Status and testing of the upgrade of material model in TkLayout

Tracker Week

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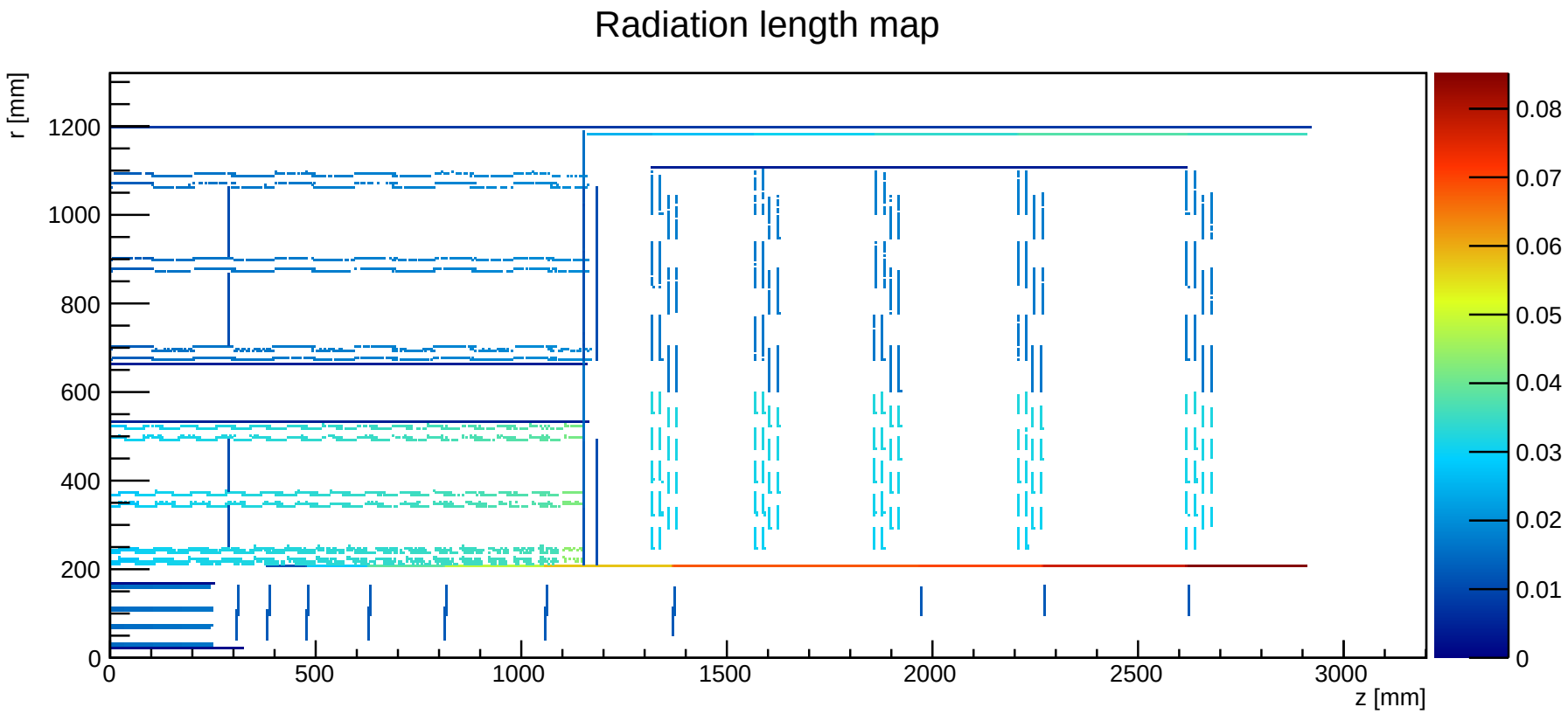
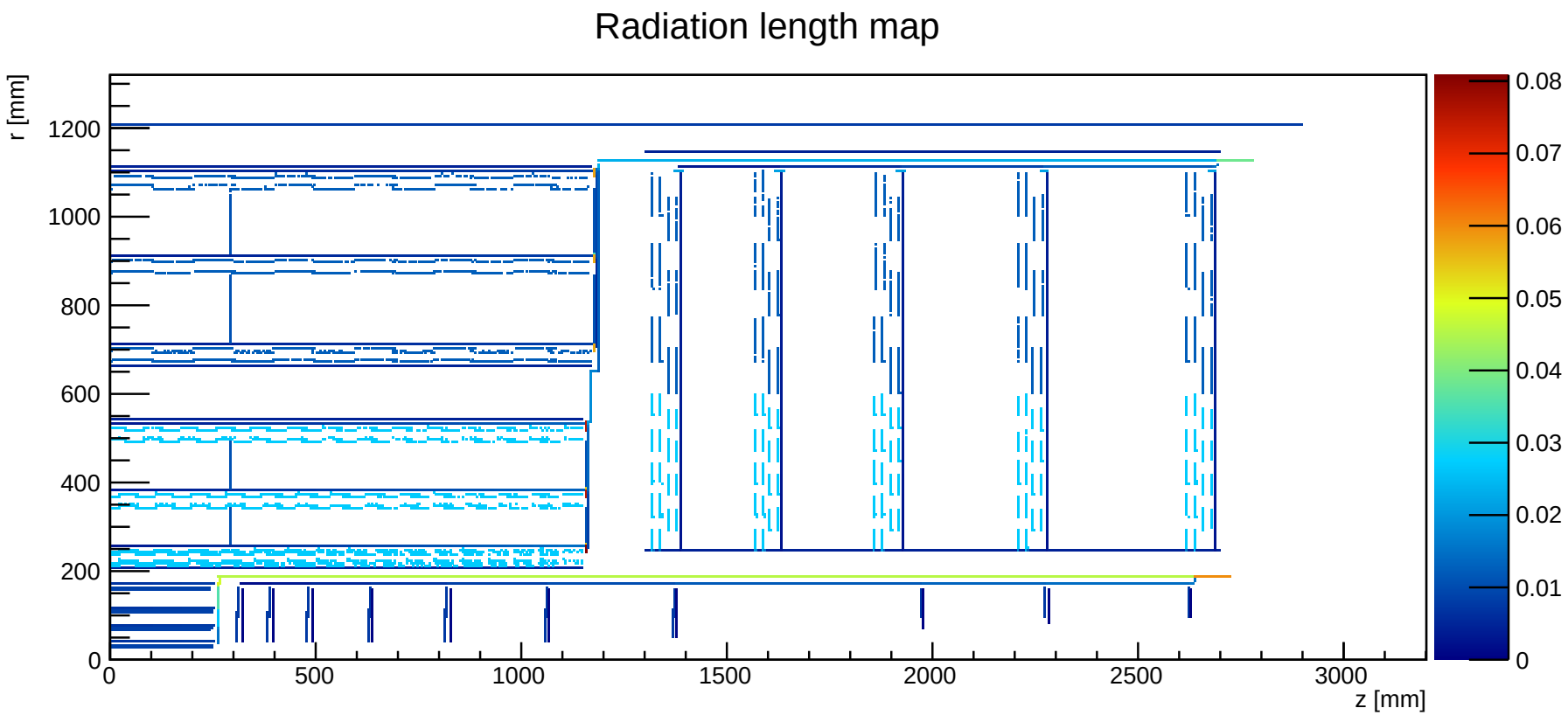
Old model



