

CalVision Simulation Update

Fiber and Sampling Calorimeters

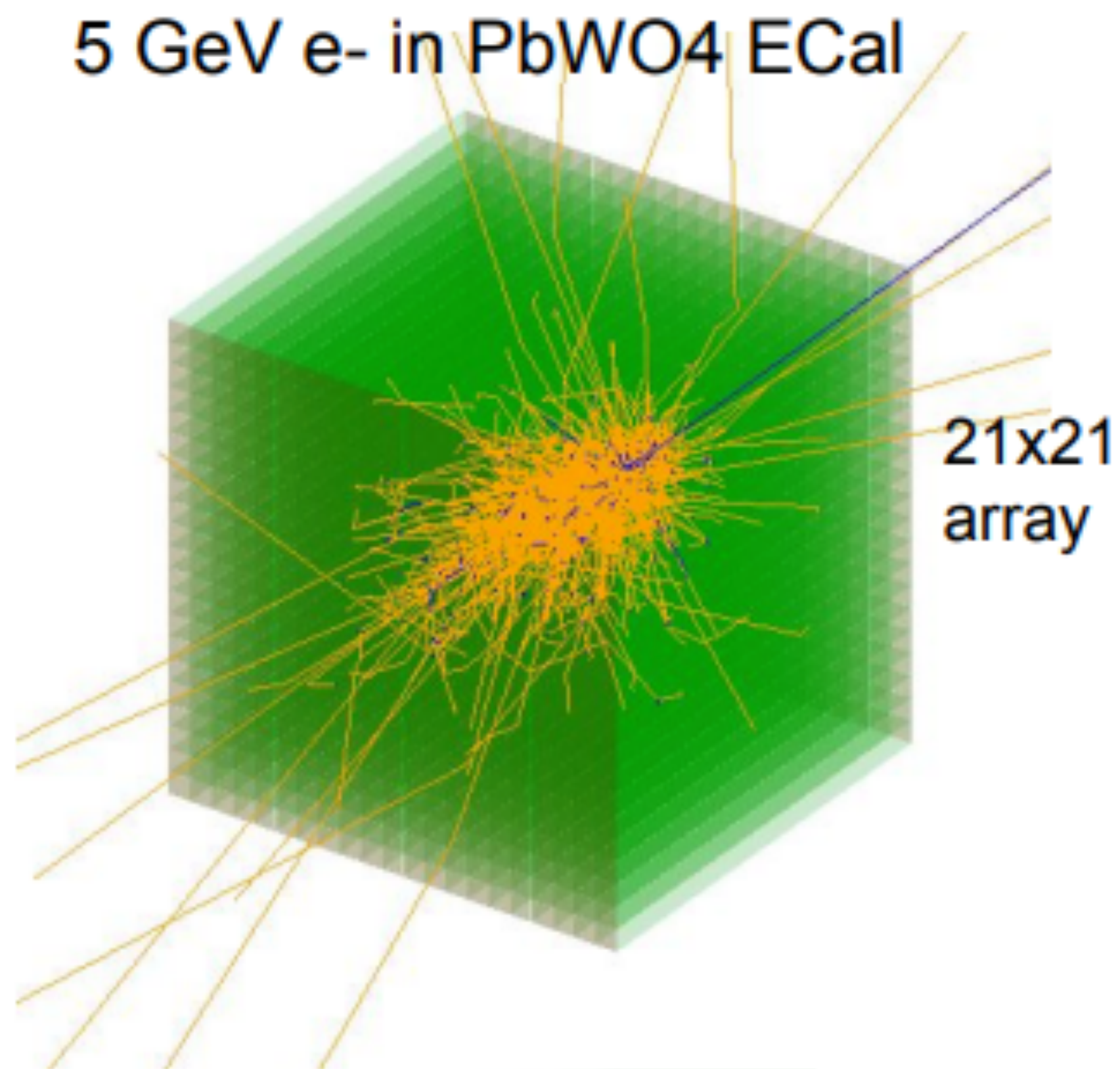
Simulation Meeting
October 25, 2024

General Information

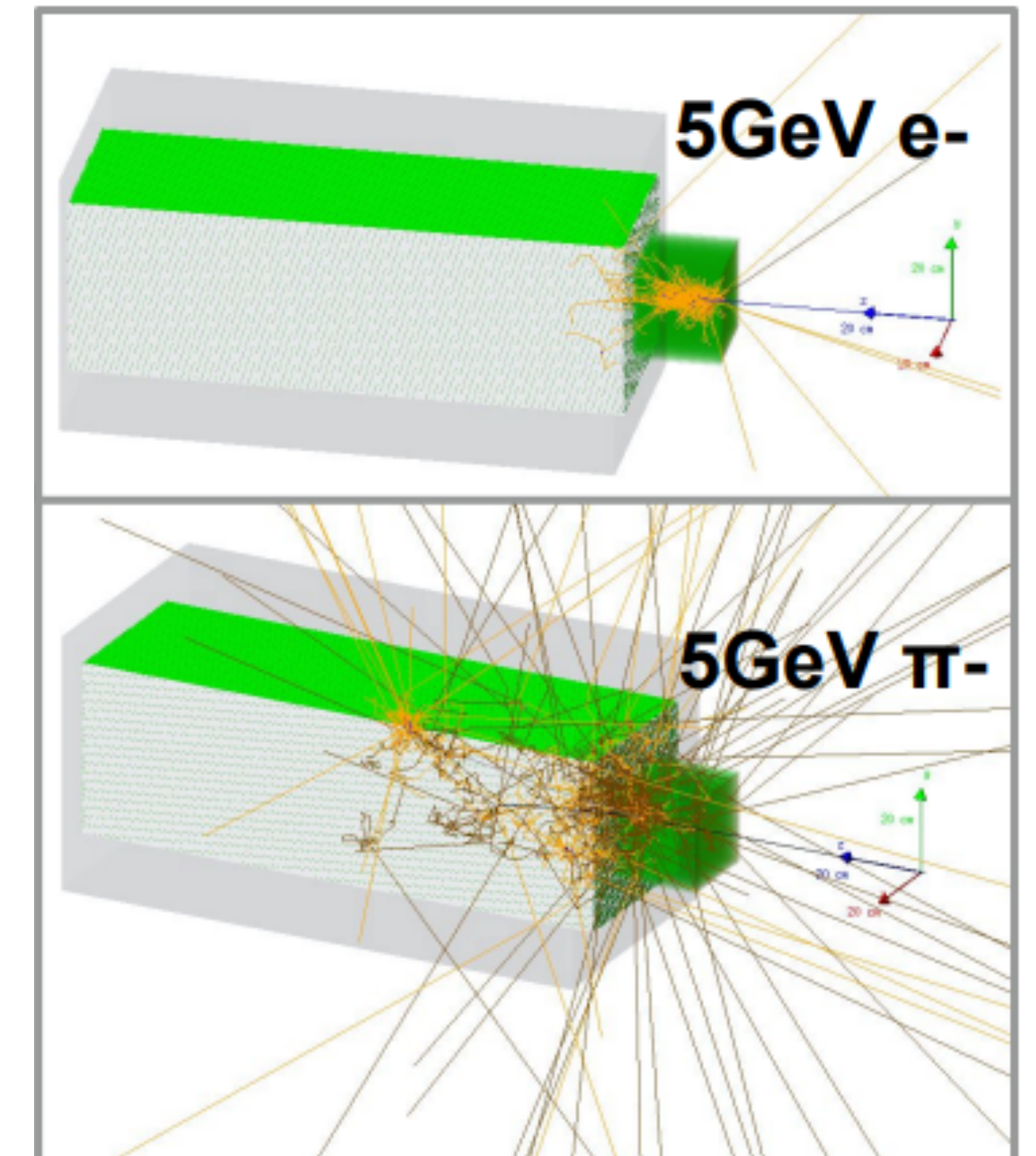
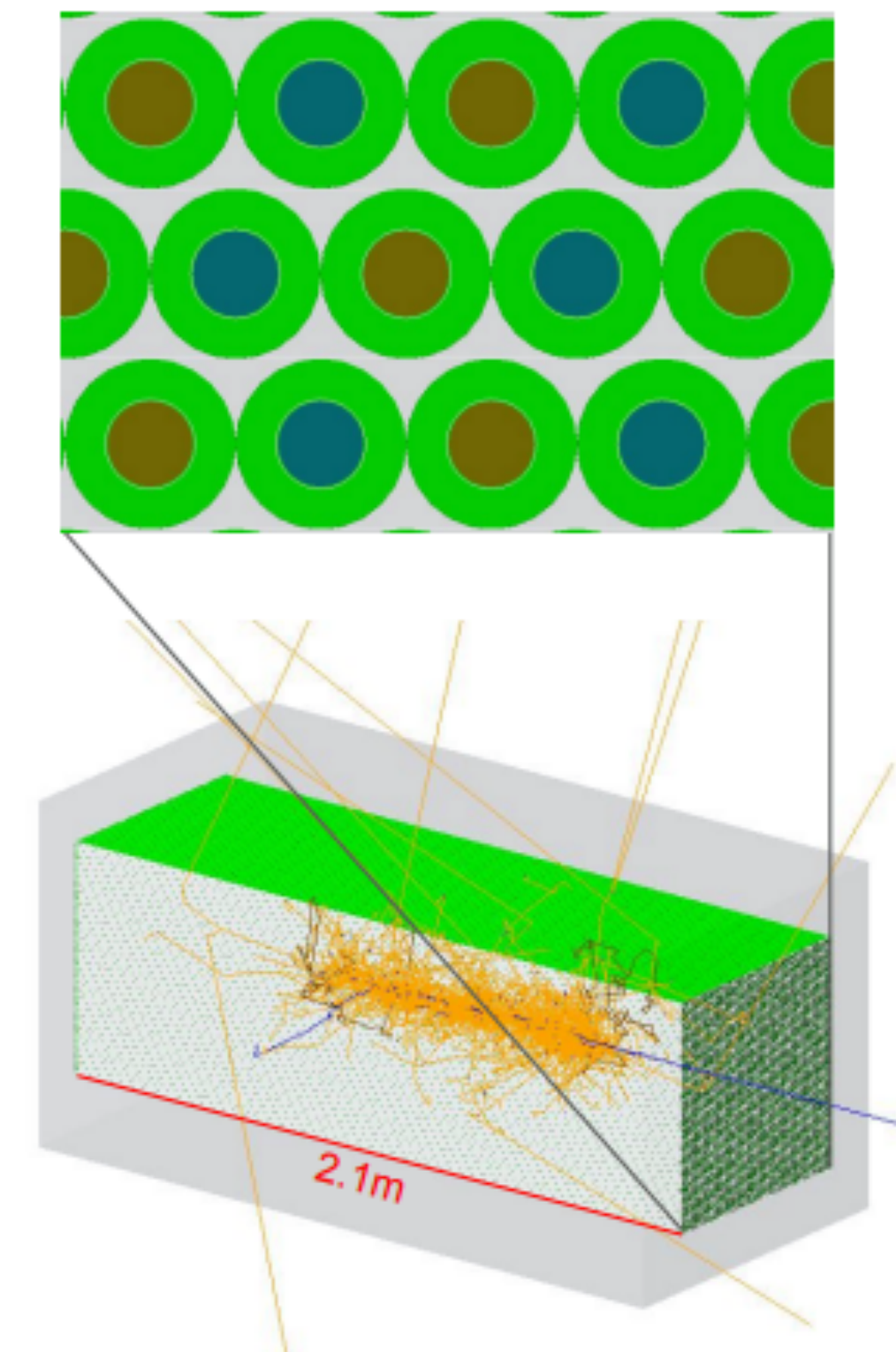
- Used DD4HEP (DetectorDescription4HighEnergyPhysics) for Dual calorimeter simulation (user-manual [link](#))
- The foswiki [link](#), and the working gitlab [link](#) used by Baylor university and UMD
- Used DD4HEP to simulate —> **WIP**
 1. ECAL crystal calorimeter in an array of 21x21 crystals; two segmented crystal simulated
 2. **HCAL fiber, Sampling**, and pure crystal calorimeter
