SiD Vertex Detector Mechanical R&D
(May Apply to Other Concepts)

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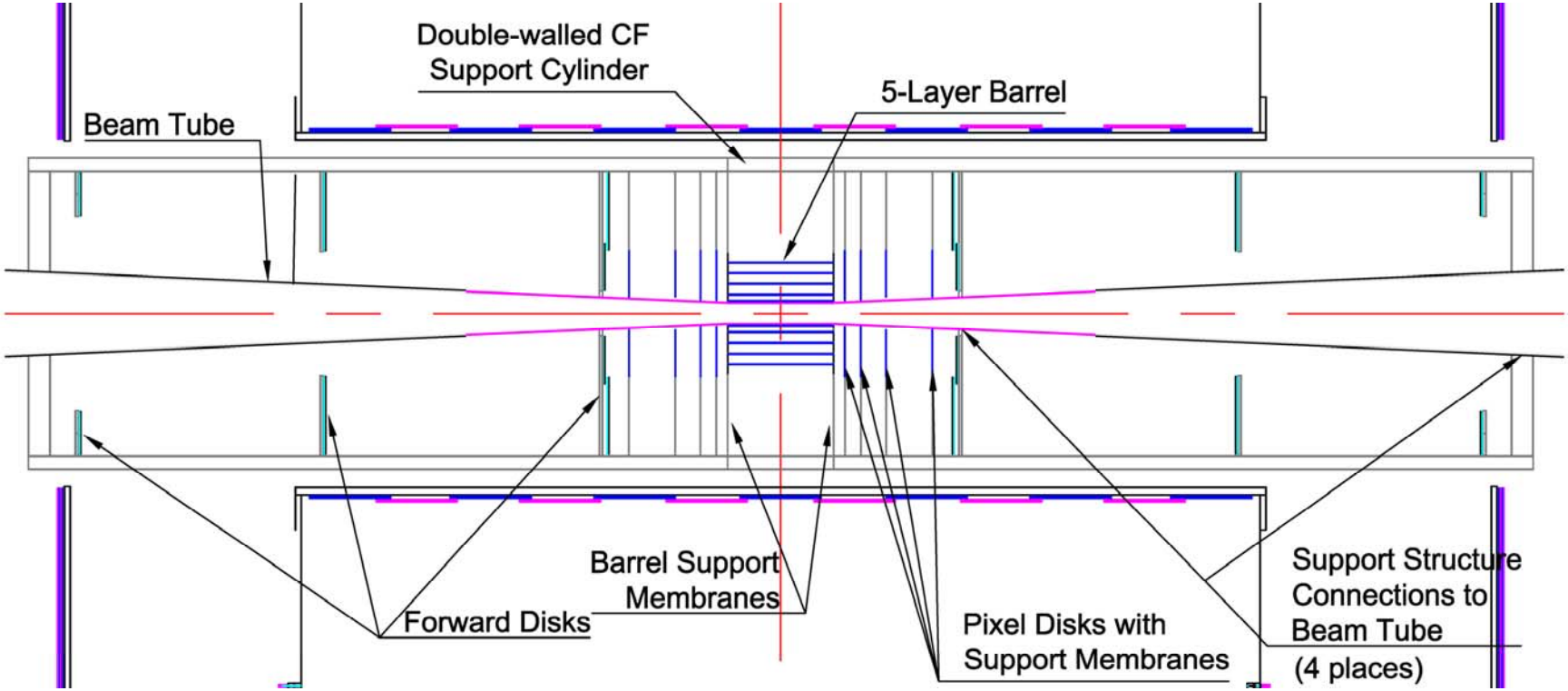
Present SiD Design

- The present SiD vertex detector geometry was developed about a year ago and is shown below.



