ECAL Simulation Status

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28.01.09

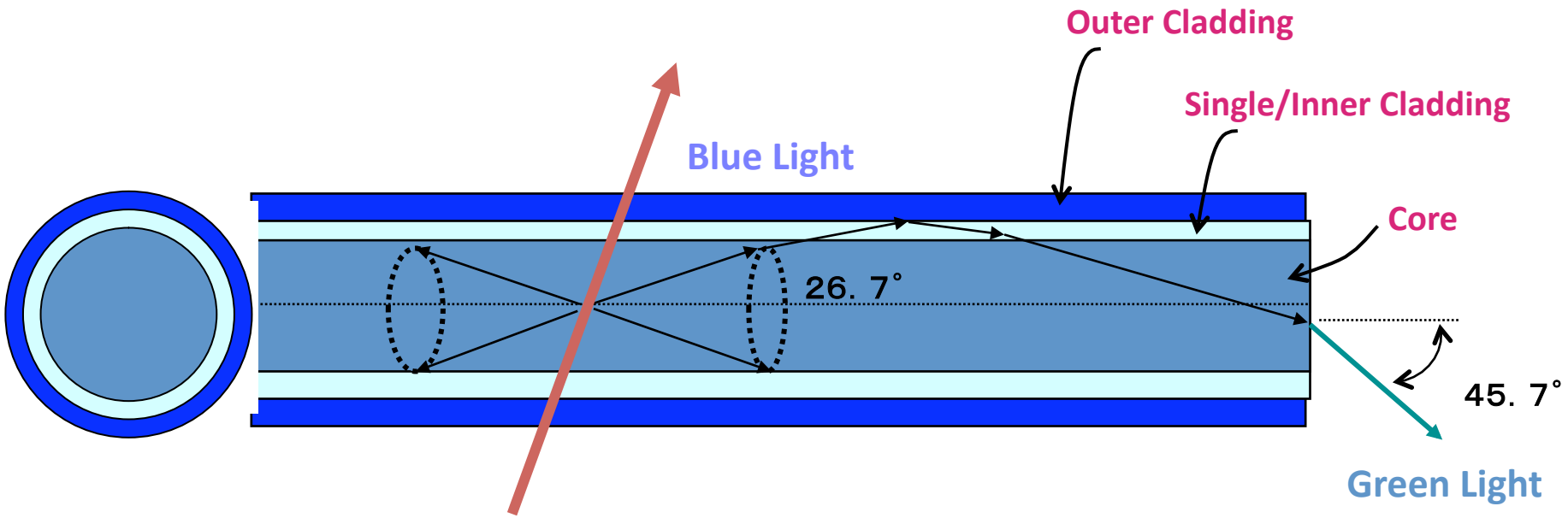
Optical processes in a bar

- Bar 839.75 x 7.75 x 2 mm^3
- Polystyrene:
  - refractive index 1.5
  - absorption length 2 cm
  - scintillation yield 10./keV (±3)
- Kuraray WLS fiber Y11 with double cladding, D=1mm:
  - quoted trapping eff. 5.4%
  - quoted peak emission 476 nm,
  - 430-620 in this simulation
  - absorption length >3.5 m (≈5 m found in ITEP test measurements, NIM A 564 (2006) 590-596)

Yuki Shiomi presentation “About Kuraray WLS Fibers”