 3. Dual calorimeter: ECAL + HCAL
- Working group meetings on Fri 3:30 to 4:30, indico [link](#)
- Working group mattermost channel: standalone simulations of ECAL plus HCAL

Event Displays \rightarrow Extra info for Crystal Calorimeter

- ECAL: 21 x 21 crystals lead tungstate (PbWO₄); old event display that shows one segmented ECAL
- HCAL: Fiber calorimeter
- DualCalorimeter: ECAL+HCAL Fiber



Front view of Fiber HCal



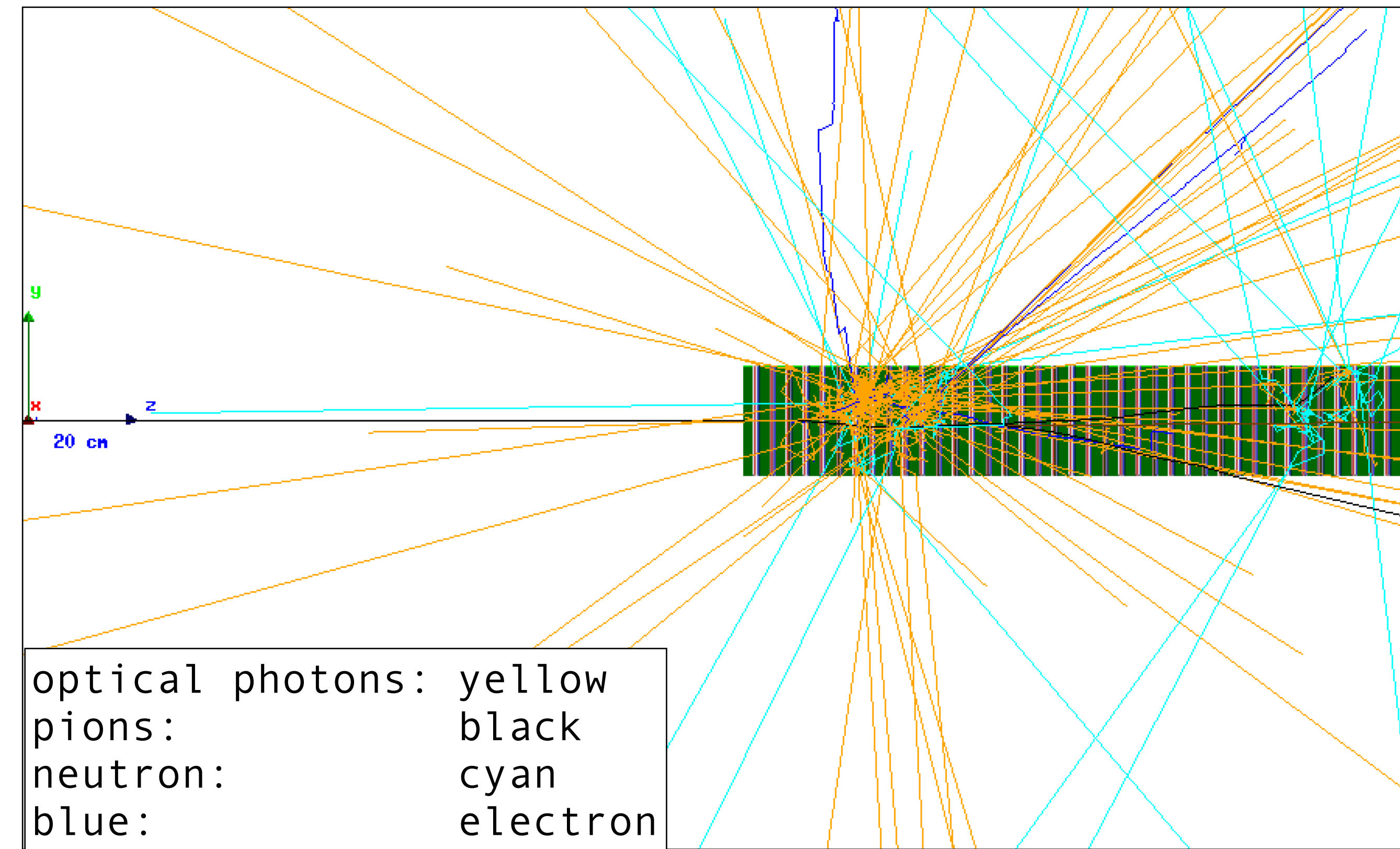
Event Display with Sampling HCAL

- Sampling HCAL event display with 5 GeV pion
- Sampling calorimeter 40 layers of: (SCEPCALConstants.xml in [link](#))