Present SiD Design

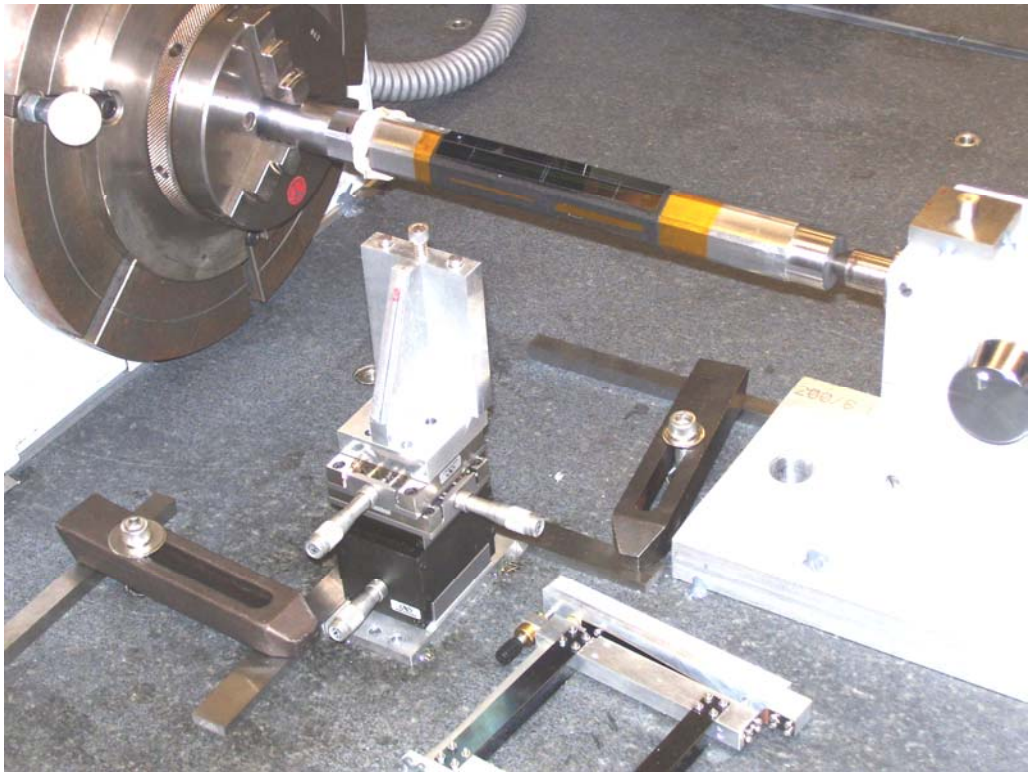
- The five barrel layers are each approximately 125 mm long.
- Four disks per end close the barrel region.
- Three additional disks per end contribute to tracking in the forward / backward direction.
- All elements are supported from double-walled, outer carbon fiber laminate half-cylinders.
  - The half-cylinders are supported from the beam pipe and hold it straight.
  - Outer radius of the half-cylinders ~ 185 mm.

SiD Design Studies and Issues

- Detailed beam pipe shape
  - Integration with the geometry of forward calorimeters
  - Integration with supports for forward calorimeters and beam line elements
- Carbon fiber laminate CTE relative to silicon
  - Thermal distortions between assembly temperature and operating temperature
  - Measurements of CTE via strain gage techniques (University of Washington) and via thermal bowing of “bi-metallic” carbon fiber laminate – silicon strips (Fermilab)
- Assembly of layer 1 model at SiDet
  - 0.1 mm thick “dummy” silicon
  - Zeiss rotary table, Brown & Sharpe CMM
  - Stages from DZero layer 0 assembly
  - Vacuum “puck” provided by University of Washington