Transmission Mechanism of Multi Cladding Fiber

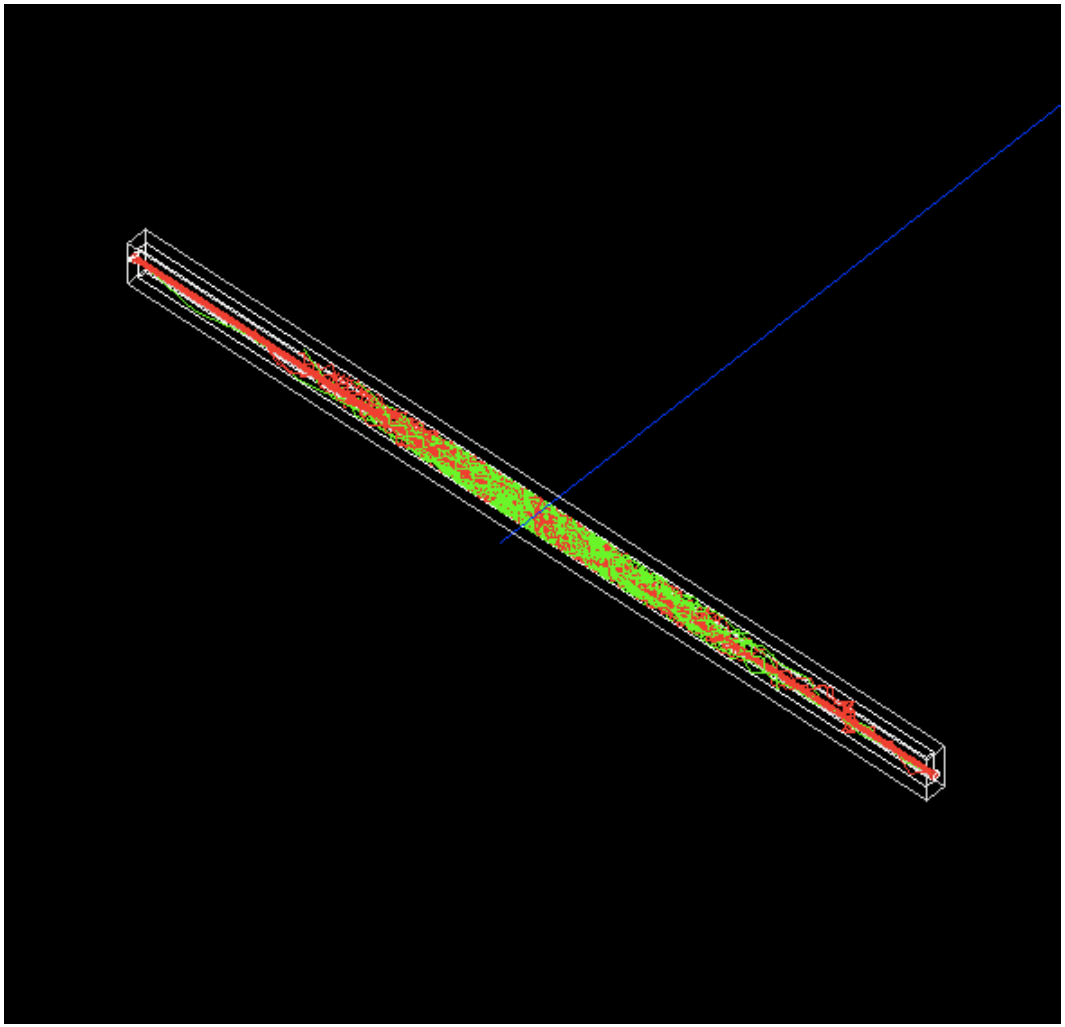
[Y-11 Multi cladding]



◆Multi cladding fiber has 50% higher light yield than single cladding fiber

	Material	Refractive Index	Density (g/cm)
Core	Polystyrene	nD=1.59	1.05
Single/Inner Cladding	Polymethylmethacrylate	nD=1.49	1.19
Outer Cladding	Fluorinated Polymer	nD=1.42	1.43

