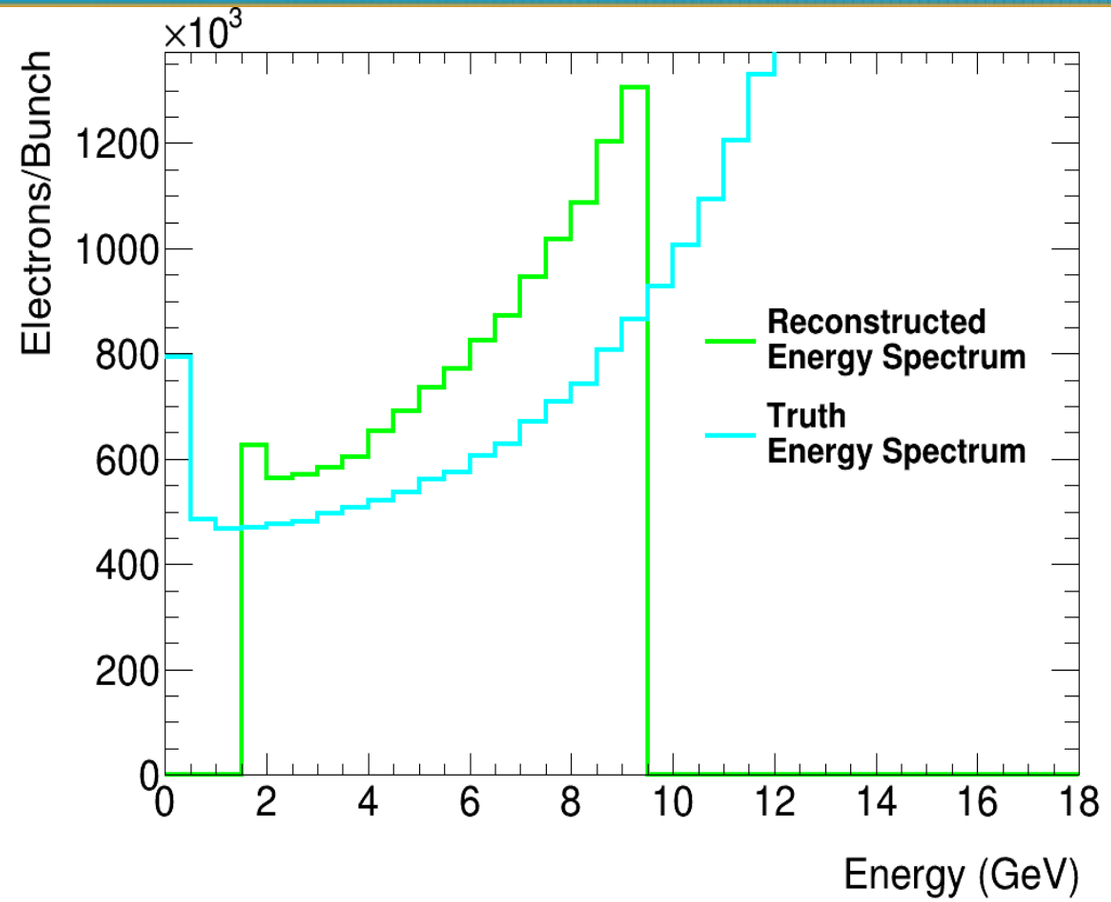
- Will also construct a couple ‘camera’ volumes, few cm Pb shielding and Al stand and monitor the radiation intercepting the camera volume

- Will not actually use them to collect scint. photon data; to accurately model screen surface/air/lens optical effects would drastically inflate runtime

