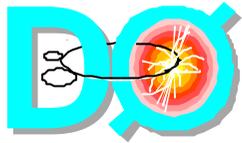


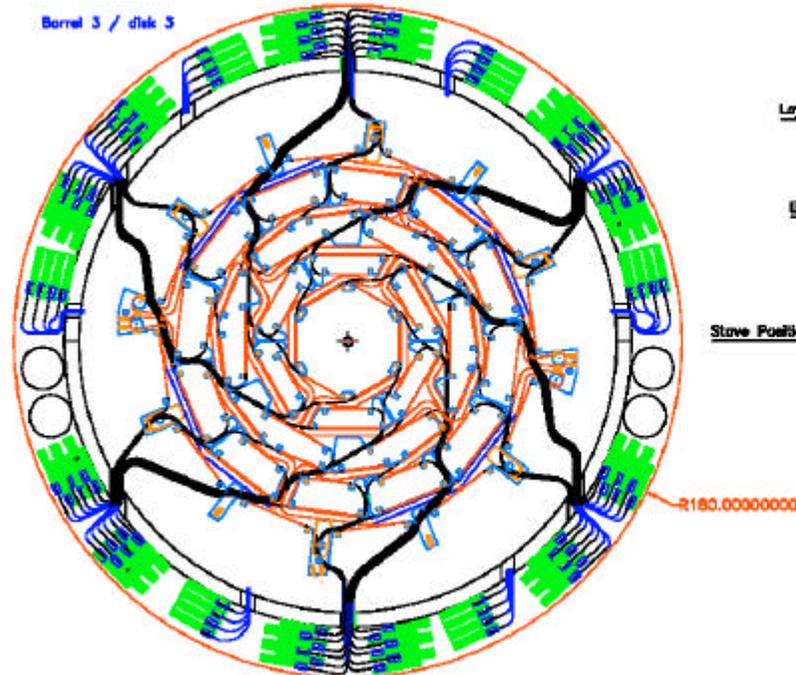
Run II b Silicon Mechanical Design

WBS 1.1.3/1.1.5

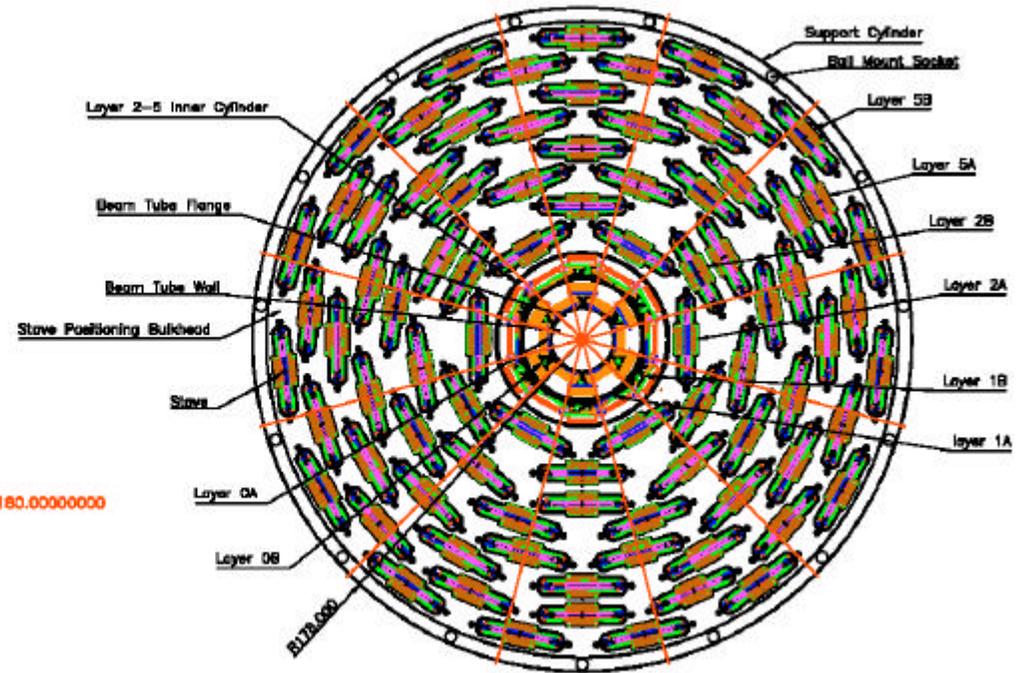
- Run II a and II b geometries
- Sensor dimensions, numbers, and drawings
- Hybrids, layouts, and drawings
- Layer 2-5 staves and cooling
- Layers 0 and 1: geometry and cooling
- Summary



