FST Simulation

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07/20/2020

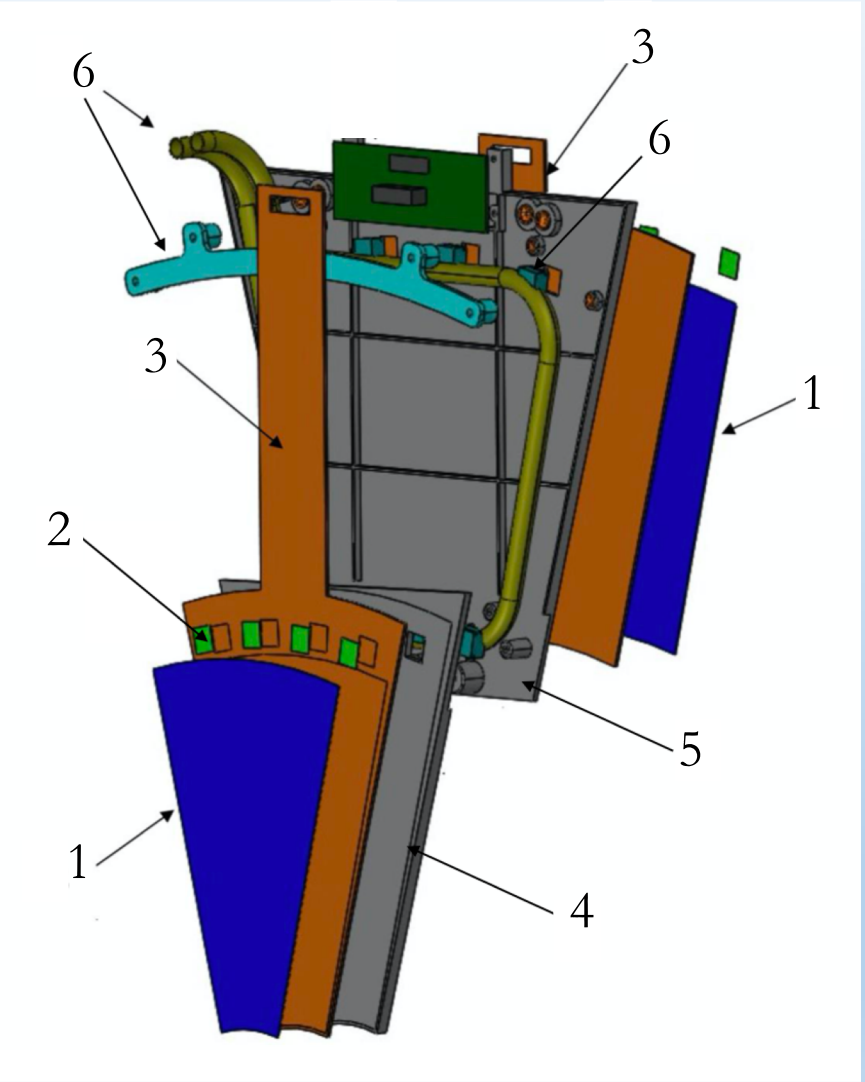
Outline

- FST material budget
- FST simulation
  - Efficiency
  - p_T resolution
  - Secondary particle production
  - Photon conversions
- Summary and outlook