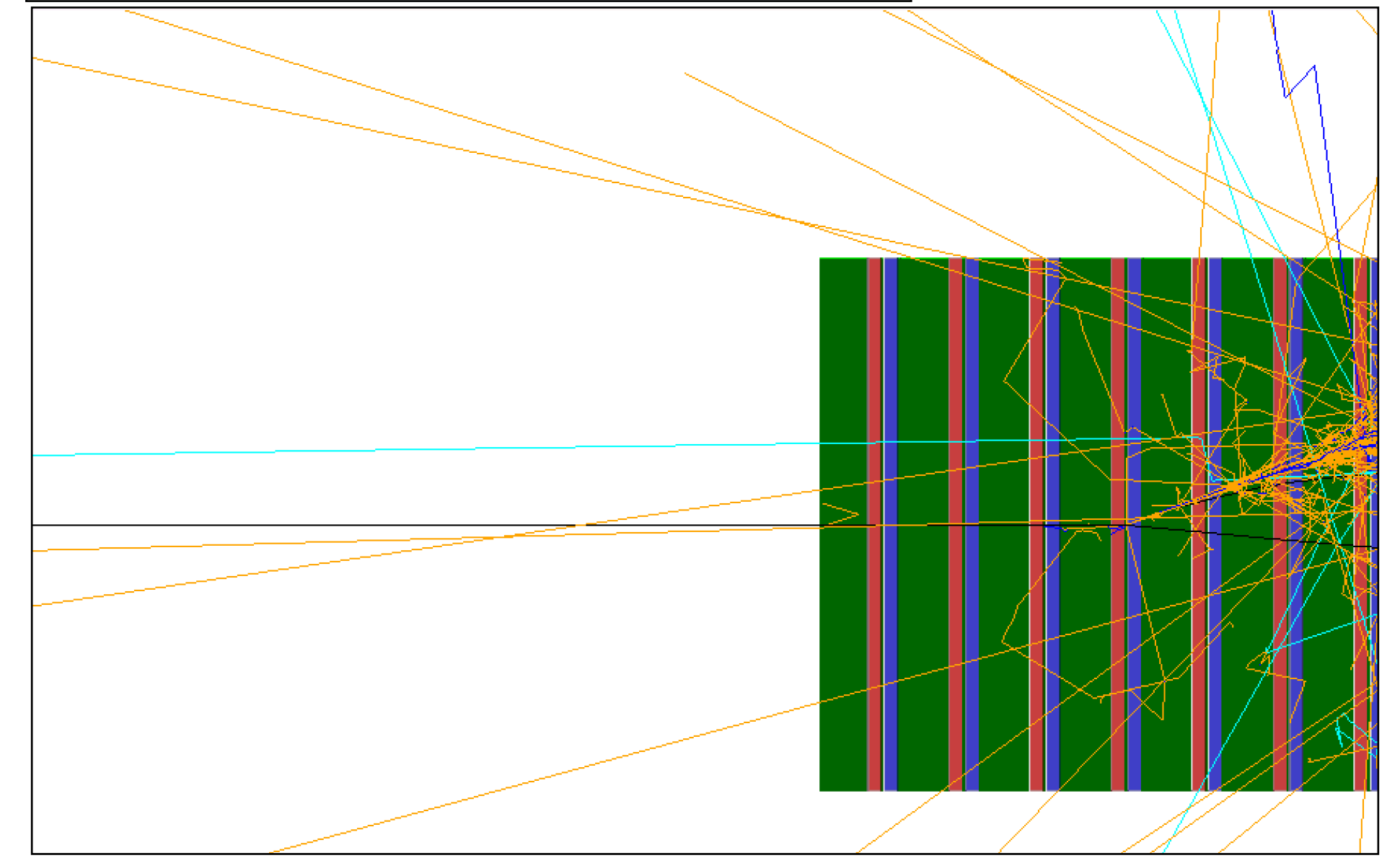
Iron absorber(**GREEN**); width=18 mm; Polystyrene (**Scintillation**); width=5 mm; Quartz (**Cerenkov**); width=5 mm

- Total length of the sampling calorimeter = $40 \times (18 + 5 + 5 + 1) = 1160\text{mm} = 1.16\text{m}$;
- Dimensions along X and Y axis = 20 cm

→ **Sampling calorimeter length presented here is about half the Fiber calorimeter**



optical photons: yellow
pions: black
neutron: cyan
blue: electron



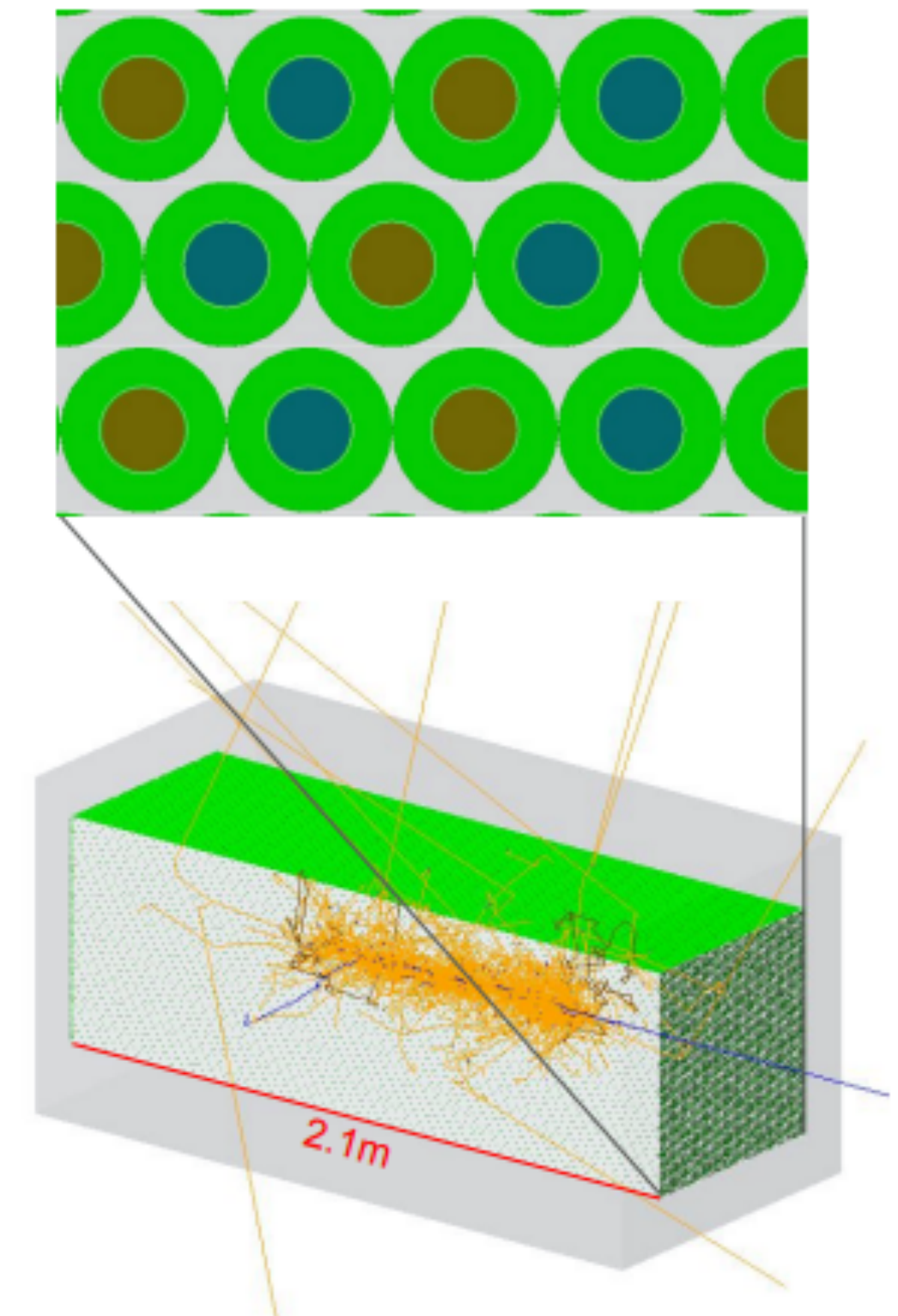
HCAL

- Sampling HCAL event display with 5 GeV electron
- Fiber calorimeter: 250 **S** and **C** fibers: (SCEPCALConstants.xml)