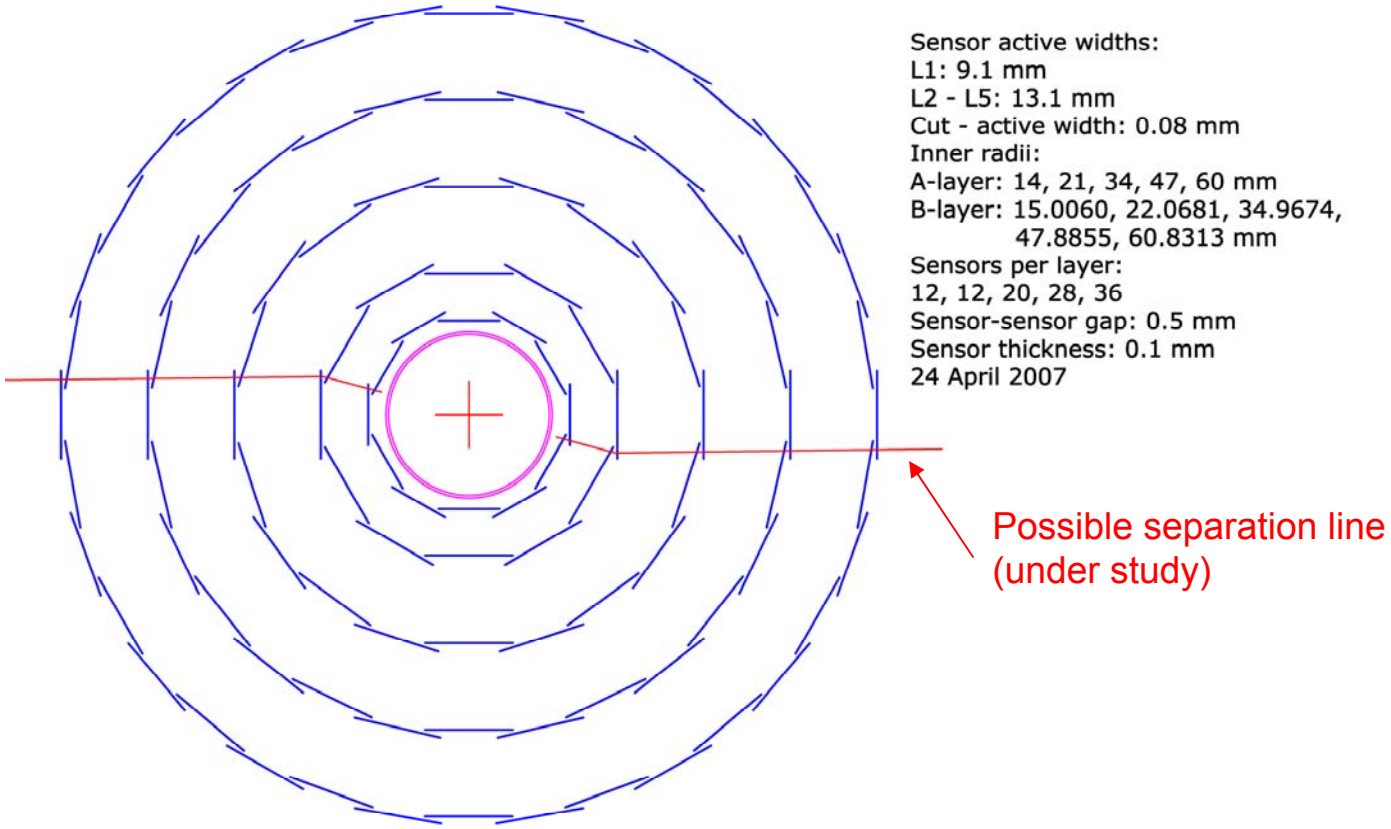
Half-Cylinder Prototyping

- Set-up to check fixturing with 0.32 mm sensors
- 0.1 mm thick silicon dummy sensors are on hand.
- Mandrel is identical to the one used to fabricate CF structure.
- Stacked stages are from DZero Layer 0.
- Vacuum pick-up is in the foreground.
- We have paused to develop fixtures more compatible with sensors carrying cabling / readout.