FST material budget

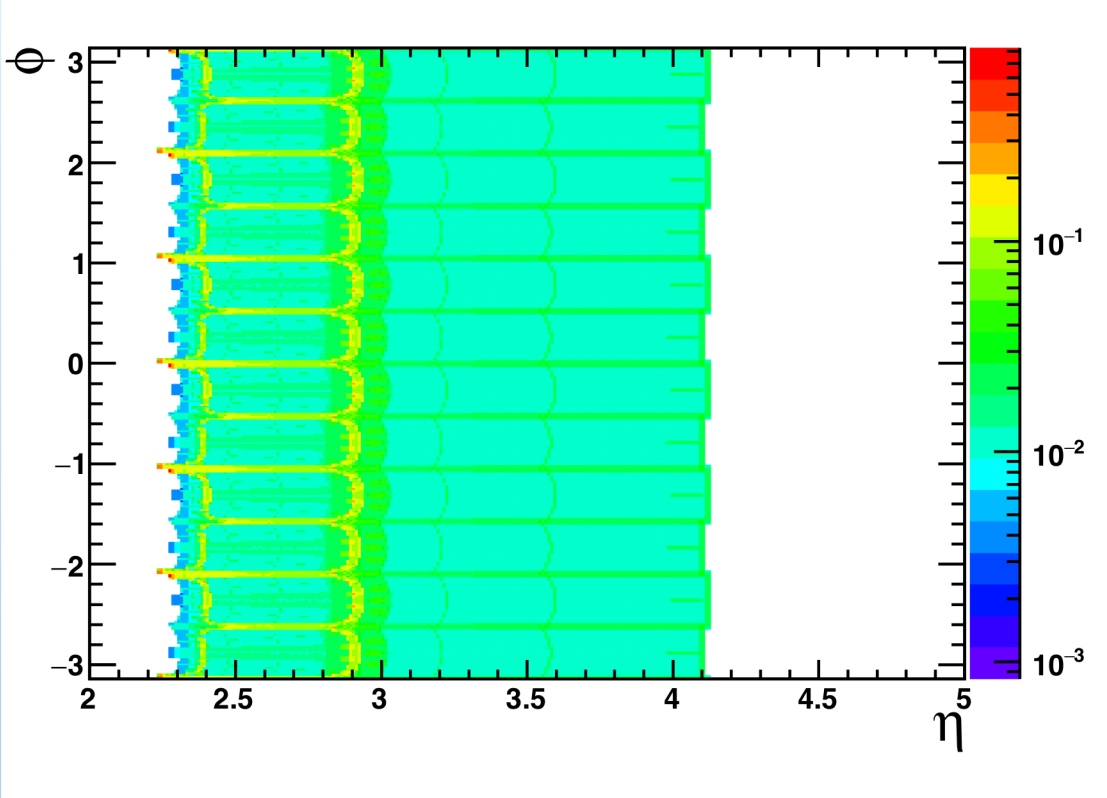
Material classes

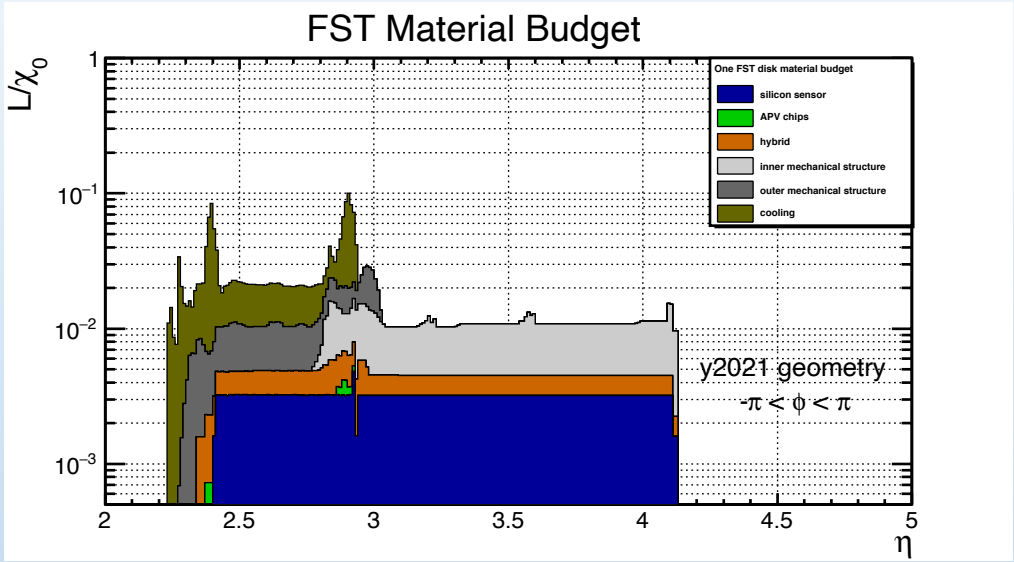
ID	Material
1	silicon sensor
2	APV chips
3	hybrid
4	inner mechanical structure
5	outer mechanical structure
6	cooling