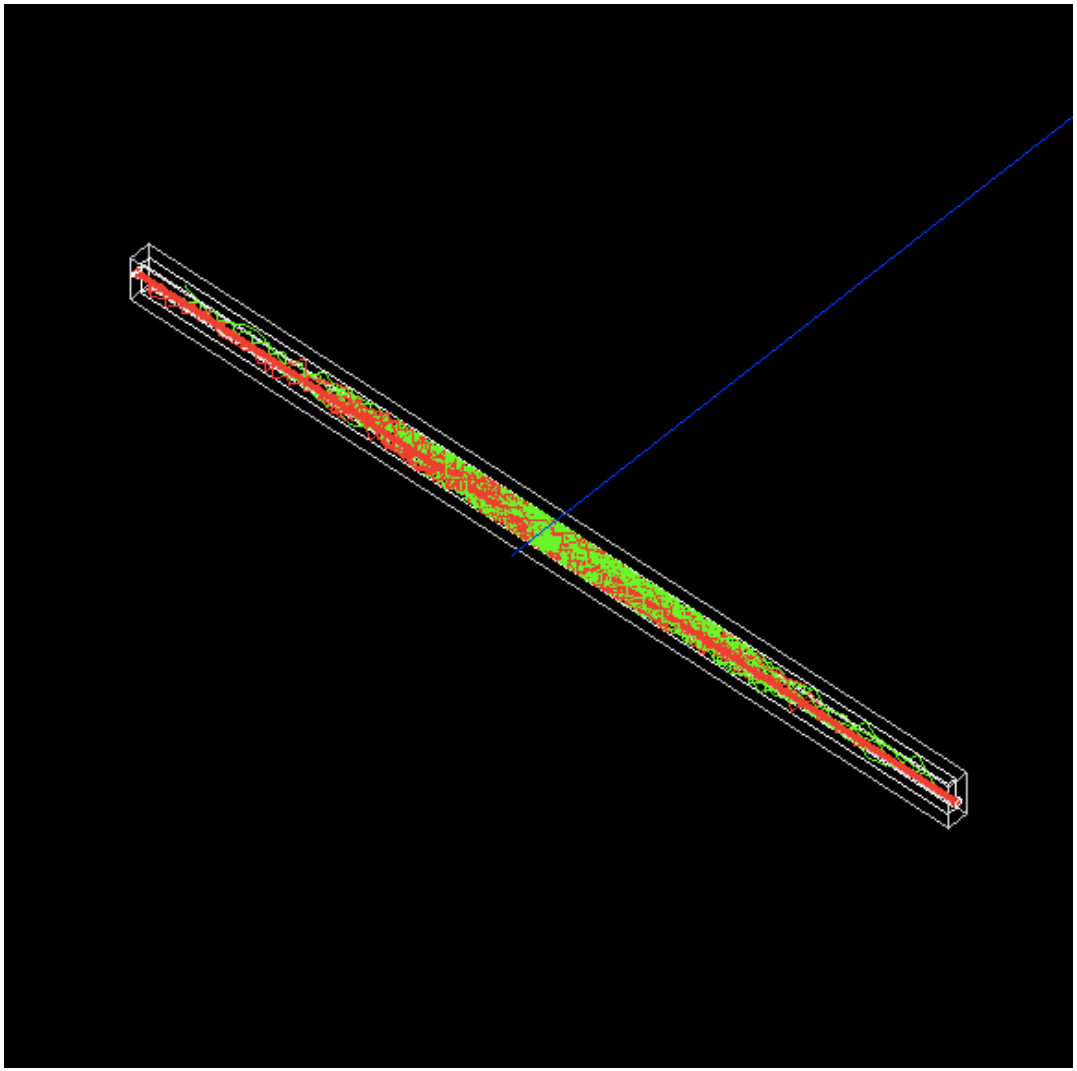
MIP passing through bar(0,0,0)



Dimensions: 200 x 7.75 x 2 mm^3
Total energy deposition in scintillator:
167. (keV)
Number of photons
that hit SiPMs in this event : 172
(9.8%)
produced by scintillation: 1700
produced by cerenkov: 53
absorbed (OpAbsorption): 1580

