tracking updates

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1. Hit Resolution

Output from DD4Hep simulation

- RawHits:
  - x,y,z position, and cell ID from segmentation

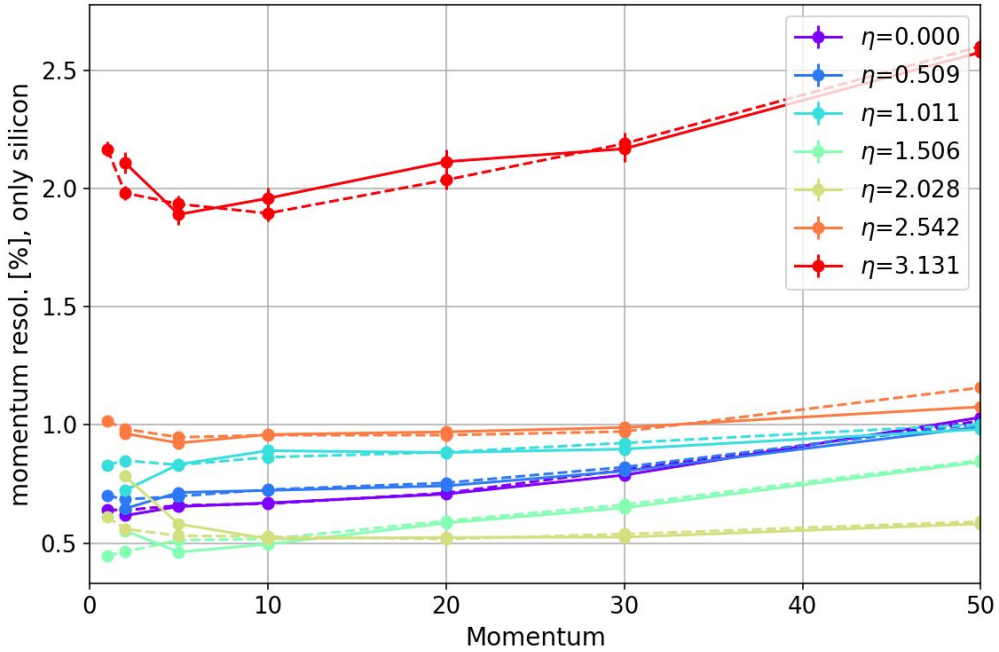
```
<readouts>
  <readout name="TrackerBarrelHits">
    <segmentation type="CartesianGridXY" grid_size_x="0.010*mm" grid_size_y="0.010*mm"
    />
    <id>system:8,layer:4,module:12,sensor:2,x:32:-14,y:-18</id>
  </readout>
```

- Hits Digitization (in JUGGLER):
  - cell ID ⇒ position at cell center, (also time and energy deposit)
- Hits Reconstruction
  - Hits at cell center, with diagonal covariance matrix variance = (pixel_size / sqrt_12)**2

Input to ACTS tracking

Momentum resolution comparison

Hit resolution = pixel size (10 mm, solid line) v.s. Pixel size/sqrt_12 (dash)



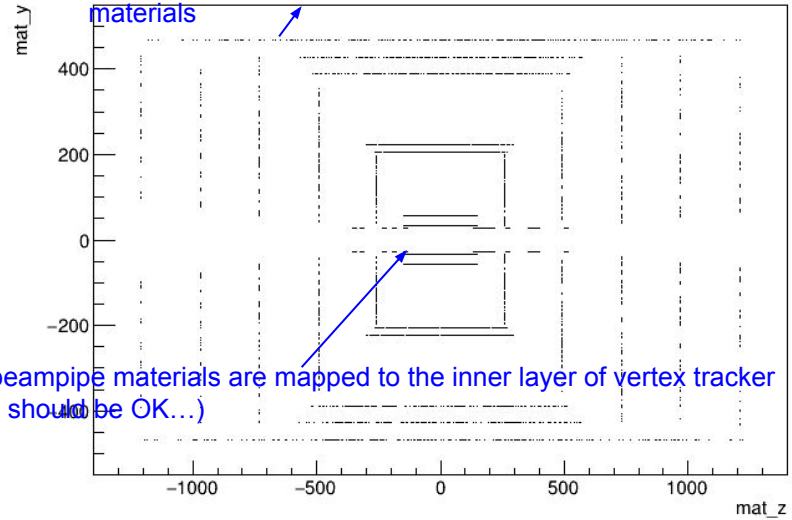
2. Material map

- To generate a json file to provide material mapping information to ACTS (Tutorial), otherwise ACTS wouldn't consider material effect in track reconstruction
- 2 methods:
  - 1. Map materials to (closest) surface along the propagation path
  - 2. Map materials to a 3D or 2D grid associated to a volume
  - Need to manually enable mapping to each surface/volume

One track from material map validation (length in mm):

event ID	instance	sqrt(x**2+y**2)	z	X0	X/X0 (%)
153	0	28.250699	1.6192829	171.10745	0.0112418
153	1	32.999999	1.8915048	197.16177	0.4074067
153	2	55.999998	3.2098264	215.1452	0.2029441
153	3	205	11.750257	133.27182	0.7623741
153	4	221.8	12.713206	138.17269	0.6613224
153	5	387.99999	22.239513	128.402	0.6153358
153	6	427.29999	24.492122	128.18264	0.6141611

Use outer volume boundary as mapping surface to absorb supporting materials



Most beampipe materials are mapped to the inner layer of vertex tracker (which should be OK…)

Material Scan comparison (Geant4 v.s. Material map)

X/X0 in fraction