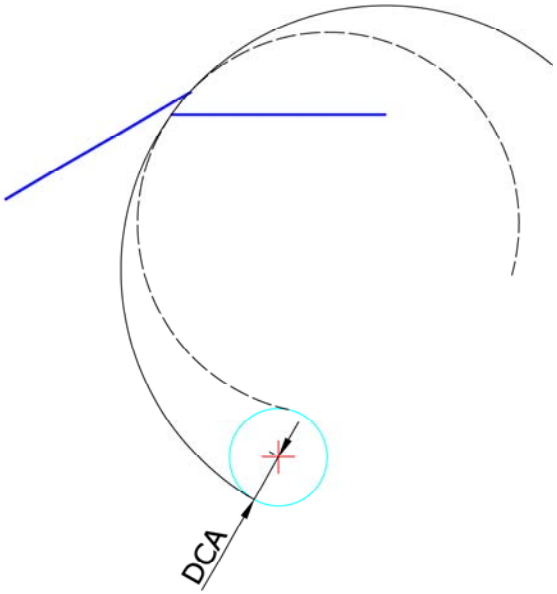
SiD Design Studies and Issues

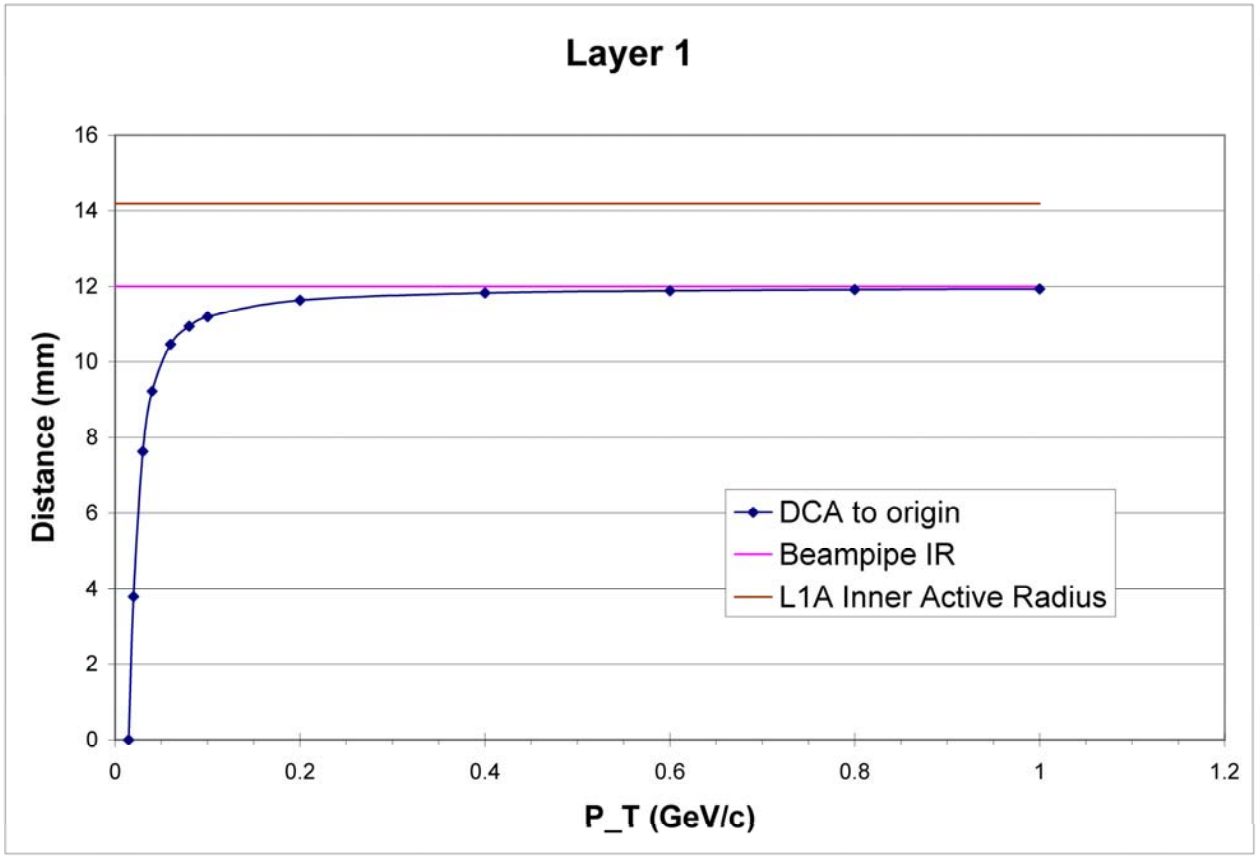
- New barrel end-view geometry under development
- Sensor counts were increased in L3, L4, L5 to obtain multiples of 4 and fully identical barrel halves.