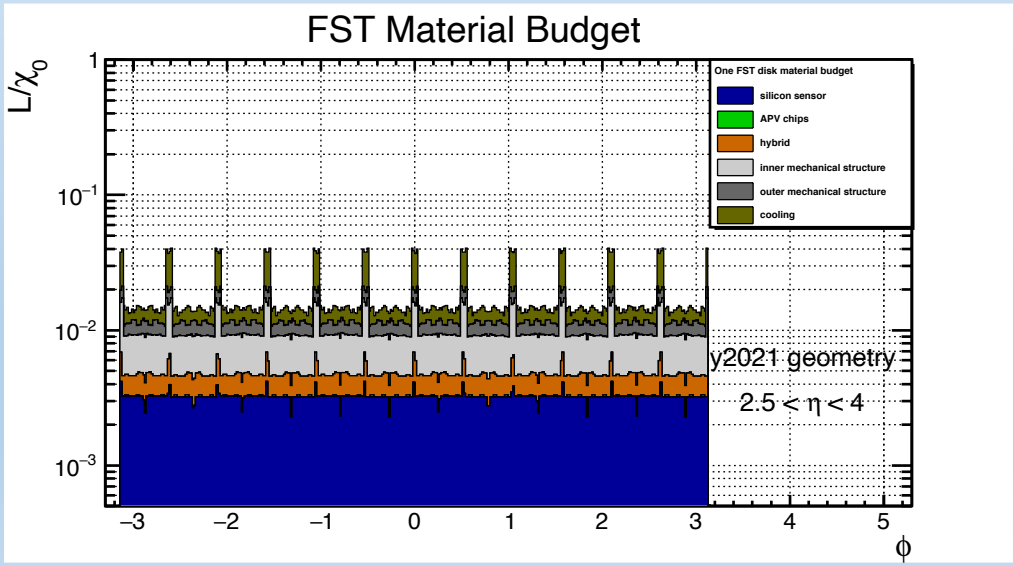


FST material budget

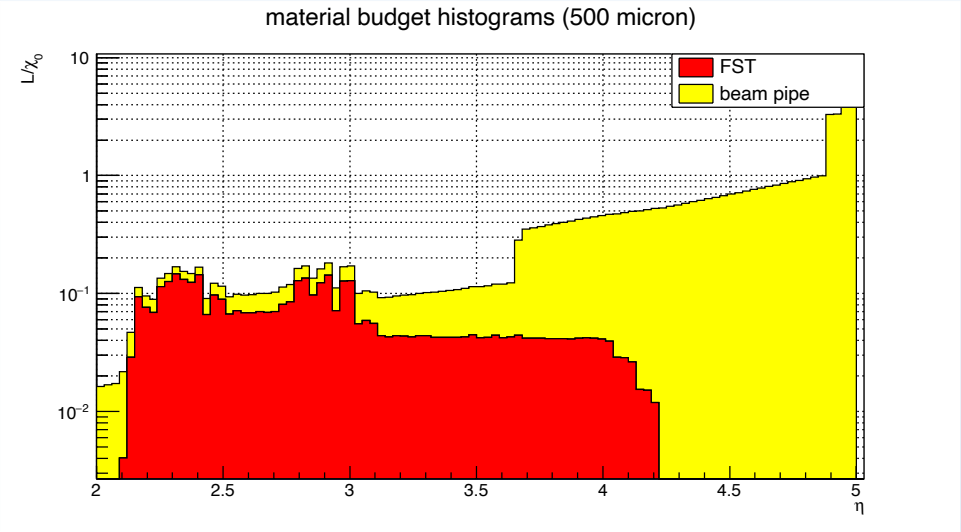
- FST material budget for one disk (z = 154 cm).