- ✓ Cables material distributed inside modules volumes
- ✓ Possible to model cooling pipe along rods, manifold in the flange and bigger cooling pipe out of the barrel

New model

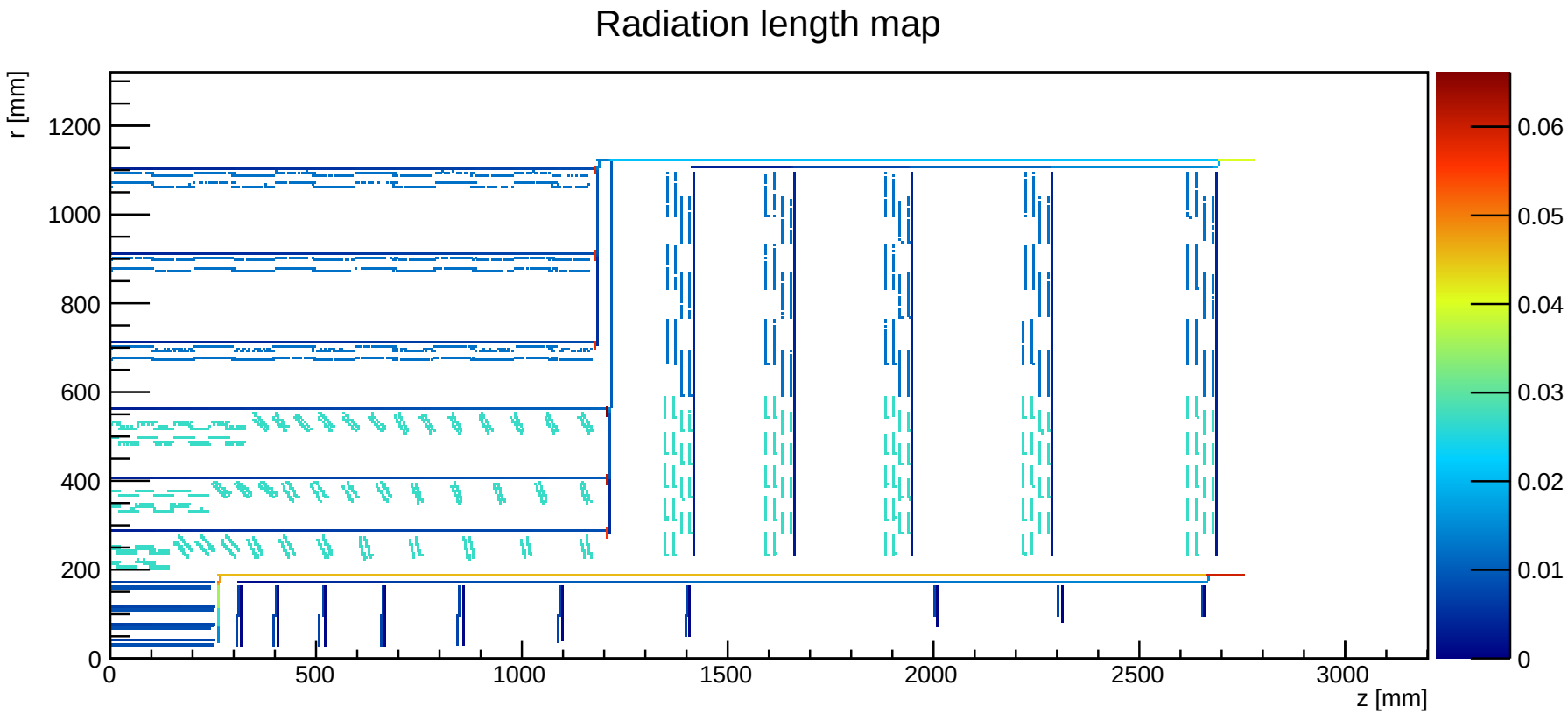


- ✓ Cables material in dedicated volumes
- ✓ More detailed
- ✓ Better routing algorithm
- ✓ More functionalities

Advantages

Correct description for tilted modules

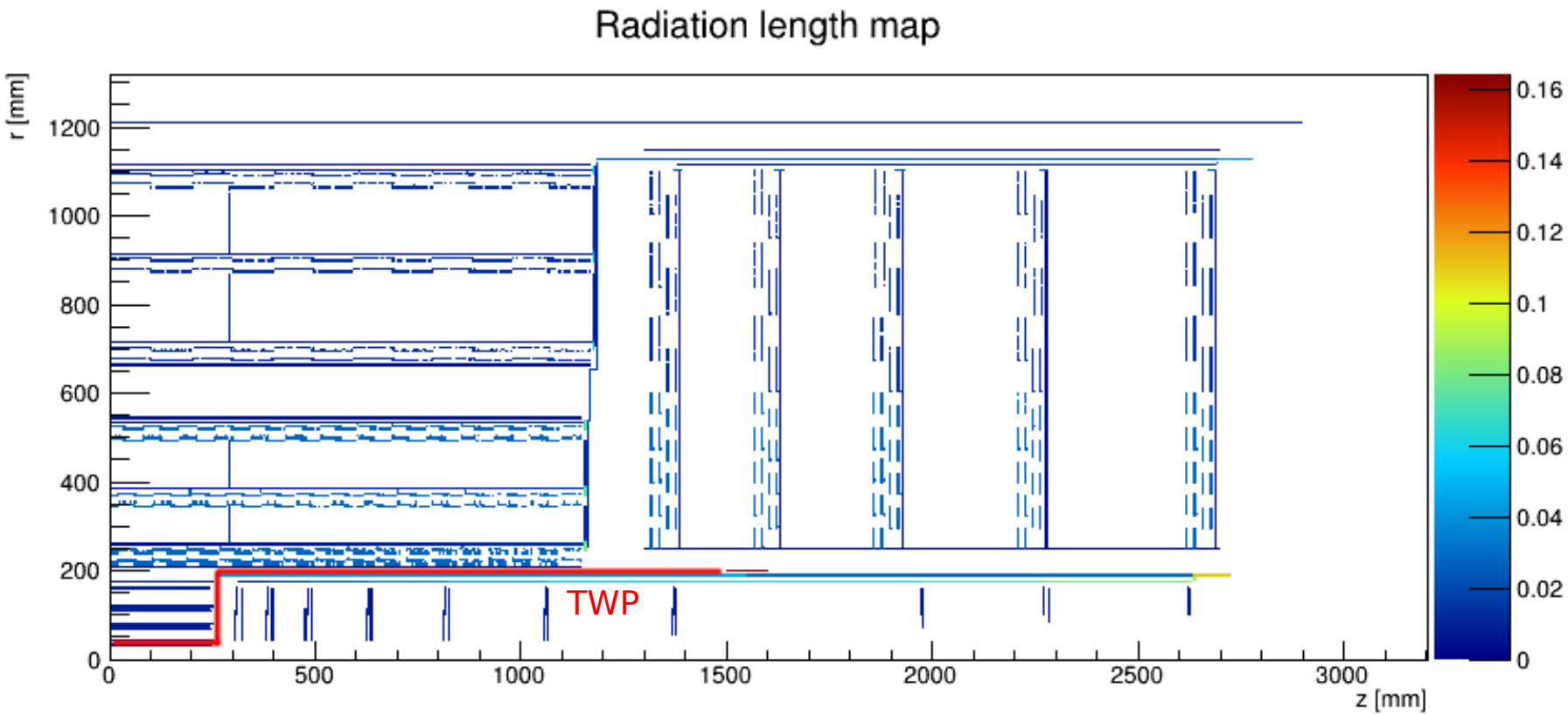
- ✓ In old model the cables were distributed over the modules
  - Not feasible in case of tilted modules
- ✓ Now is possible to model this design