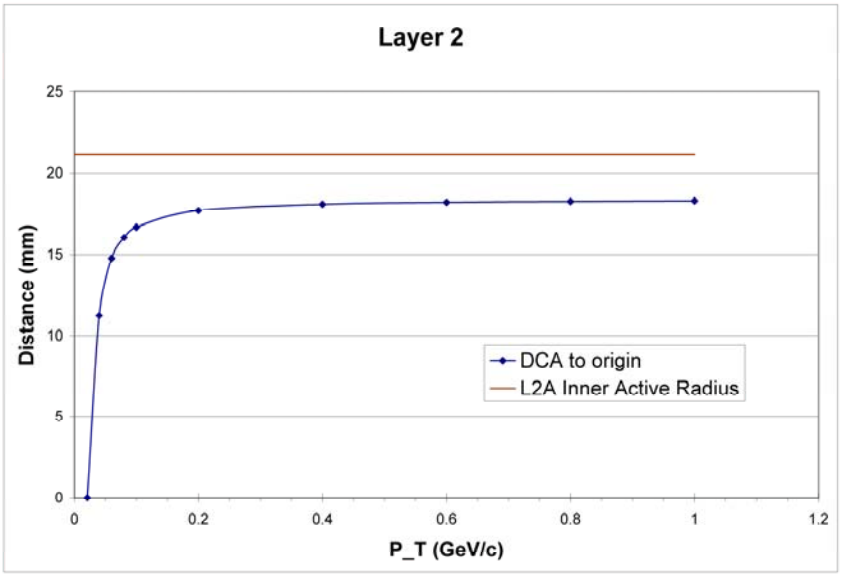
Geometric Efficiency

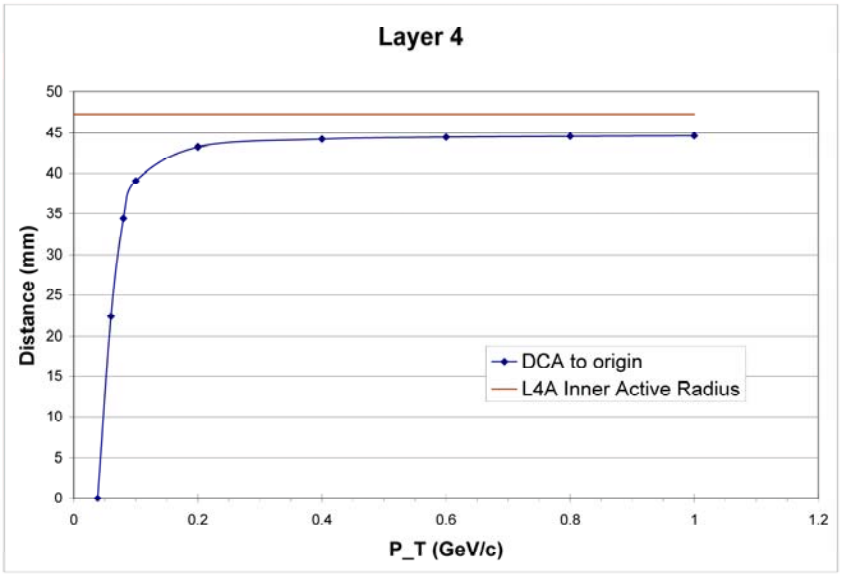
- A- to B-layer gaps determine geometric efficiency.
- Full geometric efficiency is obtained for tracks below and to the right of the curve in the right plot (spreadsheet calculation).
- Tangency to the beam pipe surface is accidental.