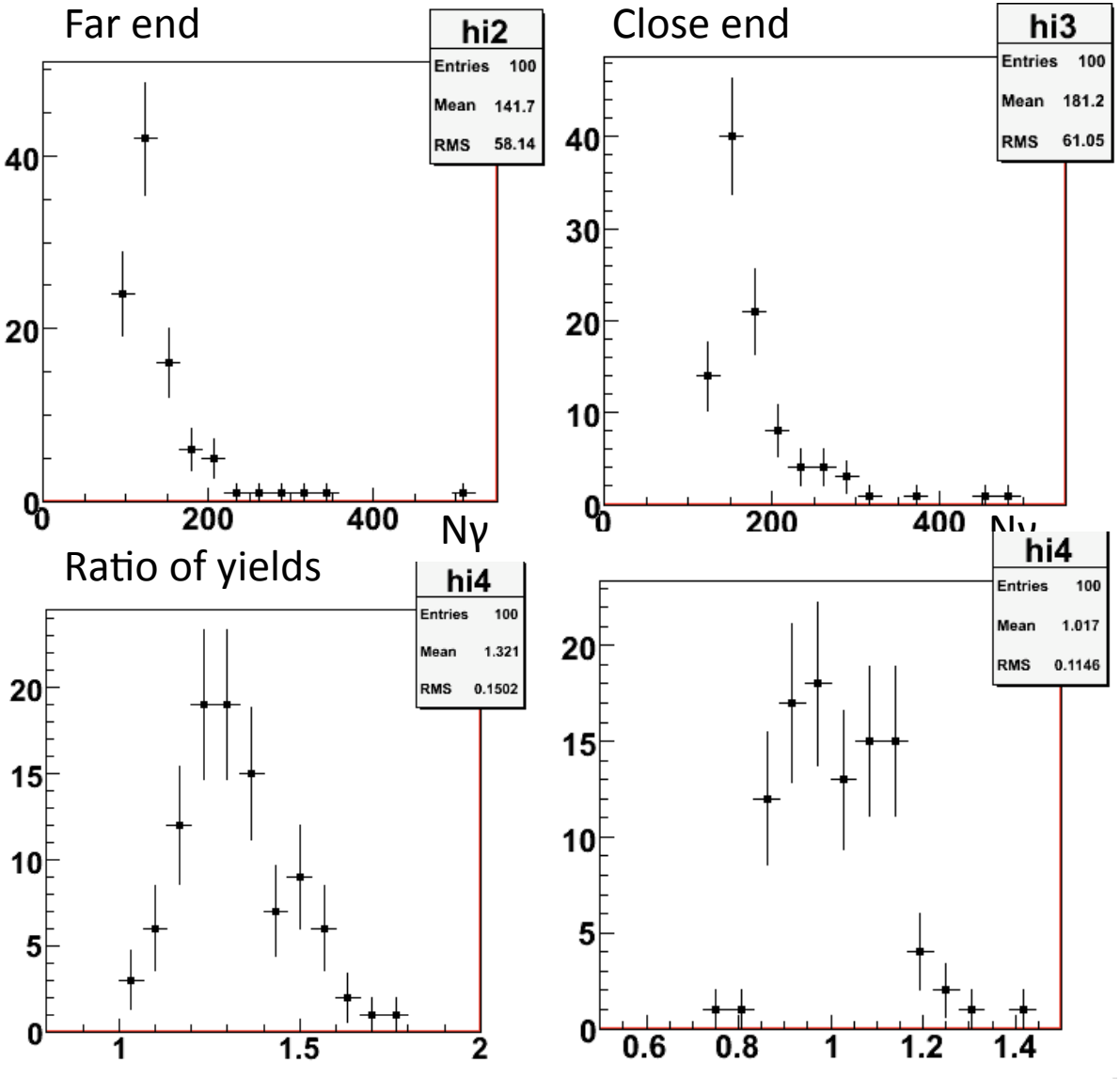
Colours: WLS photons are red, scintillation and Cerenkov photons are green

MIP passing through bar(0,2.5,0)



Dimensions: 200 x 7.75 x 2 mm^3
Total energy deposition in scintillator:
330. (keV)
Number of photons
that hit SiPMs in this event : 295
(8.9%)
produced by scintillation: 3264
produced by cerenkov: 53
absorbed (OpAbsorption): 3022
MIP: 2.052 MeV/cm => 410 keV/ 2mm

Attenuation length effect



Beam passes near the end of the bar and shifted with respect to its center. 30% difference in the number of output photons.

Beam passes through the x-center of the bar and shifted in y-direction with respect to its center.

Mean of total number of photons is the same for both cases.

Future steps for simulation

Actual SiPM simulation:

-embed into Geant simulation (account for the output WLS fiber spectrum and SiPM PDE λ dependency);

-optimize the reflective foil parameter;

-scint. bar and fiber dimensions and position already fixed?

-or once having the light output on the ends of the fibers study separately the effects of gain variations in SiPM.