New feature

Model for pixel-like materials

- ✓ For instance twisted pair from modules, electrical optical transducer, and optic fibers after it



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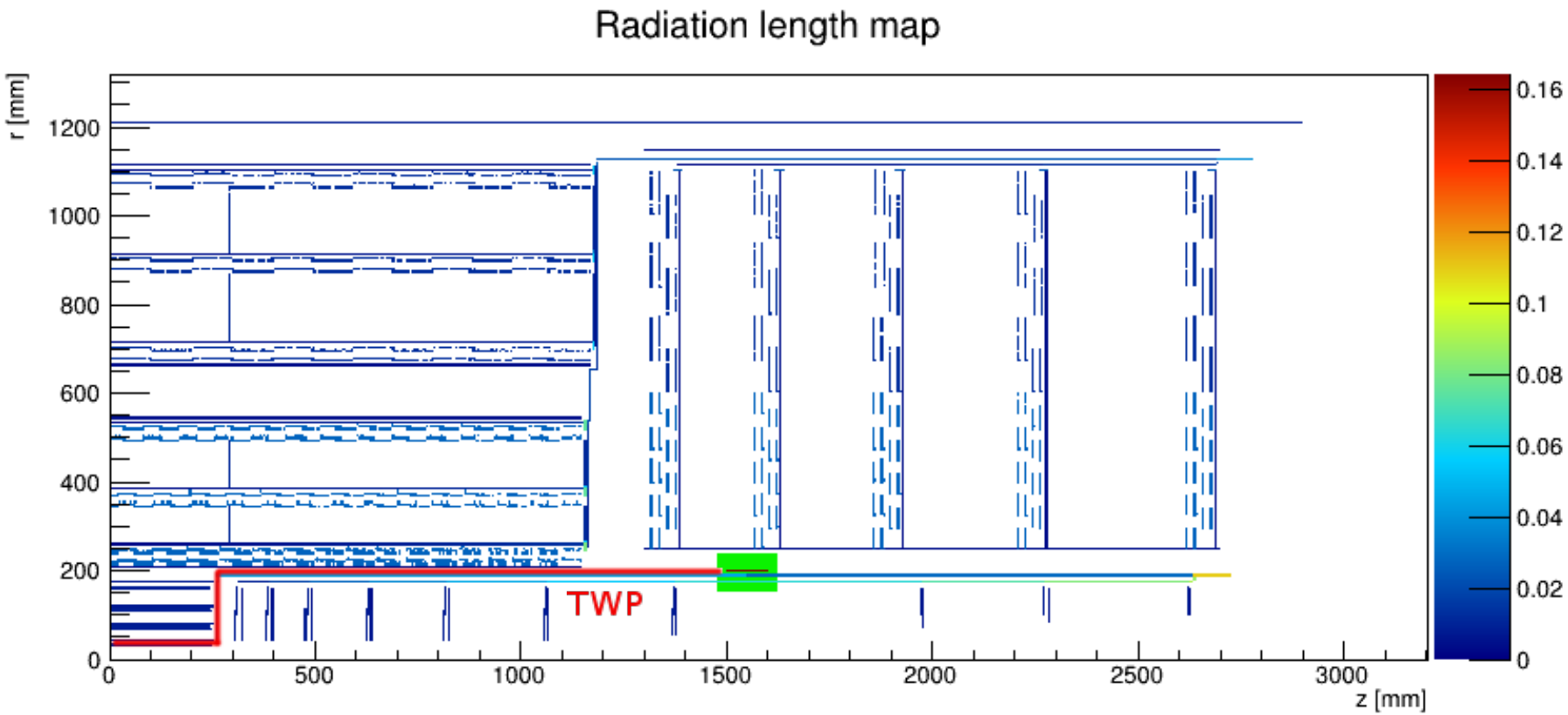