Polystyrene (**Scintillation**); Quartz (**Cerenkov**);

- Total length of the sampling calorimeter = $210m$;
- 250 fibers along X and Y directions ($= 1.0 \times 250 = 25cm$)

Front view of Fiber HCal



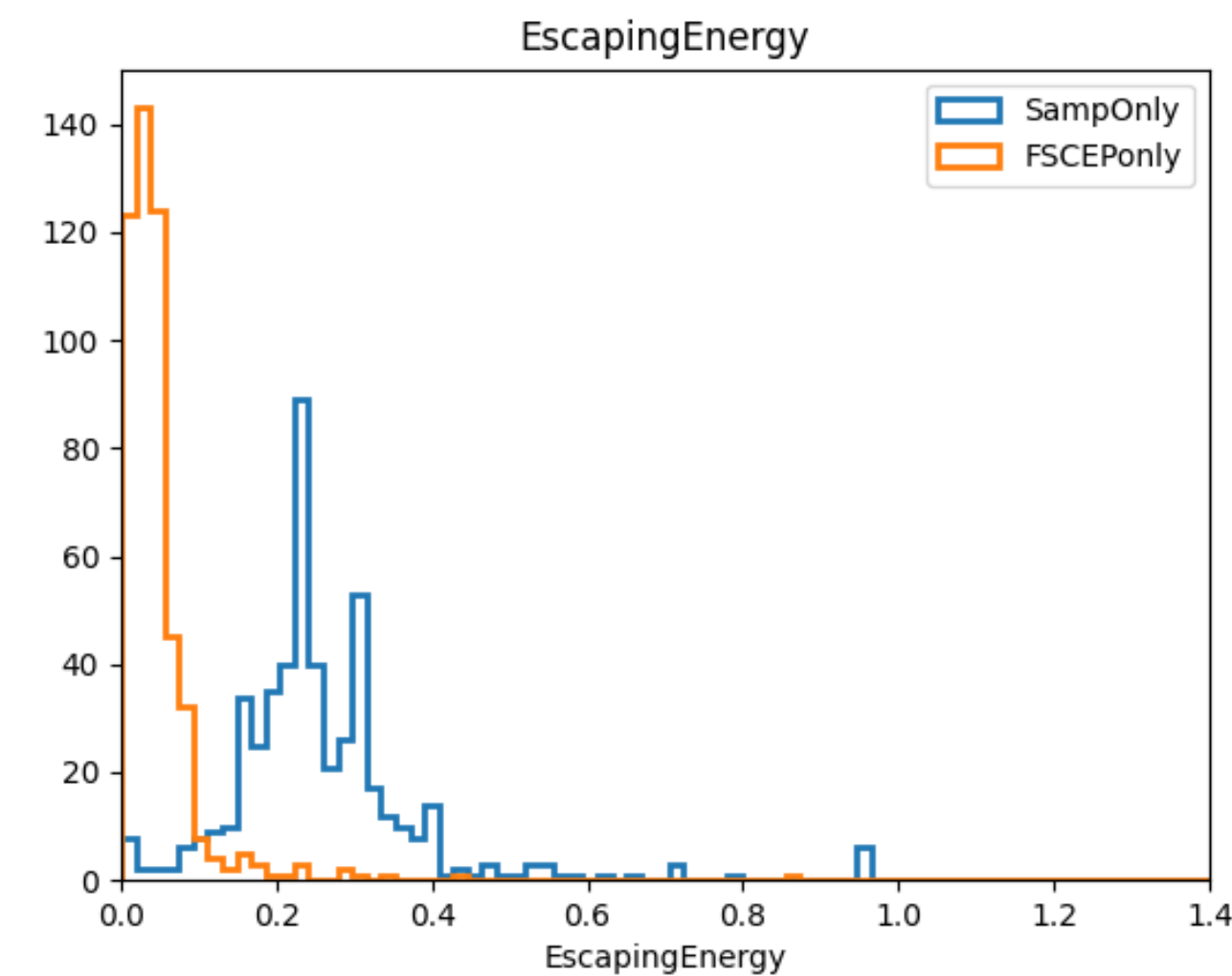
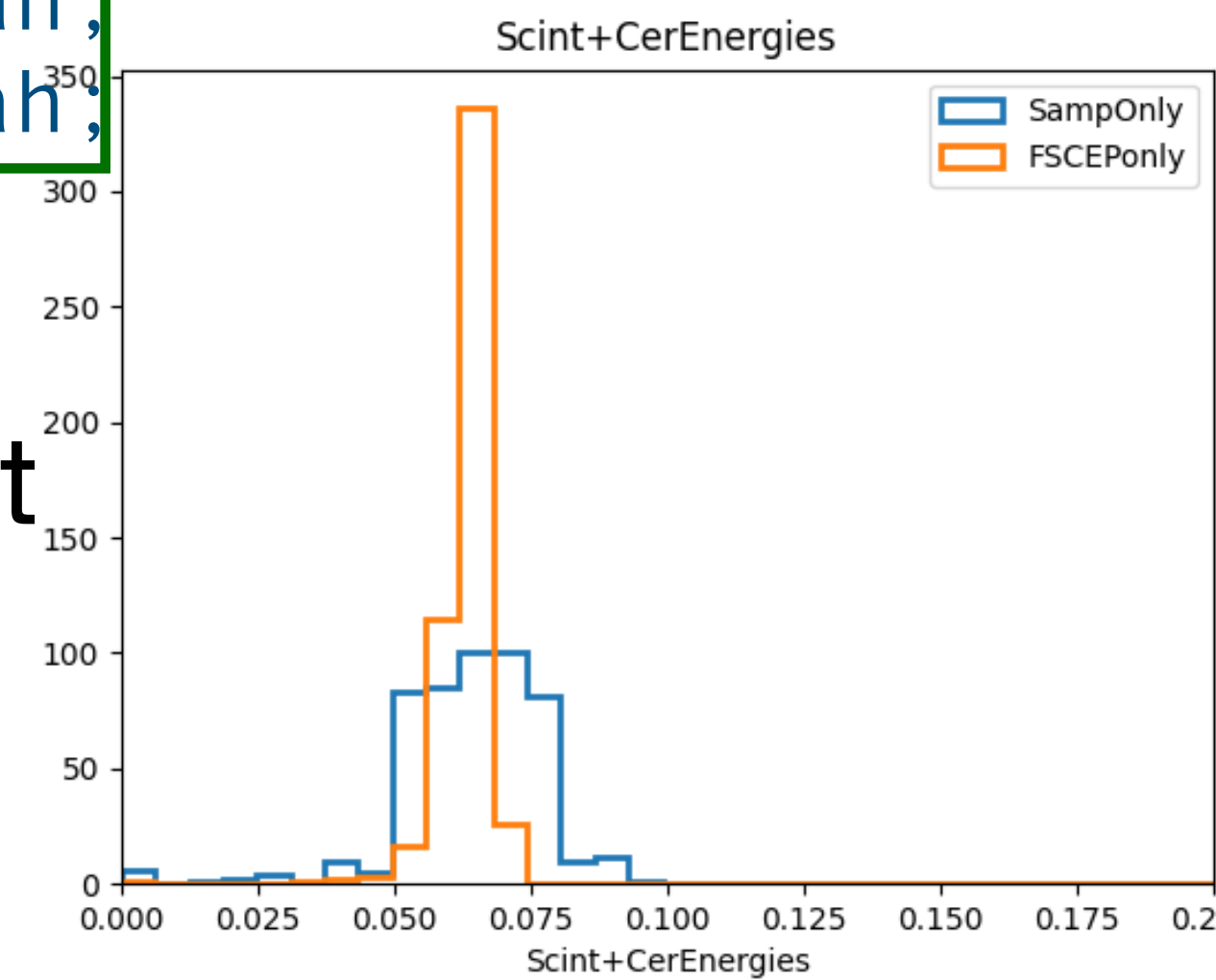
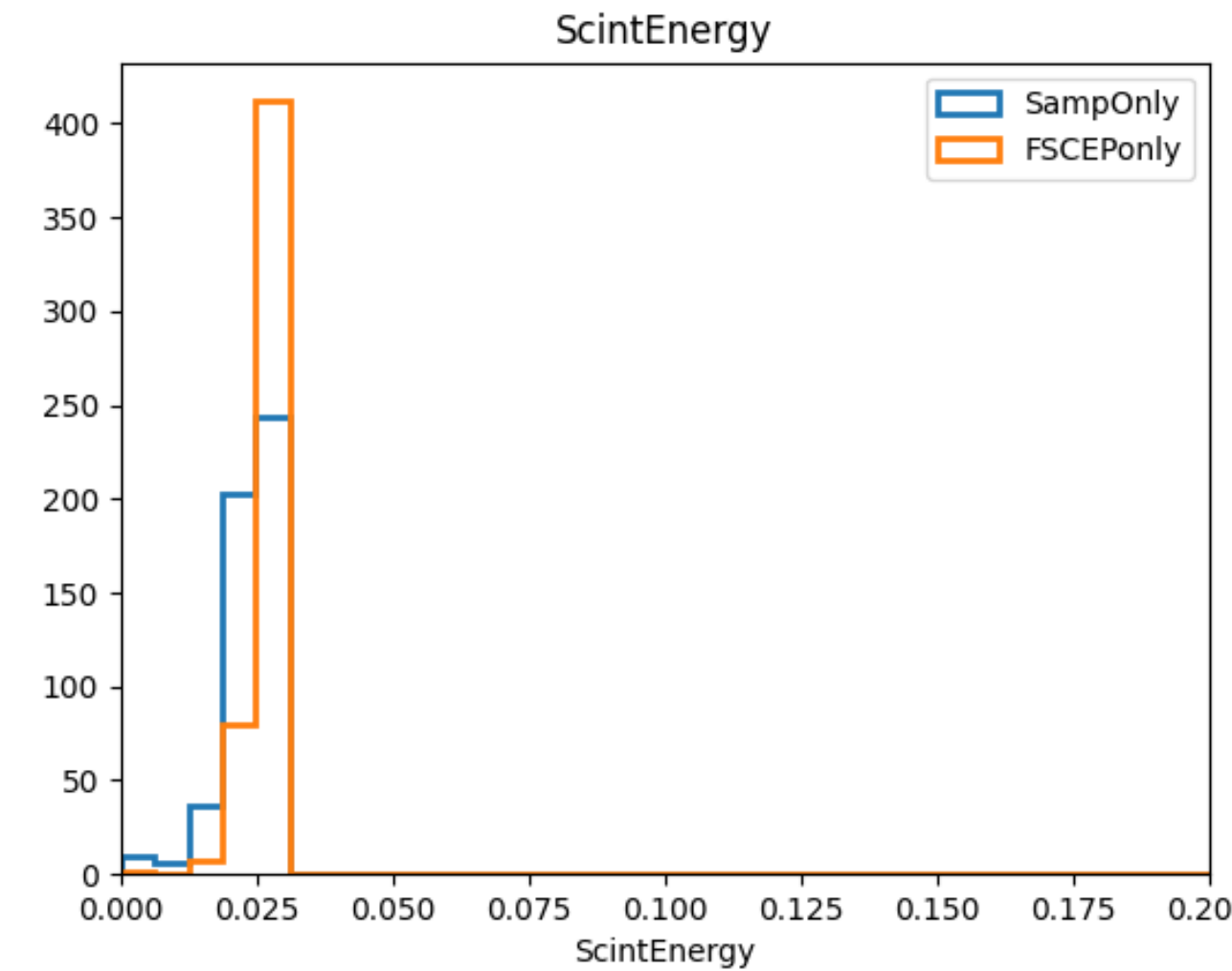
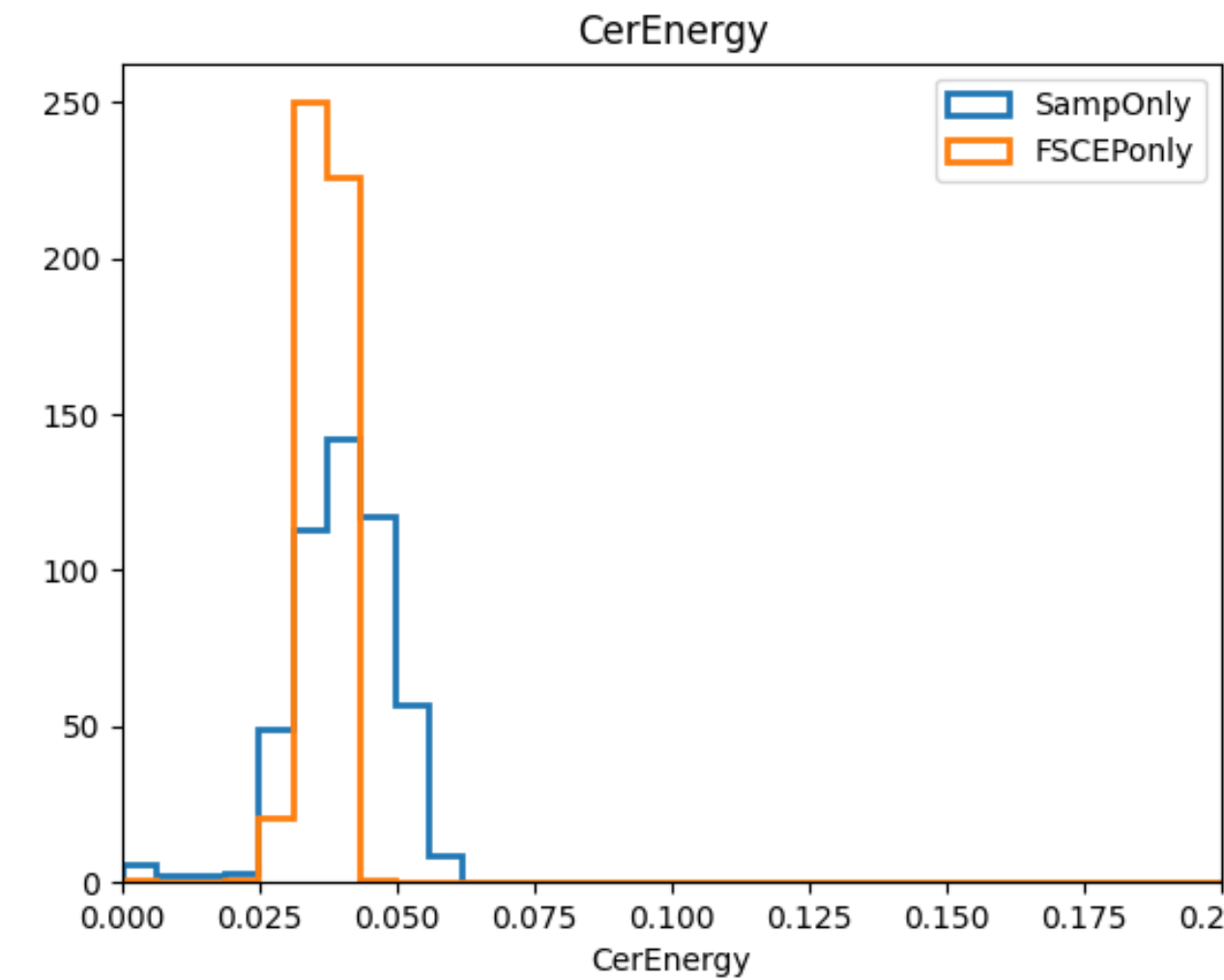
HCAL Energies: Fiber & Sampling