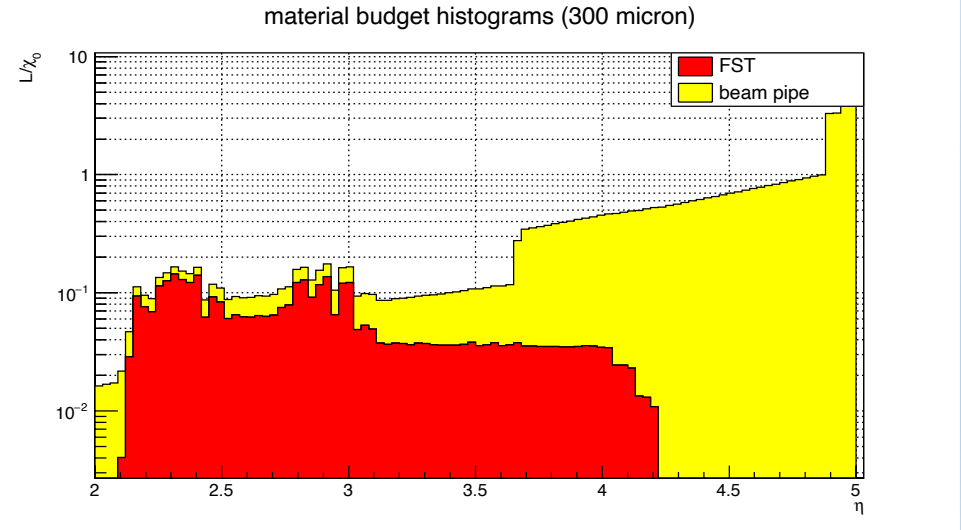




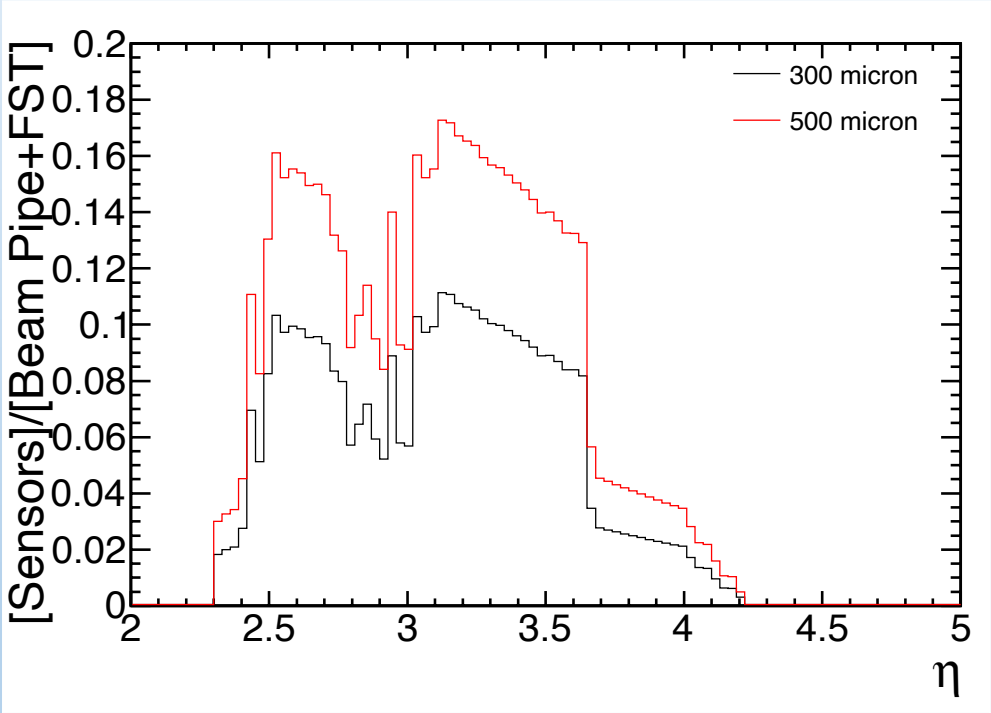


FST material budget + beam pipe



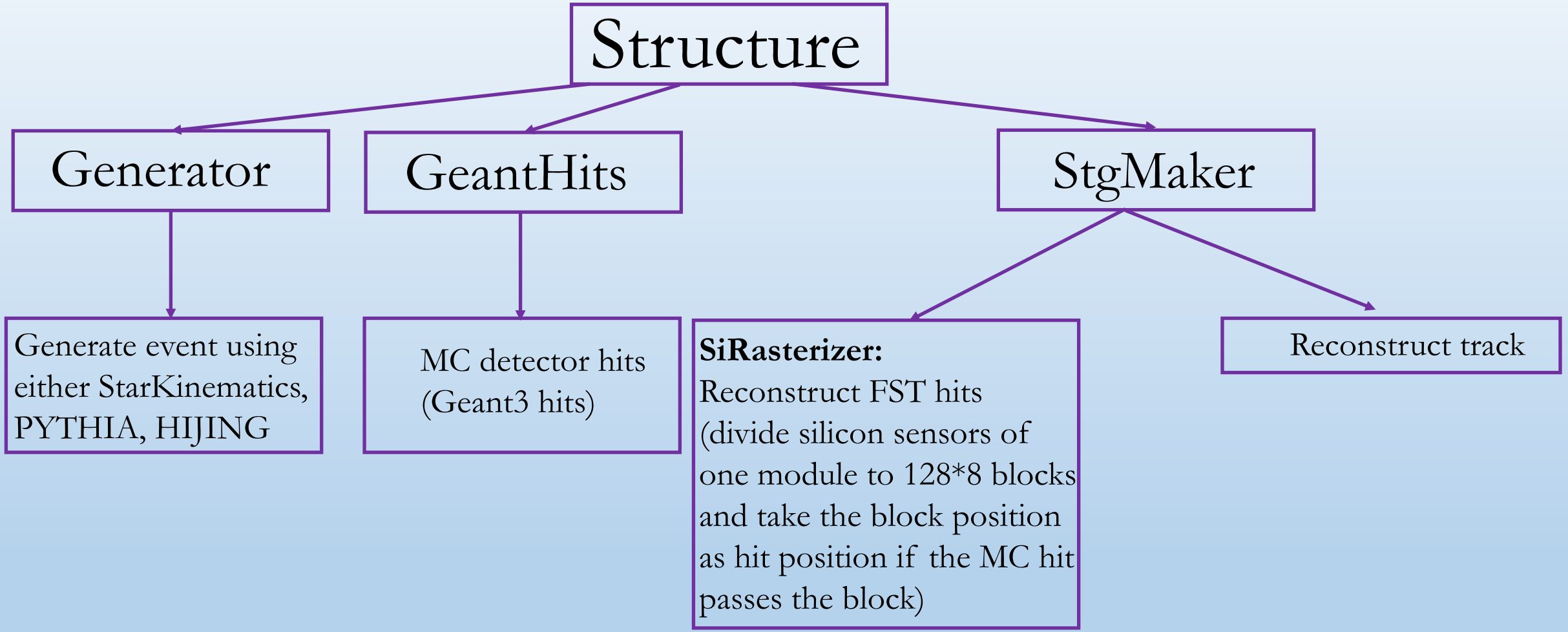


- Current thickness of silicon sensors is 300 micron.
- In order to enhance the signal (propt dX), using 500 micron thick sensors is being considered. The impact of additional materials has been checked in simulation.



~5% extra material to that of [Beam Pipe+FST] by changing from 300 to 500 micron.