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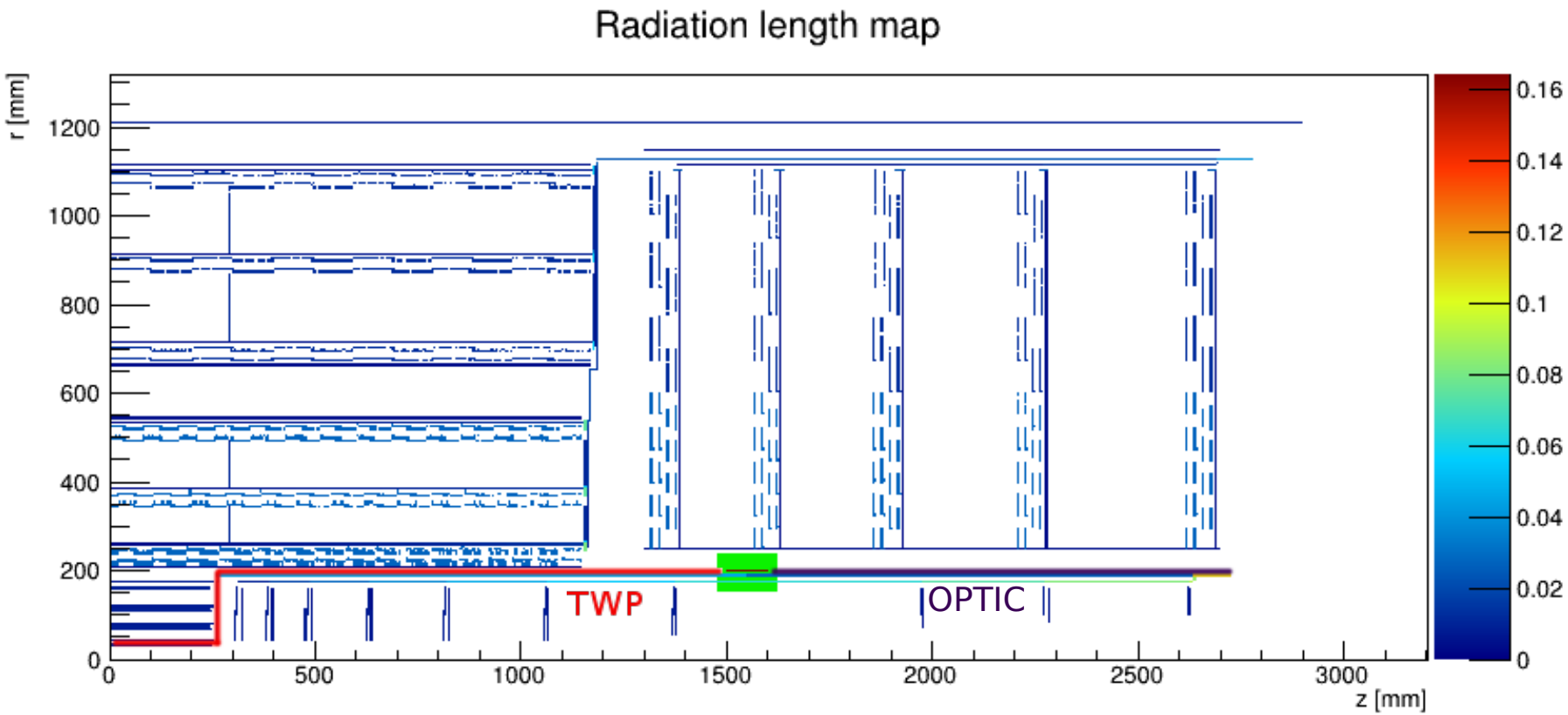


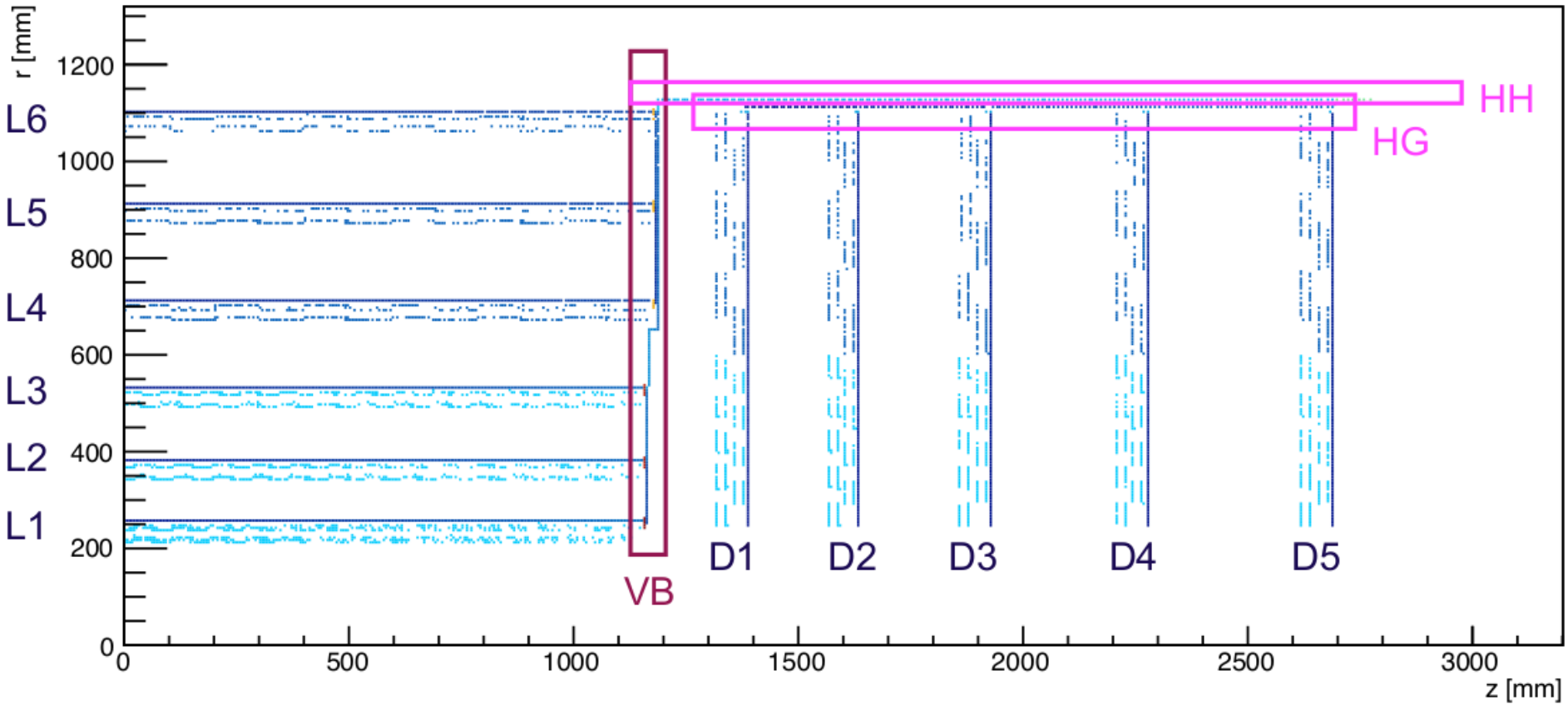
Advantages

- ✓ The new algorithm use the same underlying c++ objects of the old
- ✓ This means that the XML export is working as usual
  - only more detailed than before

Validation

1. Comparison between old and new models
2. Accurate tests new model only with controlled amount of material and exact computation of material amount