- pion beam 50 GeV

- Used relative energy (/ beamEnergy):

```
for(size_t i=0;i<hcalhits->size(); ++i) {  
  CalVision::DualCrysCalorimeterHit* ahcalhi  
  =hcalhits->at(i);  
  ah=ahcalhit->energyDeposit  
  if( ifiber==1) {eesumfiber1+=ah;}  
  if( ifiber==2) {eesumfiber2+=ah;}  
  if( islice==( *sii3).second ) eesumfiber1+=ah;  
  if( islice==( *sii6).second ) eesumfiber2+=ah;  
}
```

- Sampling calorimeter energy containment is smaller than Fiber calorimeter



Number of Cer & Scint: Sampling, Fiber Calorimeter

Values from Resolution.C code; sed gendet == 3
from `getStuff` Function:

```
CalVision::DualCrysCalorimeterHit* ahcalhit =hcalhits->at(i);  
if(ifiber==1) nscinttothcal+=ahcalhit->energyDeposit;  
if(ifiber==2) necertothcal +=ahcalhit->edeprelativistic;  
if( islice==( *sii3).second ) nscinttothcal+=ahcalhit->energyDeposit;  
if( islice==( *sii6).second ) necertothcal+=ahcalhit->edeprelativistic;
```

The normalization from electrons (`getMeanPhot` Function):

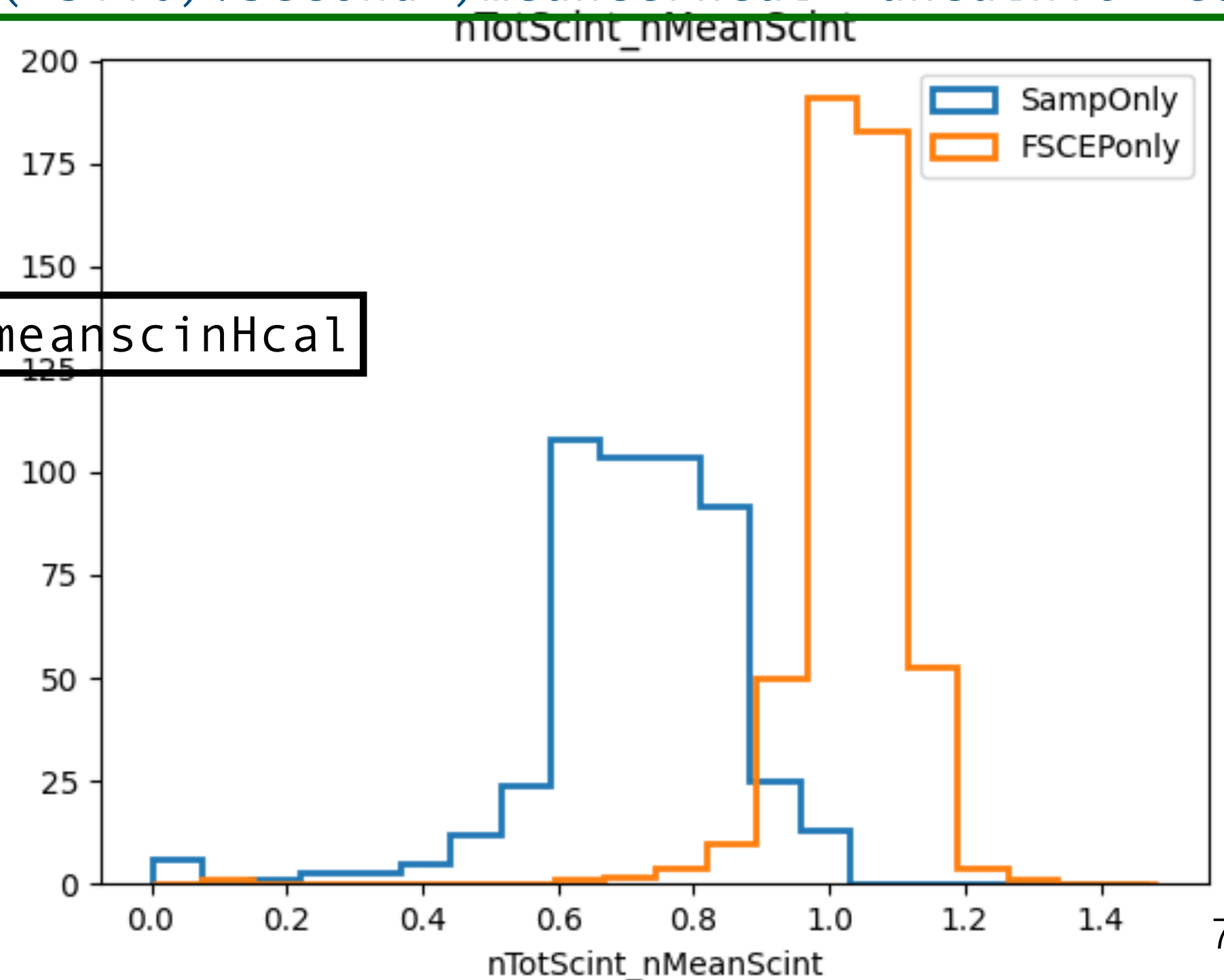
```
if(ifiber==1) meanscinHcal+=ahcalhit->energyDeposit;  
if(ifiber==2) meancerHcal+=ahcalhit->edeprelativistic;  
if( islice==( *sii3).second) meanscinHcal+=ahcalhit->energyDeposit;  
if( islice==( *sii6).second )meancerHcal+=ahcalhit->edeprelativistic;
```