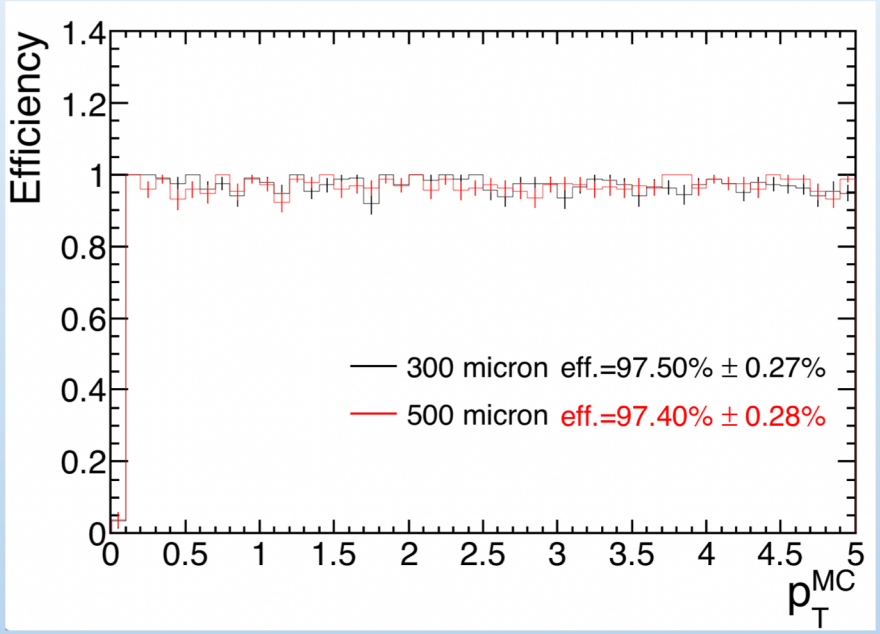
Forward Simulation and Tracking Package

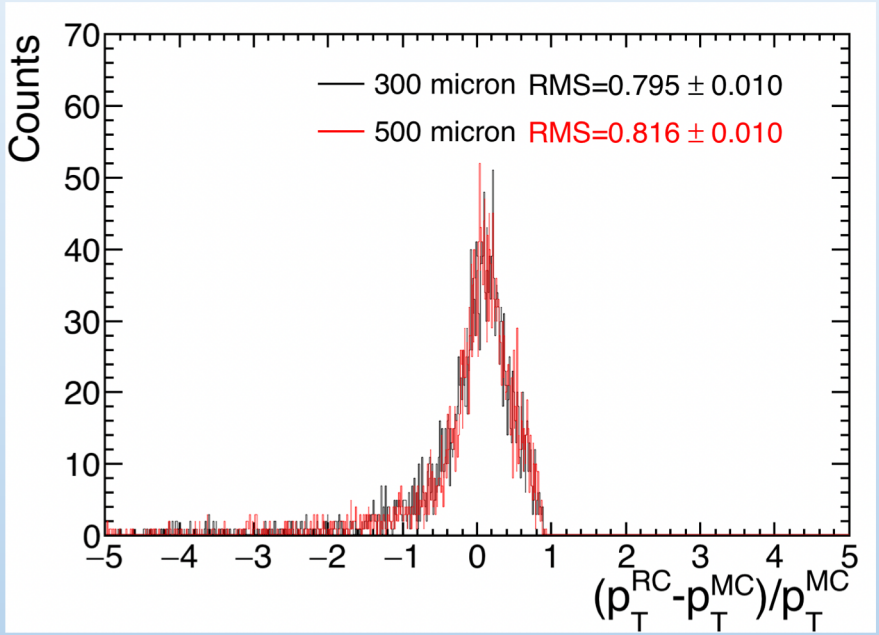


Performance

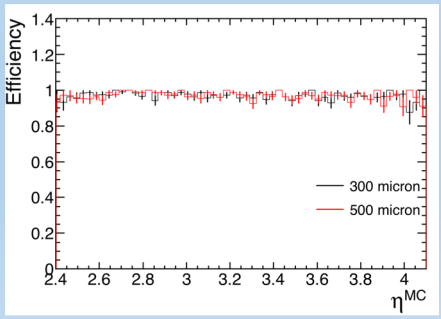
- Efficiency and p_T resolution distribution.
- Comparison for different thickness of silicon sensors.

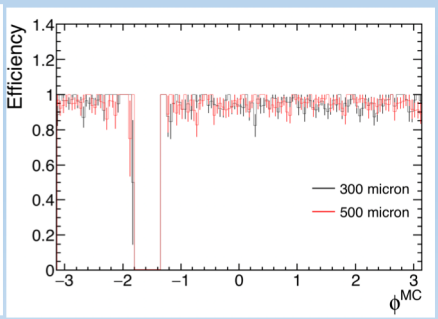
input:
1 $\boldsymbol{\mu}$-/Event
Number of events = 5000
$0.2 < p_T < 5.0$
$2.4 < \boldsymbol{\eta} < 4.1$





Will plot $(p_T^{RC}-p_T^{MC})/p_T^{MC}$ $vs.$ p_T^{MC} after increasing the statistics.