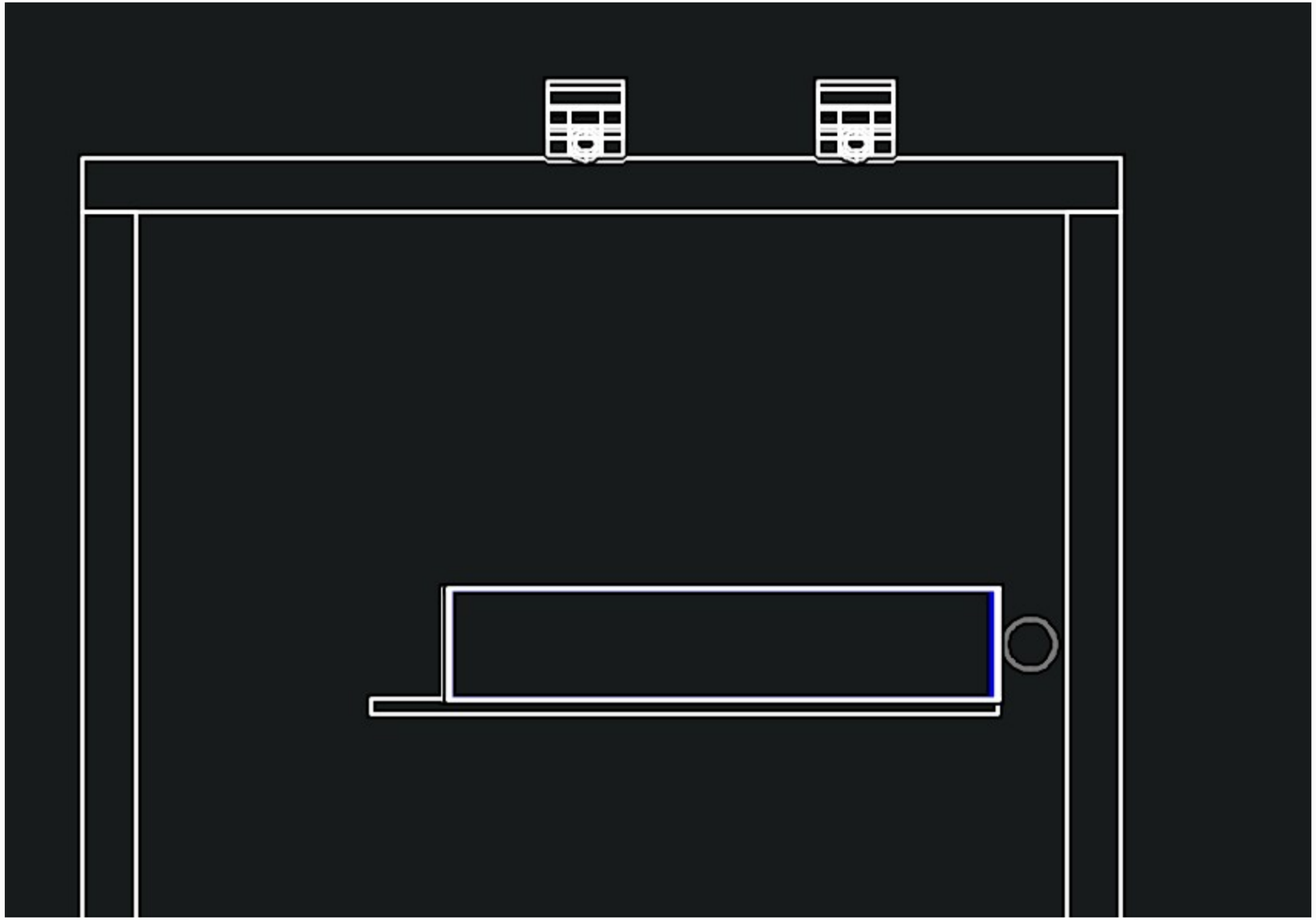
- Instead just use some reasonable figure for (solid angle covered by camera) * (detector efficiency)
And produce e.g. 1/100 number of photons, reducing runtime