Sampling

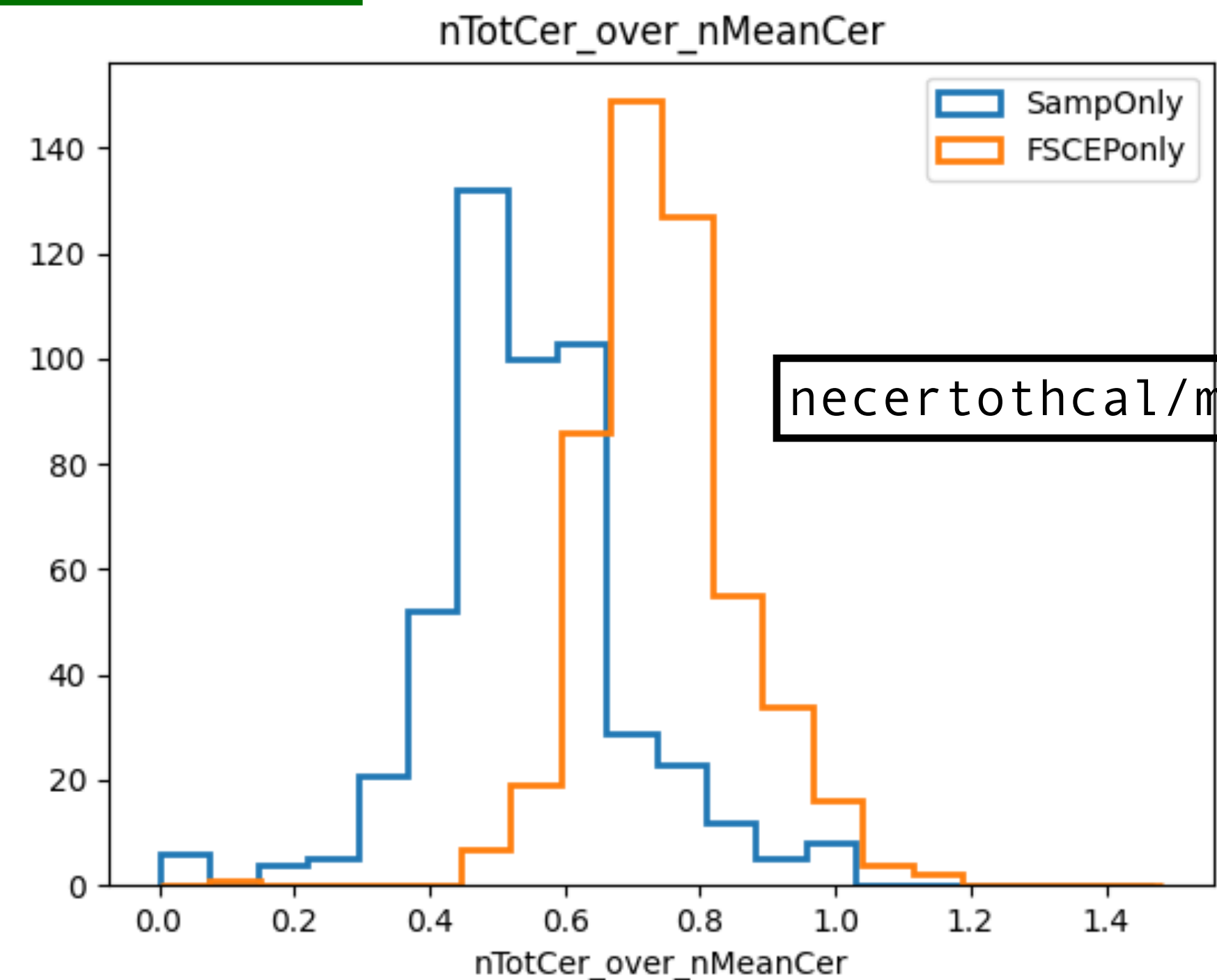
Fiber

Conclusion: Sampling Calorimeter has **lower** number of total Cer and Scint w.r.t. Fiber Calorimeter

`nscinttothcal/meanscinHcal`



`necertothcal/meancerHcal`



Sampling Calorimeter

- Comparison between Chekanov (left) and dd4hep (right) results —> Good agreement
- nCer vs nScint (normalized to the meanCer and meanScint of an electron) plot for pions and electrons

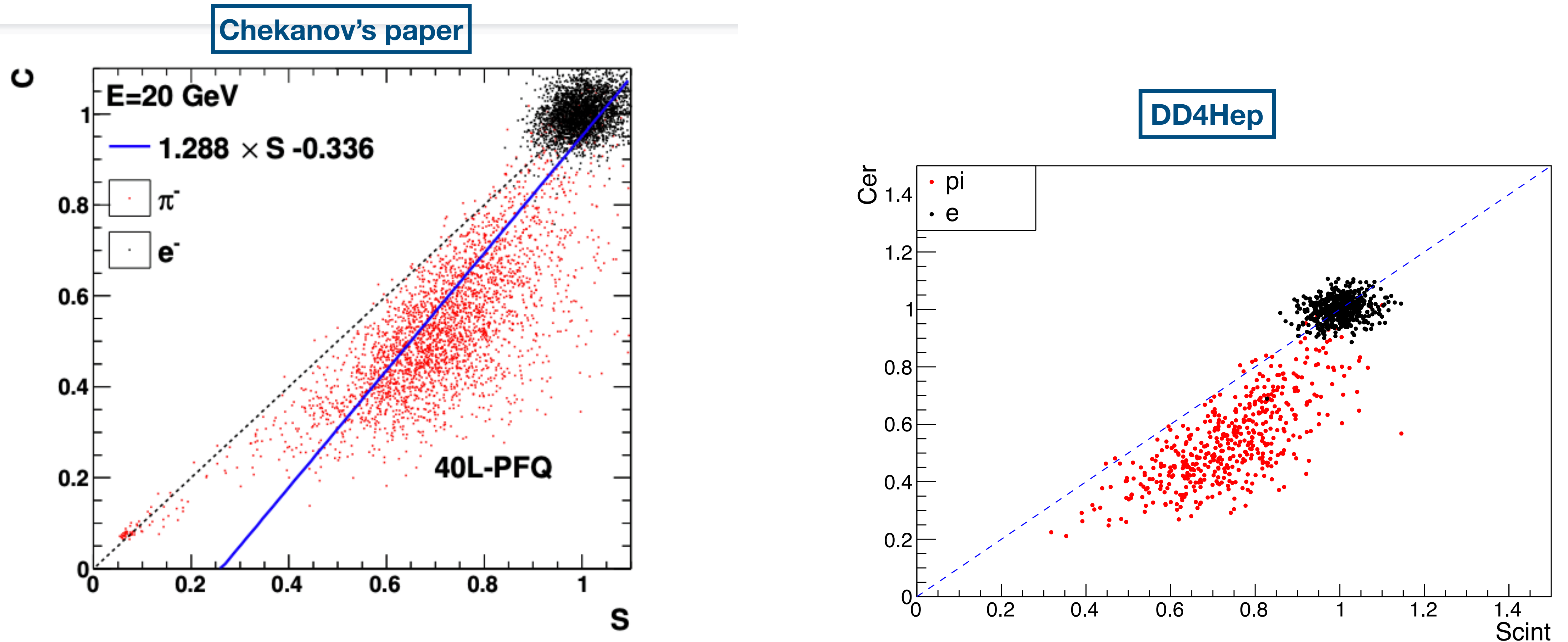
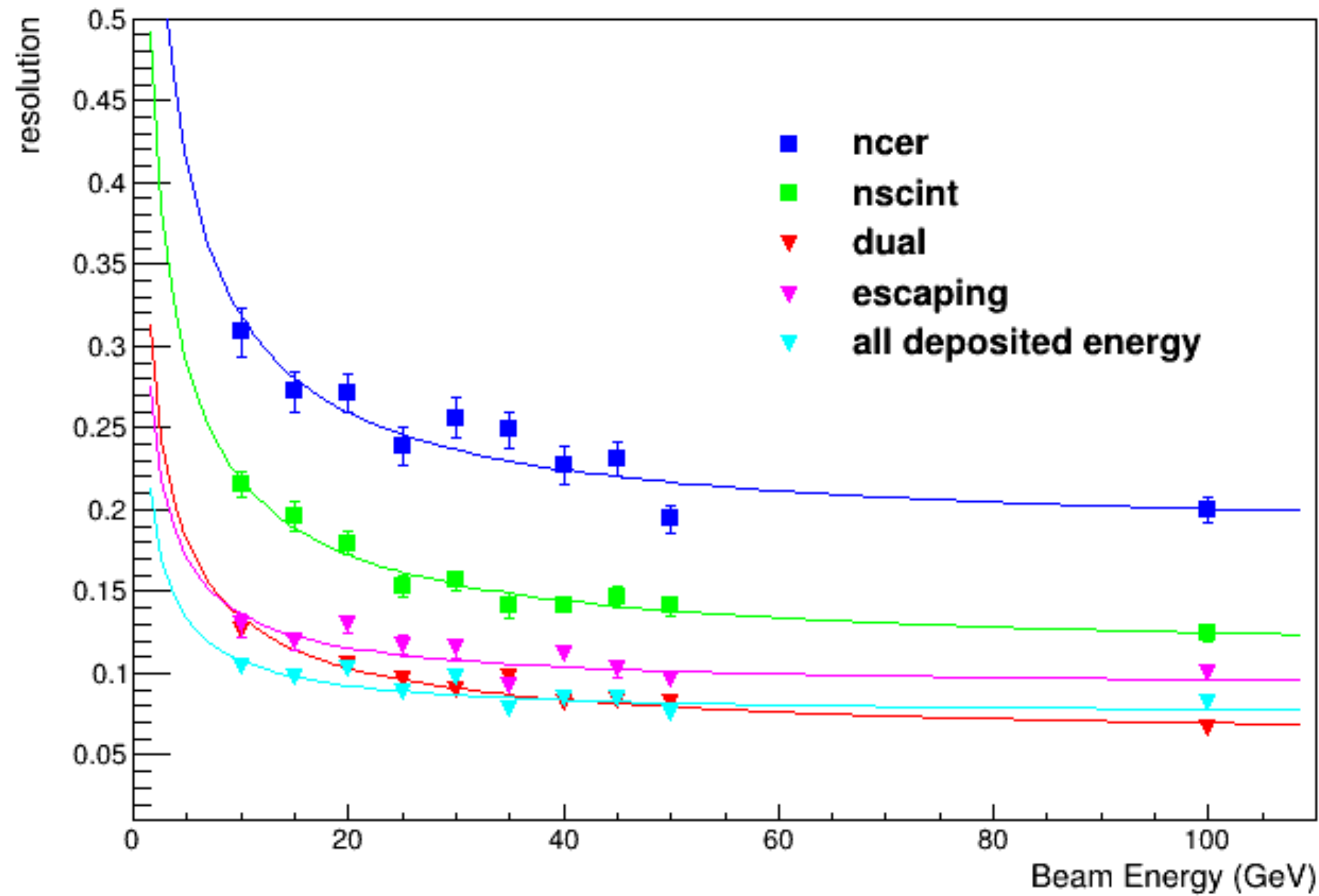