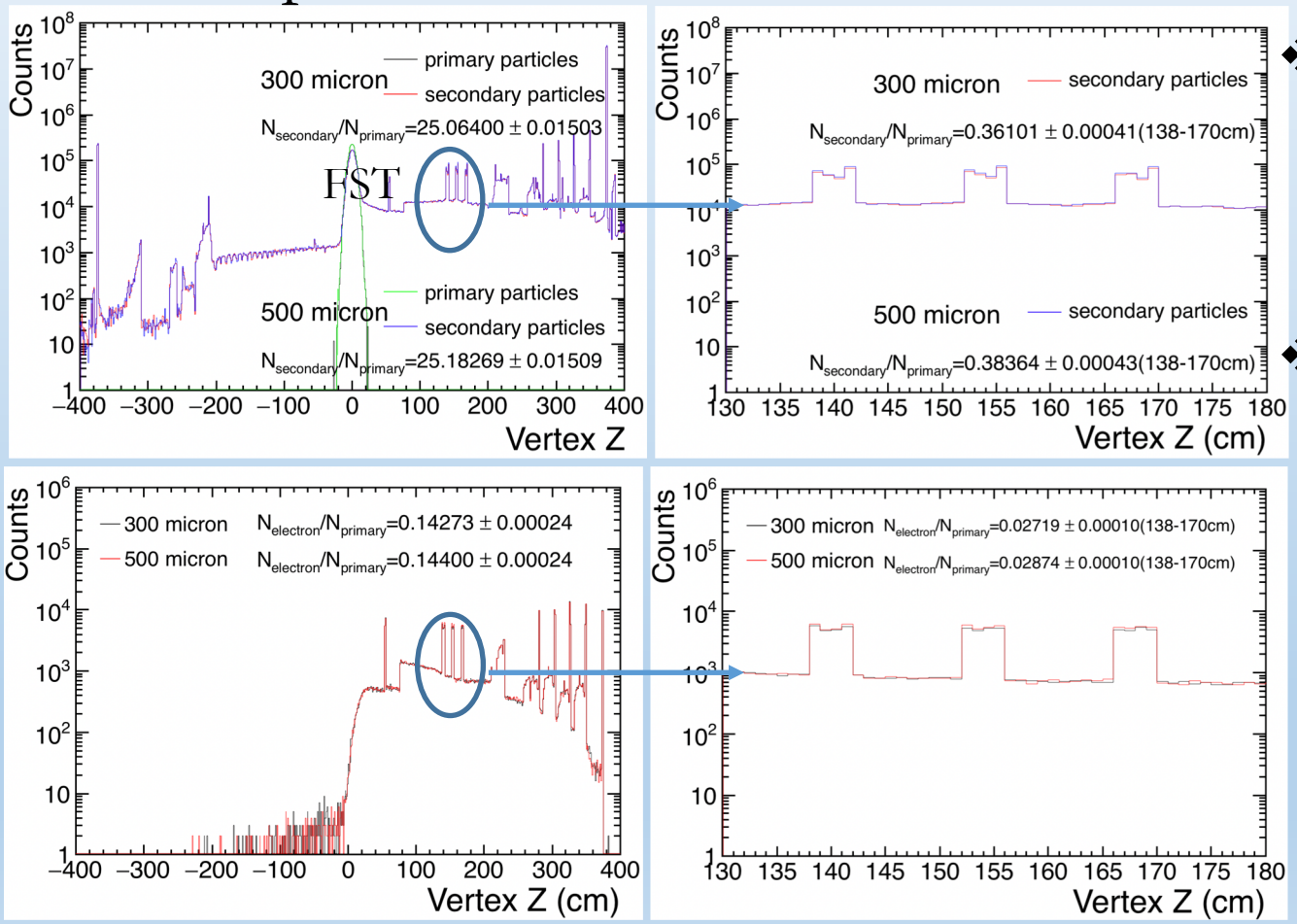


1) The efficiency is 97.50% and p_T resolution is 0.795 for 300 micron.
2) No obvious difference between 300 and 500 micron for efficiency and p_T resolution .

Performance

- Secondary particle production and photon conversions.
- Comparison for different thickness of silicon sensors.