1. Comparison between old and new model (Giacomo Sguazzoni)



1. Comparison between old and new model (Giacomo Sguazzoni)

Area	New model [g]	Old model [g]	Diff. [g]	Diff. [%]
L1	39871	39665	206	-0.5%
L2	53159	52780	379	-1%
L3	73872	73643	228	...
L4	51557	49828	1730	
L5	66595	64361	2234	
L6	81632	78894	2739	
2xD1	48869	55666	-6796	
2xD2	48869	55666	-6796	
2xD3	48869	55666	-6796	
2xD4	48869	55666	-6796	
2xD5	48869	55666	-6796	
2xVB	29807	29294	513	
2x(HG+HH)	99554	164713	-65159	
Total	740394	831505	-91111	
Total (web, in kg)	725	831	-106	
Total services (web, in kg)	269	194	75	

2. Test of new model

✓ Computed the expected material amount for given cylinders and disks of material

Cylinder, L g/mm of material M

$$\frac{X_0}{X_{0M}} = \frac{L}{2\pi r \cdot X_{0M}} \cdot \frac{e^{\eta} + e^{-\eta}}{2}$$

Disk, L g/mm of material M

$$\frac{X_0}{X_{0M}} = \frac{L}{\pi(r_1 + r_2) \cdot X_{0M}} \cdot \frac{e^{2\eta} + 1}{e^{2\eta} - 1}$$

Cylinder, L mm of material M

$$\frac{X_0}{X_{0M}} = \frac{L \cdot \rho_M}{X_{0M}} \cdot \frac{e^{\eta} + e^{-\eta}}{2}$$

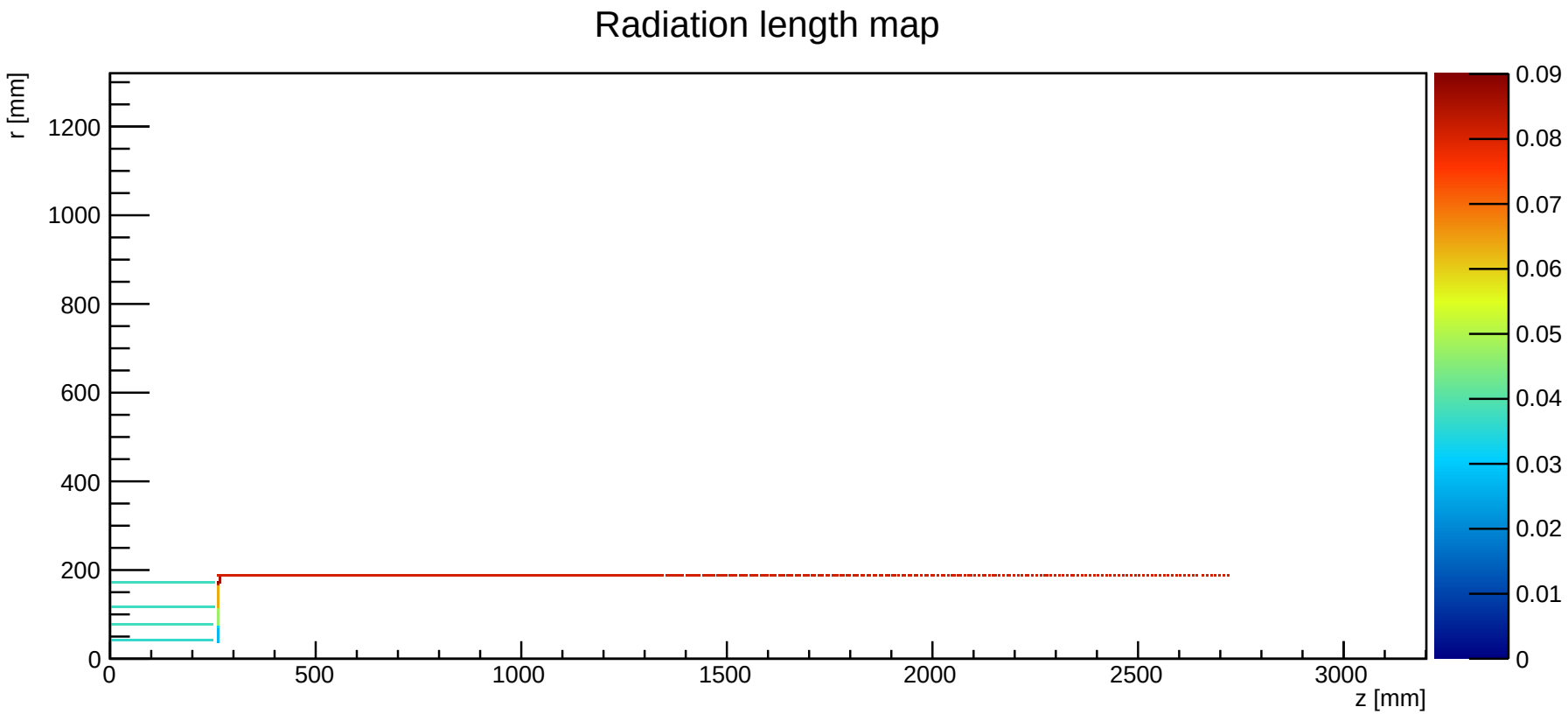
Disk, L mm of material M

$$\frac{X_0}{X_{0M}} = \frac{L \cdot \rho_M}{X_{0M}} \cdot \frac{e^{2\eta} + 1}{e^{2\eta} - 1}$$