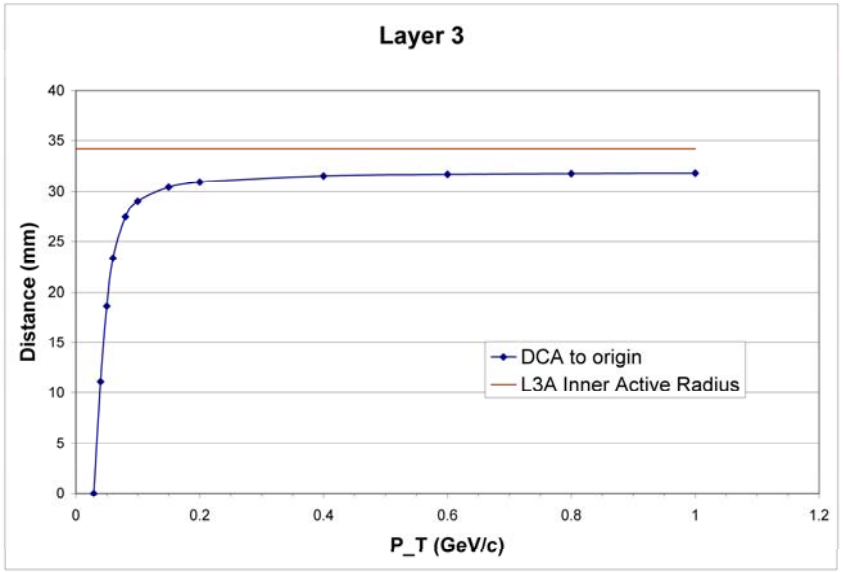


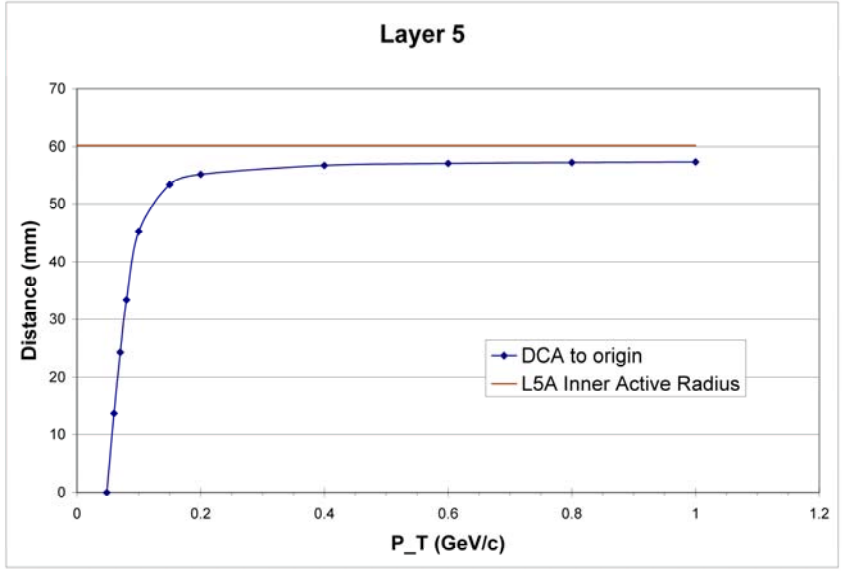


Geometric Efficiency









Geometric Efficiency

- We could obtain geometric efficiency from the spreadsheet and tune sensor locations, sizes, and A- to B-layer gaps to optimize it.
- That hasn't been done yet.
- Similar, but different, geometric efficiency issues arise with a "spiral" geometry.