input: PYTHIA6 pp MB event



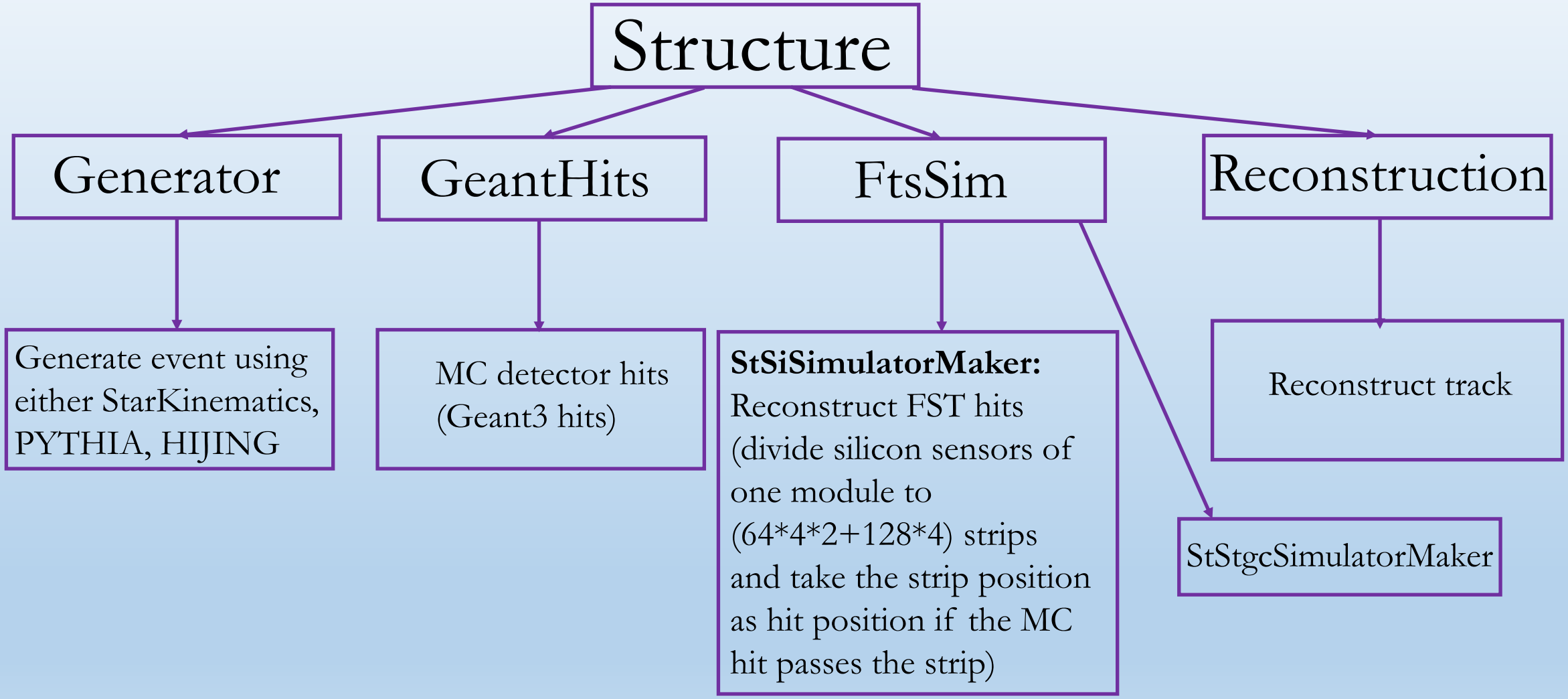
Definition

1) Primary particles are produced from pp collisions directly.
2) Secondary particles are produced from the interaction with the materials and including those produced from decay

Conclusion

1) $\frac{N_{secondary}}{N_{primary}}$ of 300 micron changes by 0.5% compared with that of 500 micron.
2) $\frac{N^{FST}_{secondary}}{N_{primary}}$ of 300 micron changes by 6.3% compared with that of 500 micron.
3) $\frac{N^{FST}_{electron}}{N_{primary}}$ of 300 micron changes by 5.7% compared with that of 500 micron.

Forward Simulation and Tracking Package - New



The complete package was provided by Daniel (thanks!) on 7/17/2020.

Summary and Outlook

Summary

- Obtain FST material budget

  ~5% extra material to that of [Beam Pipe+FST] by changing from 300 to 500 micron silicon.

- Study the FST performance in STAR simulation

  1) Efficiency, p_T resolution, secondary particle production and photon conversions.

  2) Changes can be negligible comparing 300 micron with 500 micron thick sensors.

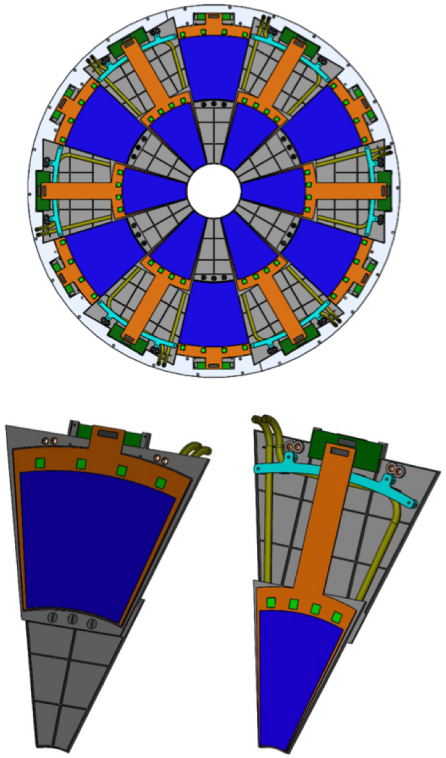
Outlook

- Test the FST fast simulator with Forward tracking.
- Develop a FST slow simulator by using the efficiency and residual measured with cosmic ray (see Xu's talk).

Back Up

Back Up

- Each disk: 12 modules, $\leq 1\%\ X_0$
- Each module split into two regions
  - **inner region (front side)**
    - 1 Silicon microstrip sensor: each 128×4 $(\phi \times r)$ strips
    - 4 APV chips
    - 1 Kapton flexible hybrid
  - **outer region (back side)**
    - 2 Silicon microstrip sensors: each 64×4 $(\phi \times r)$ strips
    - 4 APV chips
    - 1 Kapton flexible hybrid
- Mechanical structure for each module
  - Made of PEEK + Carbon Fiber, with Stainless Steel cooling pipe



Symmetric pentagon chambers