Test 1: Barrel materials

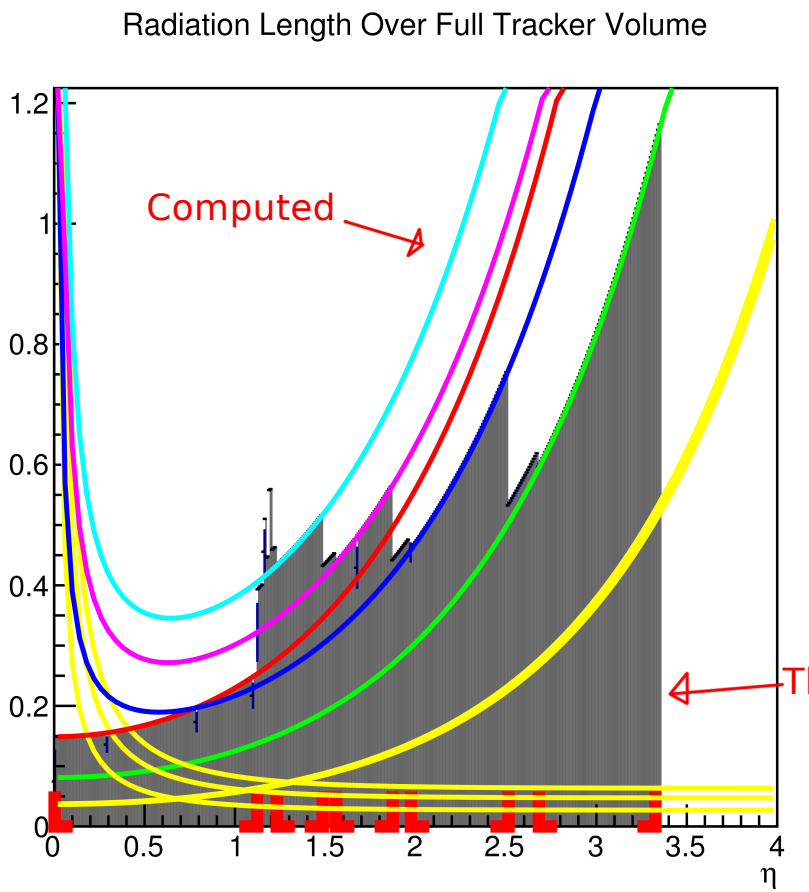
✓ Built simplified geometry

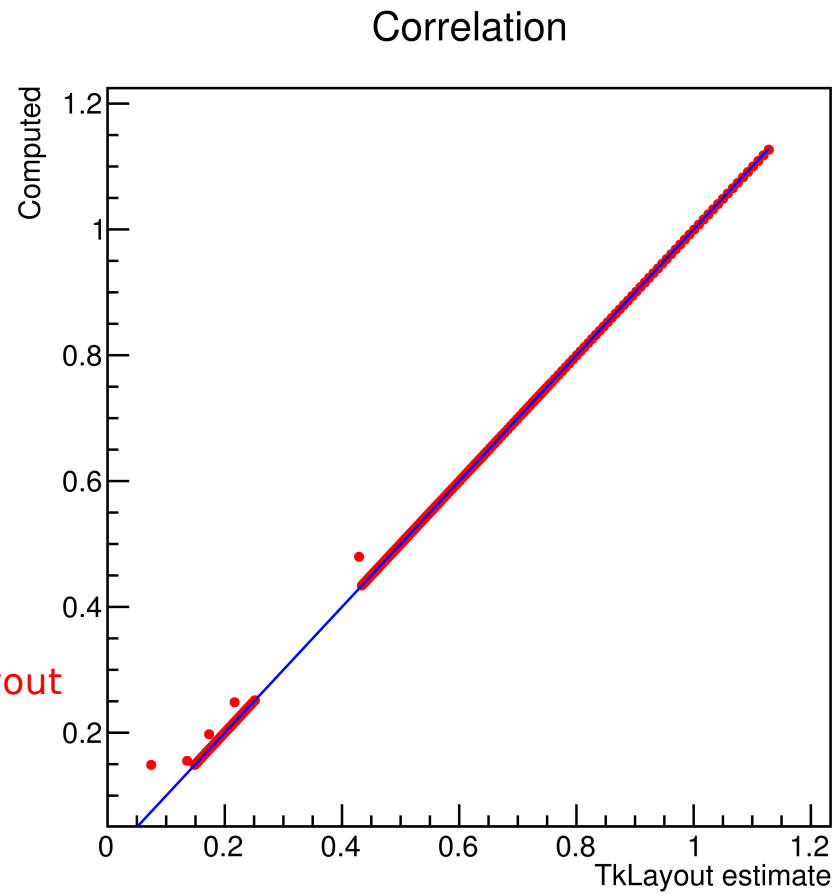
$100g/m$ of Cu in each rod of each layer of pixel barrel, routed out



Test 1: Barrel materials

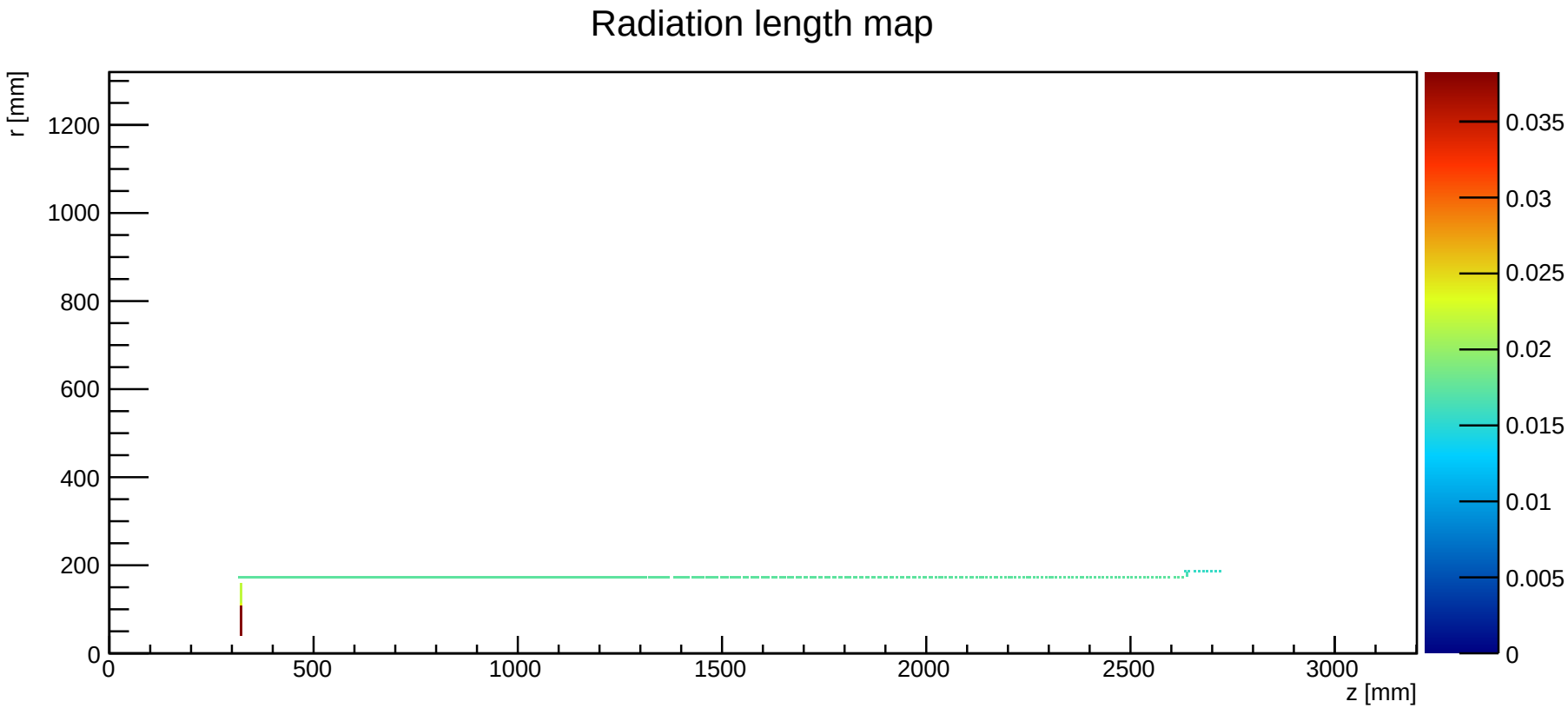
✓ Compare computed volumes with TkLayout's output



