SVT with curved sensor in DD4hep

Shujie Li

ePIC tracking++ meeting

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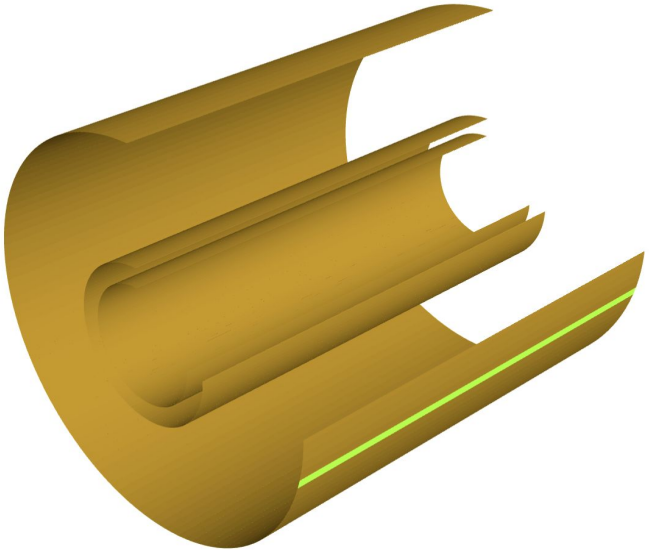
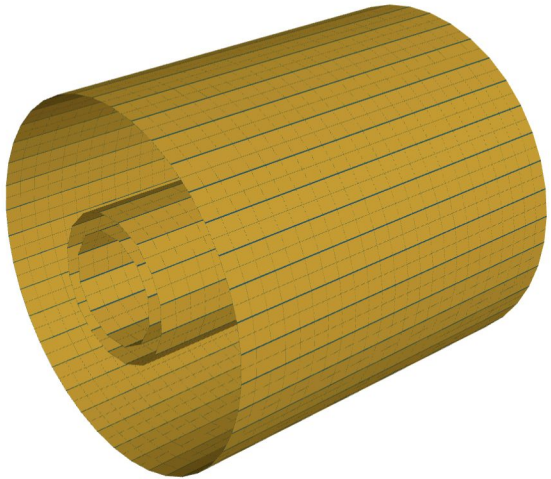
Vertex layers in ePIC simulation

- Official (24.10):
  - 128 staves per layer to approximate the cylinder
  - No RSU structure

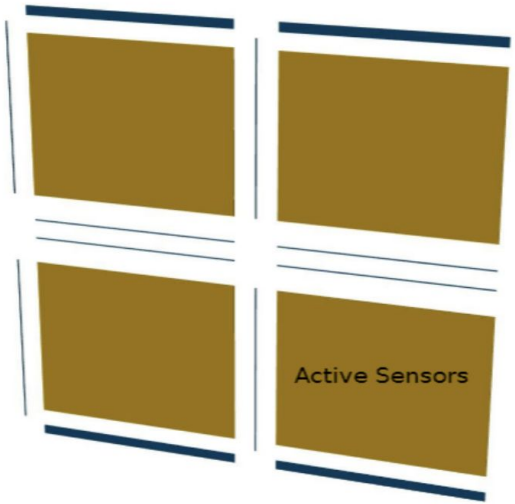


- Recent developments (epic/si_sensor_unit):
  - With RSU structure:
    - 4 tiles + inactive areas
  - Sensor not curved



Slides from Joe Xu (UC EIC consortium meeting at Davis, 08,2024)

Sensor Dimensions (ITS3)



Implemented by Jonathan Witte, numbers from Nikki Apadula

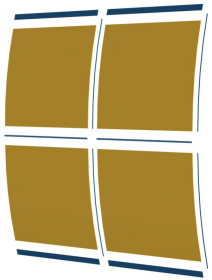
Tiles: 9.197mm x 10.773mm
Backbone: 0.06mm x 9.782mm
Readout: 10.773mm x 0.525mm
Biasing: 0.06mm x 10.773mm

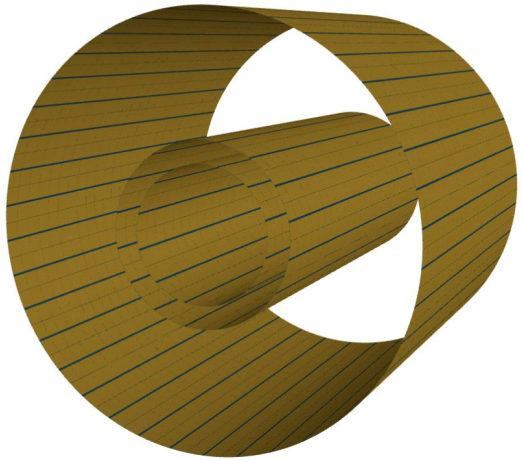
Active Area: 99.079mm
Inactive Area: 6.889mm