Figure 3: Correlation between calibrated scintillation yield (S) and Cherenkov yield (C) for a

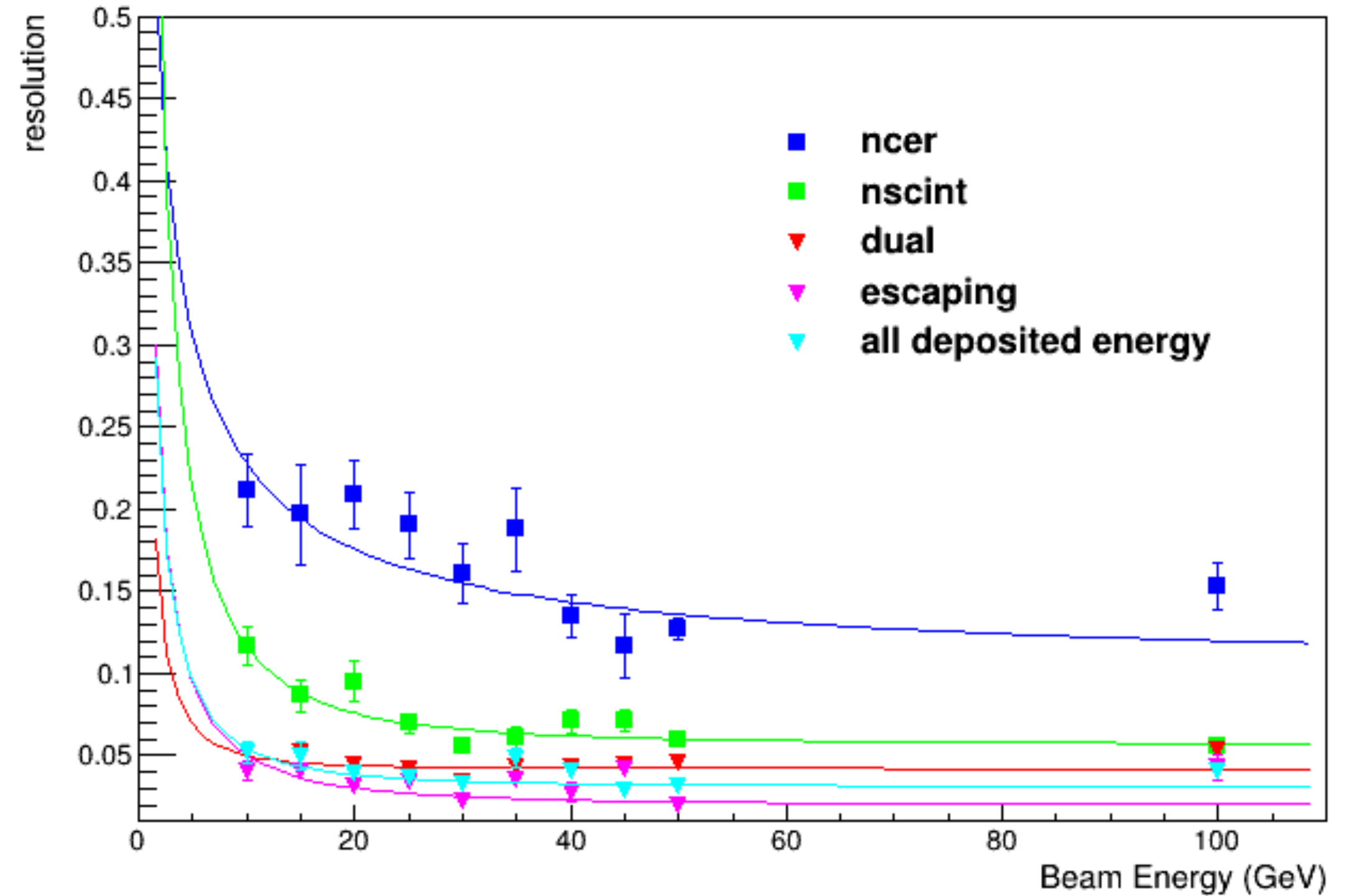
HCAL Calorimeter Resolutions

- Left Sampling Calorimeter (500 events)
- right Fiber Calorimeter (120 events)

Sampling HCAL pi- Resolution vs Energy

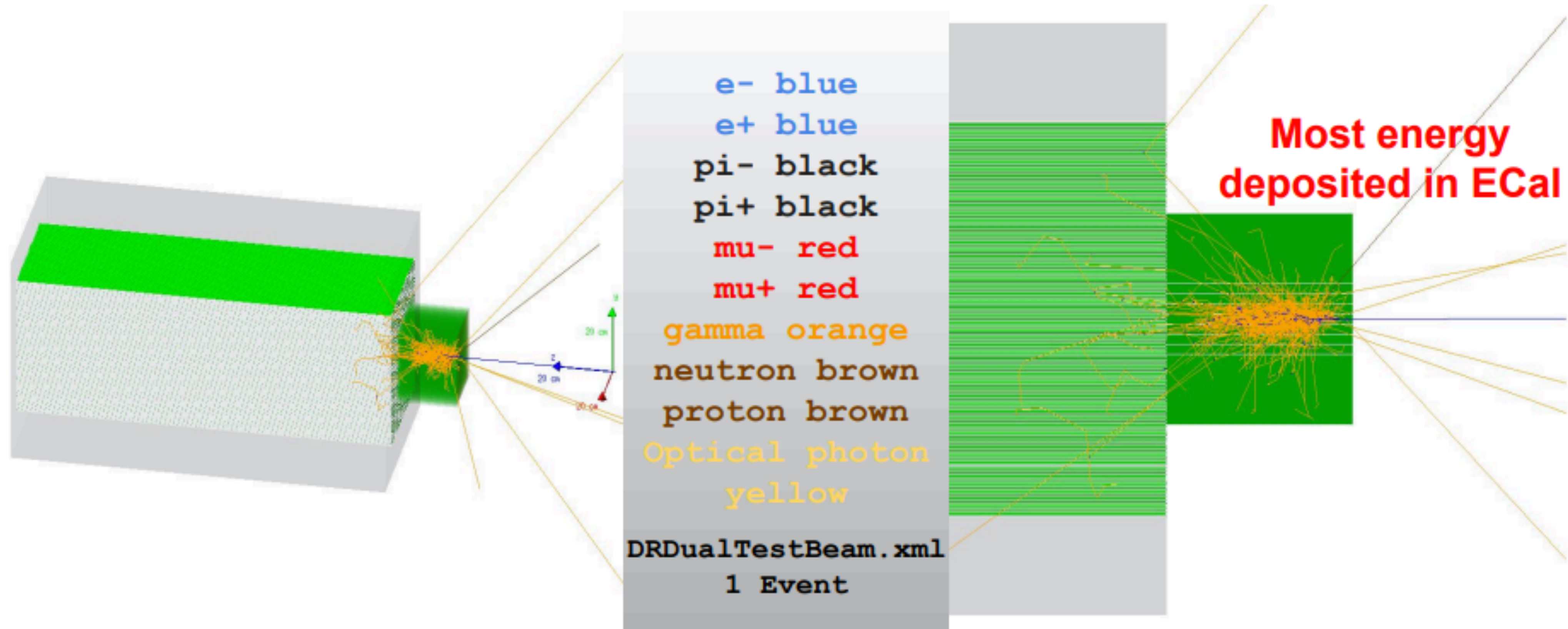


FiberOnly HCAL pi- Resolution vs Energy



Backup slides

5 GeV Electron Beam into ECal + HCal



5 GeV Pion- Beam into ECal and HCal