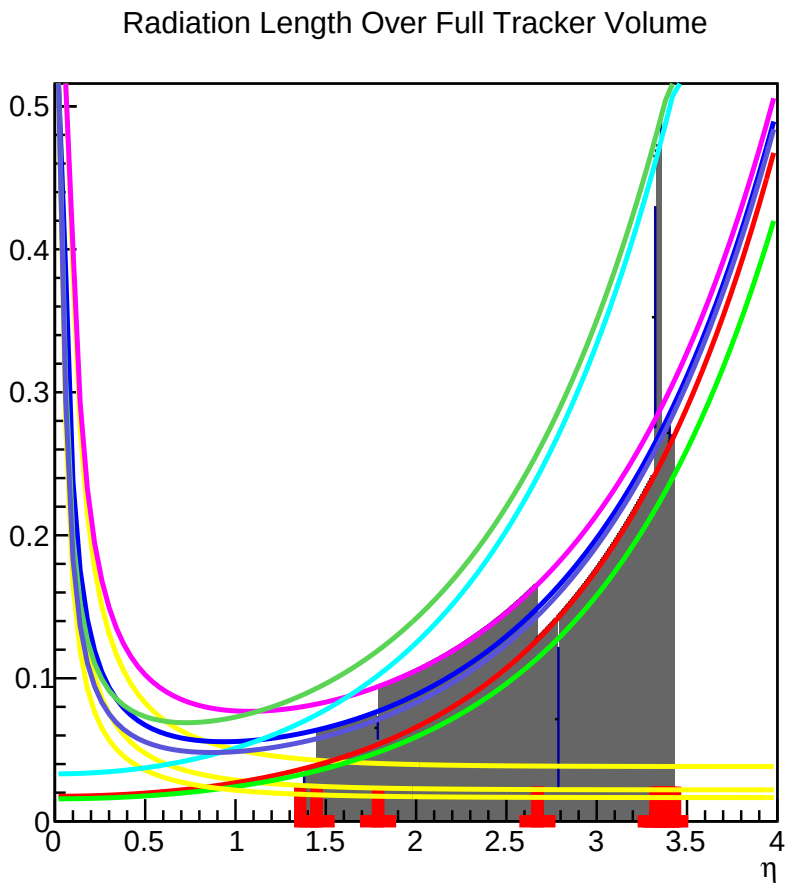


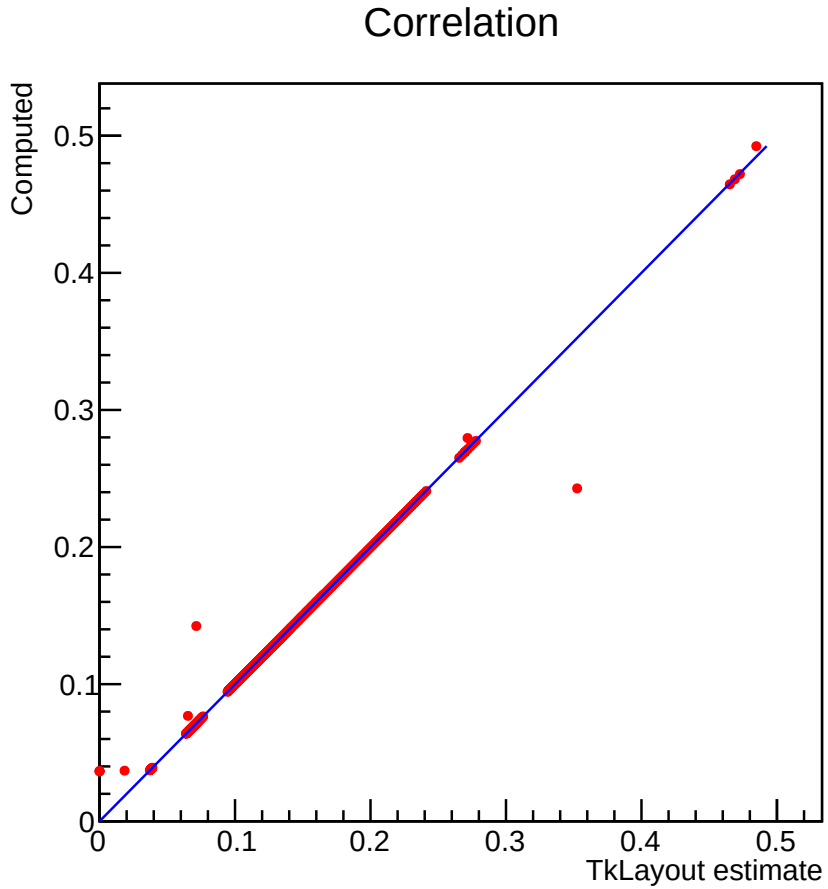
Test 2: Endcap materials

$100 g/m$ of Cu in each "rod" of each disk of pixel endcap, routed out



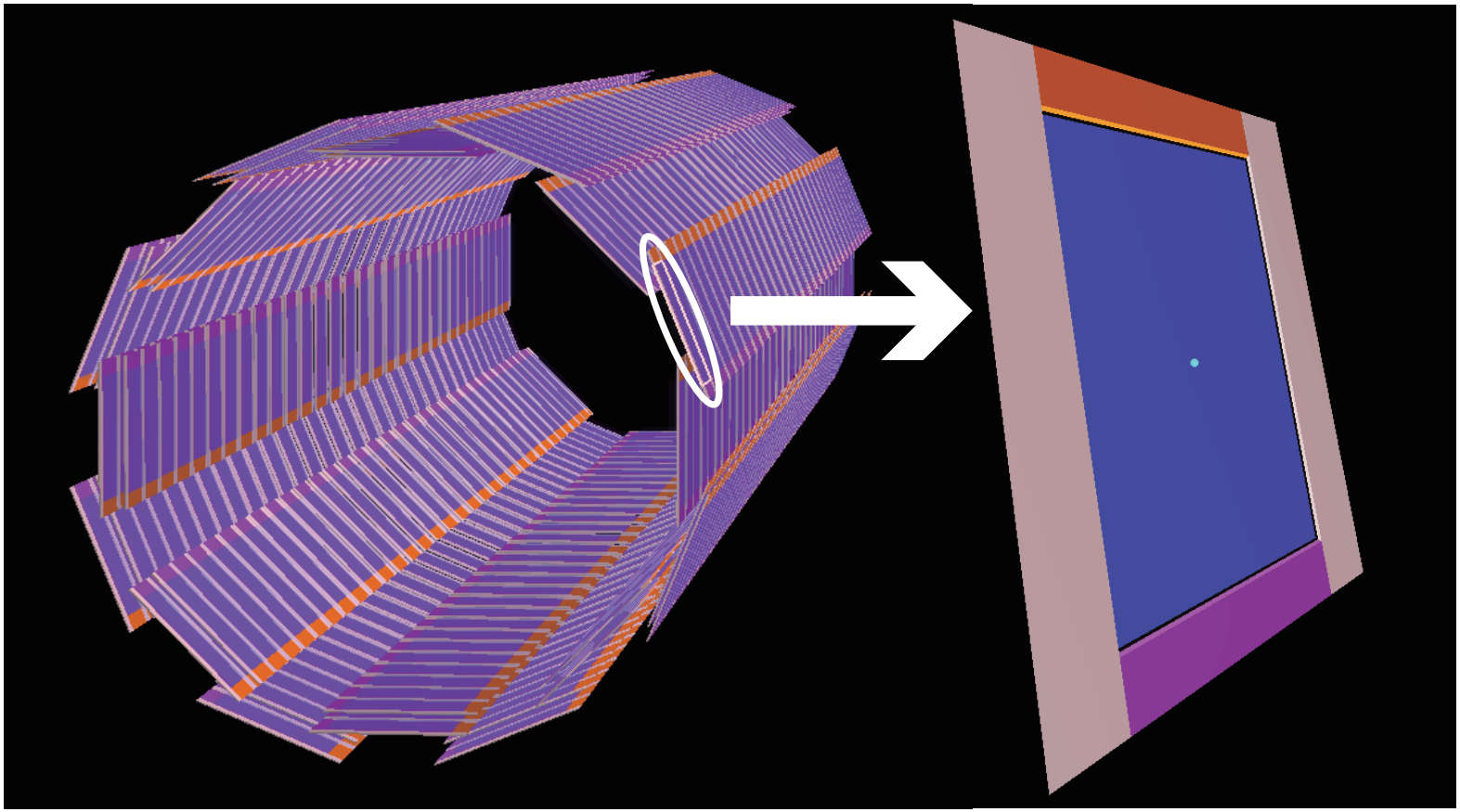
Test 2: Endcap materials





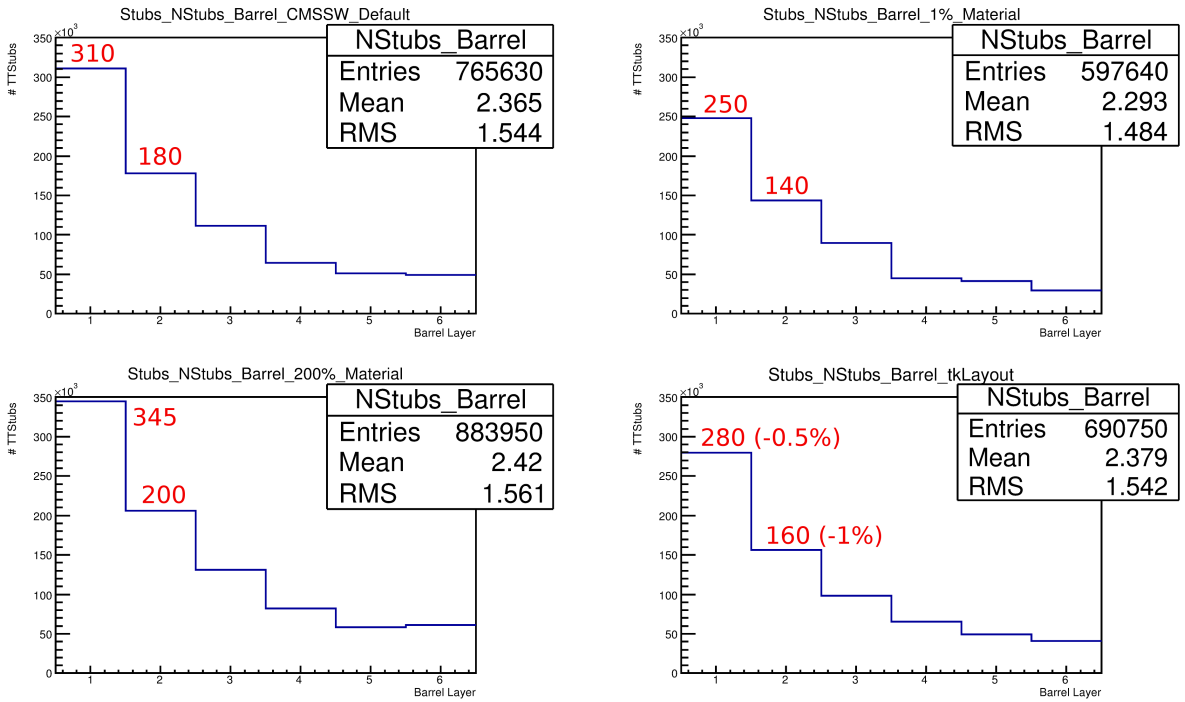
Module material (Ryo Yonamine)

1. Increased level of details for module description.
   → 4 hybrids + 2 sensors + 1 volume between sensors
2. Moved materials out from between sensors.
   → Less material between sensers
   → May affect rate of stubs produced by secondary interactions



Preliminarily Testing XMLs in CMSSW (Ryo Yonamine)

- ✓ Started to compare number of stub with different configurations
  - → (TechProp old material model(top-left), 1% density material(top-right), 200% density material(bottom-left), new material model and output(bottom-right))
    - T-r, b-l to quantify the effect of change in material amount



- ✓ Material position has a visible effect on number of stubs

Summary

1. Internal
   - New material model
   - More precise and detailed
   - New features (pixel-alike trackers)
2. Working XML export
3. Export
   - New volumes for outer modules (from 2+1 to 2+1+4)
   - Just started to look for the pixel

To do

1. Complete validation
2. Review material input files with up-to-date information
3. Complete exported XML for pixels

Thank you

Questions?