~6.50% Inactive Area

Curved Sensor

- Git branch: epic/svt_curved
- **New geometry plugin:**
  - SVTBarrelTracker_geo.cpp
  - Use Tube instead of Box shape in TGeo.
  - Build each part as described on page 3 explicitly
    - Tried to use SubtractionSolid for the frame, b it has weird residual volumes (internal precision issue b/w G4 and TGeo?)
  - Passed overlap check
  - Still need to update the segmentation for tube.
    - Was: CartesianGridXY for staves
    - Default for Tube; phi and z
    - Want: rphi and z
- **New geometry description:**
  - Vertex_barrel_curved.xml
  - Radius (L0, L1, L2):
    - Was: 36, 48, 120 mm
    - Now: 37.365, 49.820, 118.321mm
      for 12, 16, 38 RSU in a row

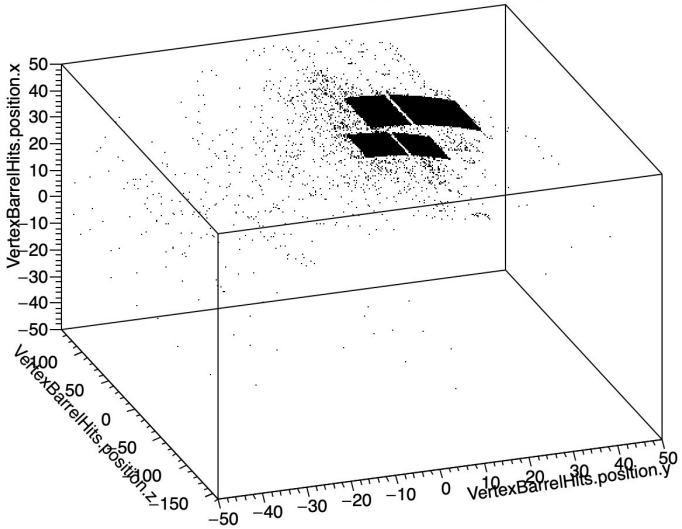




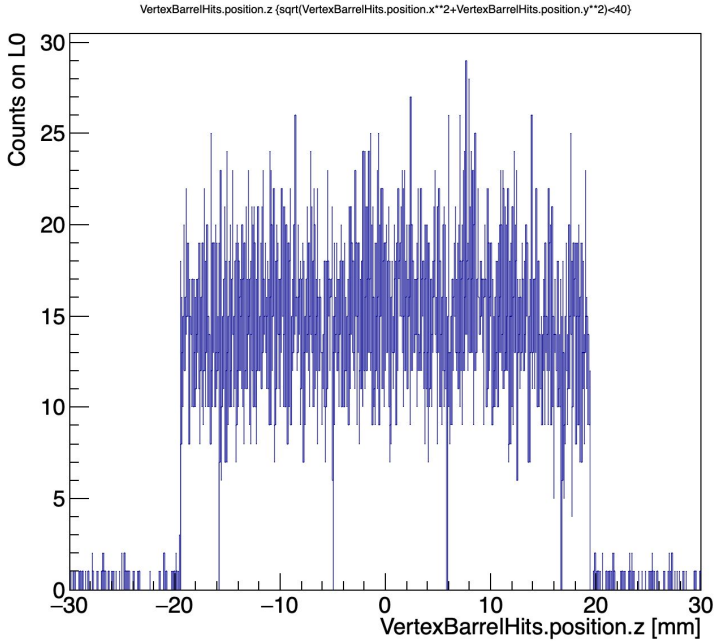
Check with DD4hep

Event sample:
20k 5GeV pi+, -0.5<eta<0.5, 0<phi<30 degrees

Sim hits from L0 and L1:
Sensors are curved with gap
from readout pads



Sim hits from L0:
Gaps along z are backbones



To do:

1. Update the tube segmentation
    - Current: one readout plugin for three layers, XY grid for box

```
<readouts>
  <readout name="VertexBarrelHits">
    <segmentation type="CartesianGridXY" grid_size_x="0.020*mm" grid_size_y="0.020*mm" />
    <id>system:8,layer:4,module:12,sensor:2,x:32:-16,y:-16</id>
  </readout>
</readouts>
```

2. validation with EICrecon
3. Performance study