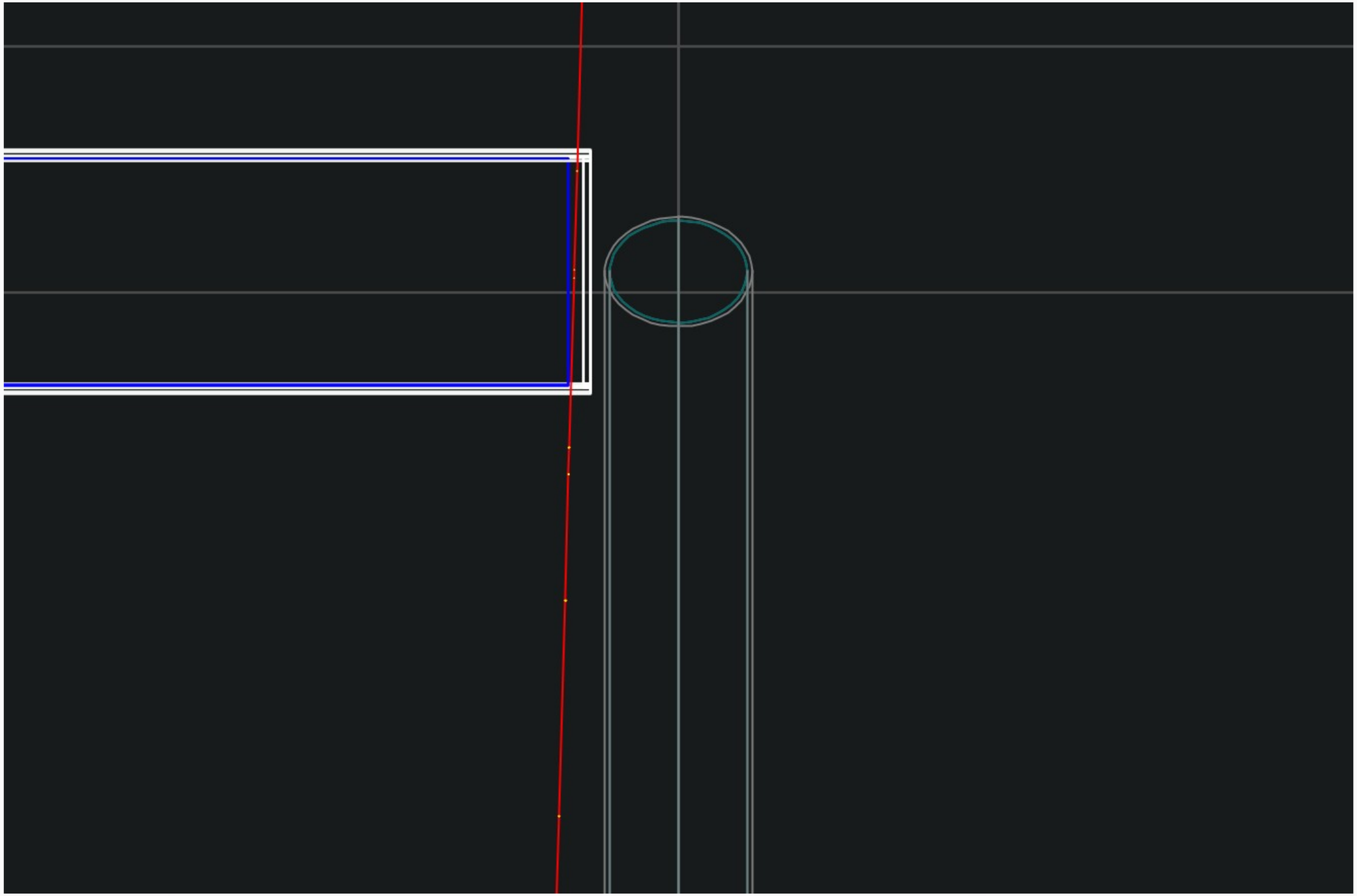


Minimal Scattering from environment
Brem Scint. Screen



Full Scattering
Brem. Scint. Screen





```
File  Edit  View  Search  Terminal  Help
Energy interval 1.5 GeV to 2 GeV
X coord interval -9.44744 cm to 0.29804 cm

Energy interval 2 GeV to 2.5 GeV
X coord interval 0.29804 cm to 6.04324 cm

Energy interval 2.5 GeV to 3 GeV
X coord interval 6.04324 cm to 9.84073 cm

Energy interval 3 GeV to 3.5 GeV
X coord interval 9.84073 cm to 12.5402 cm

Energy interval 3.5 GeV to 4 GeV
X coord interval 12.5402 cm to 14.5587 cm

Energy interval 4 GeV to 4.5 GeV
X coord interval 14.5587 cm to 16.1256 cm

Energy interval 4.5 GeV to 5 GeV
X coord interval 16.1256 cm to 17.3774 cm

Energy interval 5 GeV to 5.5 GeV
X coord interval 17.3774 cm to 18.4005 cm

Energy interval 5.5 GeV to 6 GeV
X coord interval 18.4005 cm to 19.2525 cm

Energy interval 6 GeV to 6.5 GeV
X coord interval 19.2525 cm to 19.973 cm

Energy interval 6.5 GeV to 7 GeV
X coord interval 19.973 cm to 20.5903 cm

Energy interval 7 GeV to 7.5 GeV
X coord interval 20.5903 cm to 21.1251 cm

Energy interval 7.5 GeV to 8 GeV
X coord interval 21.1251 cm to 21.5929 cm

Energy interval 8 GeV to 8.5 GeV
X coord interval 21.5929 cm to 22.0055 cm

Energy interval 8.5 GeV to 9 GeV
X coord interval 22.0055 cm to 22.3723 cm
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File  Edit  View  Search  Terminal  Help
Energy interval 9 GeV to 9.5 GeV
X coord interval 22.3723 cm to 22.7003 cm

Energy interval 9.5 GeV to 10 GeV
X coord interval 22.7003 cm to 22.9956 cm

Energy interval 10 GeV to 10.5 GeV
X coord interval 22.9956 cm to 23.2627 cm

Energy interval 10.5 GeV to 11 GeV
X coord interval 23.2627 cm to 23.5054 cm

Energy interval 11 GeV to 11.5 GeV
X coord interval 23.5054 cm to 23.7271 cm

Energy interval 11.5 GeV to 12 GeV
X coord interval 23.7271 cm to 23.9302 cm

Energy interval 12 GeV to 12.5 GeV
X coord interval 23.9302 cm to 24.1171 cm

Energy interval 12.5 GeV to 13 GeV
X coord interval 24.1171 cm to 24.2896 cm

Energy interval 13 GeV to 13.5 GeV
X coord interval 24.2896 cm to 24.4493 cm

Energy interval 13.5 GeV to 14 GeV
X coord interval 24.4493 cm to 24.5976 cm

Energy interval 14 GeV to 14.5 GeV
X coord interval 24.5976 cm to 24.7357 cm

Energy interval 14.5 GeV to 15 GeV
X coord interval 24.7357 cm to 24.8646 cm

Energy interval 15 GeV to 15.5 GeV
X coord interval 24.8646 cm to 24.9851 cm

Info in <TCanvas::SaveSource>: C++ Macro file: EDS-recon-scintCerenkov_3um-compton.
C has been generated
Info in <TCanvas::Print>: file EDS-recon-scintCerenkov_3um-compton.png has been cre
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root [2]
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