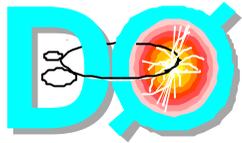
Silicon End View (Barrels)



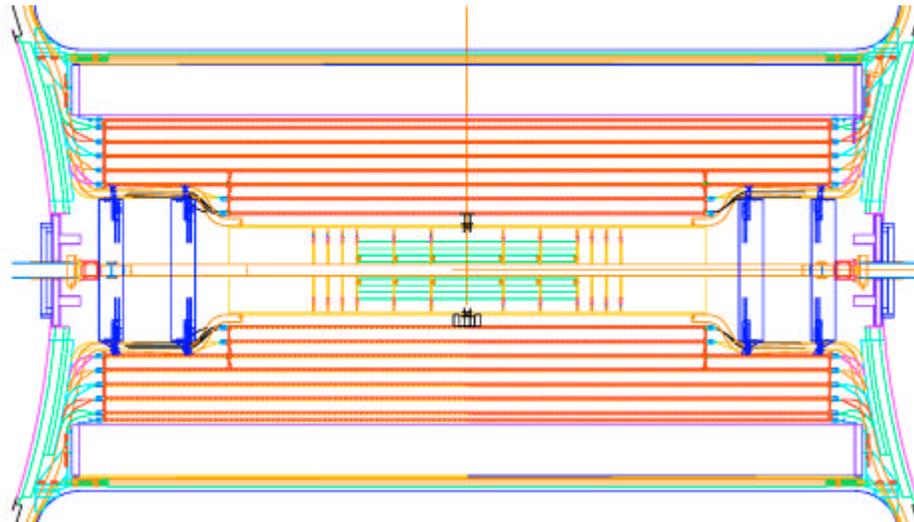
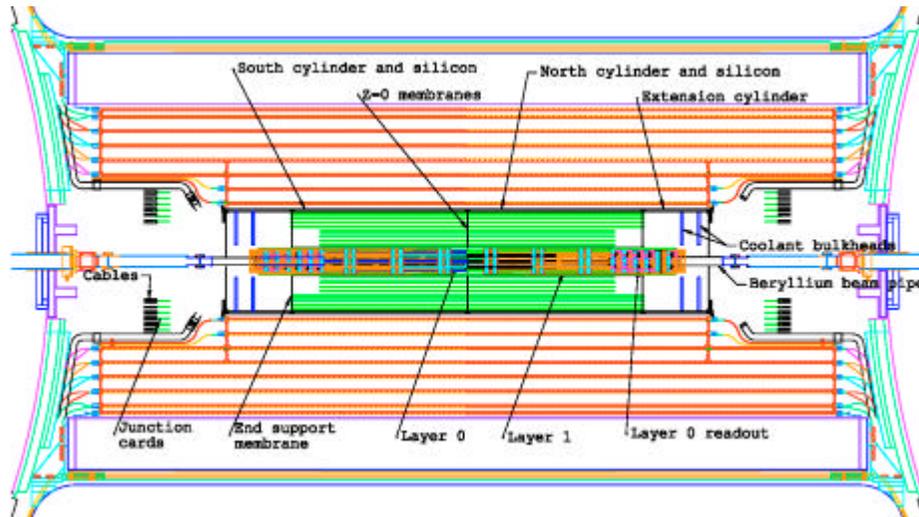
- Run IIa barrels:
- 1.3 m² silicon
- 4 layers
- 864 sensors
- Double-sided except for layers 1 and 3 of the outermost barrels



- Run IIb barrels:
- 8.1 m² silicon
- 6 layers
- 2184 single-sided sensors
- Stereo and axial sensors in layers 2-5, axial only in layers 0-1

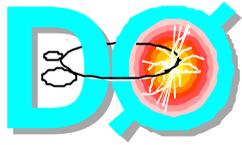


Plan View



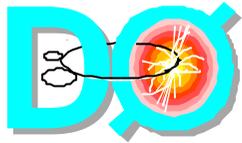
- Run II b:
- 18.542 mm IR beam tube
- L0 and L1: 12 sensors long
- L2 and L3: 10 sensors long
- L4 and L5: 12 sensors long
- 1220 mm long barrel region
- Support from “bulkheads” at $z = 0$ and $z = \pm 610$ mm

- Run II a:
- 14.224 mm IR beam tube
- Six barrels, twelve F-disks, four H-disks
- 1070 mm long barrel plus F-disk region

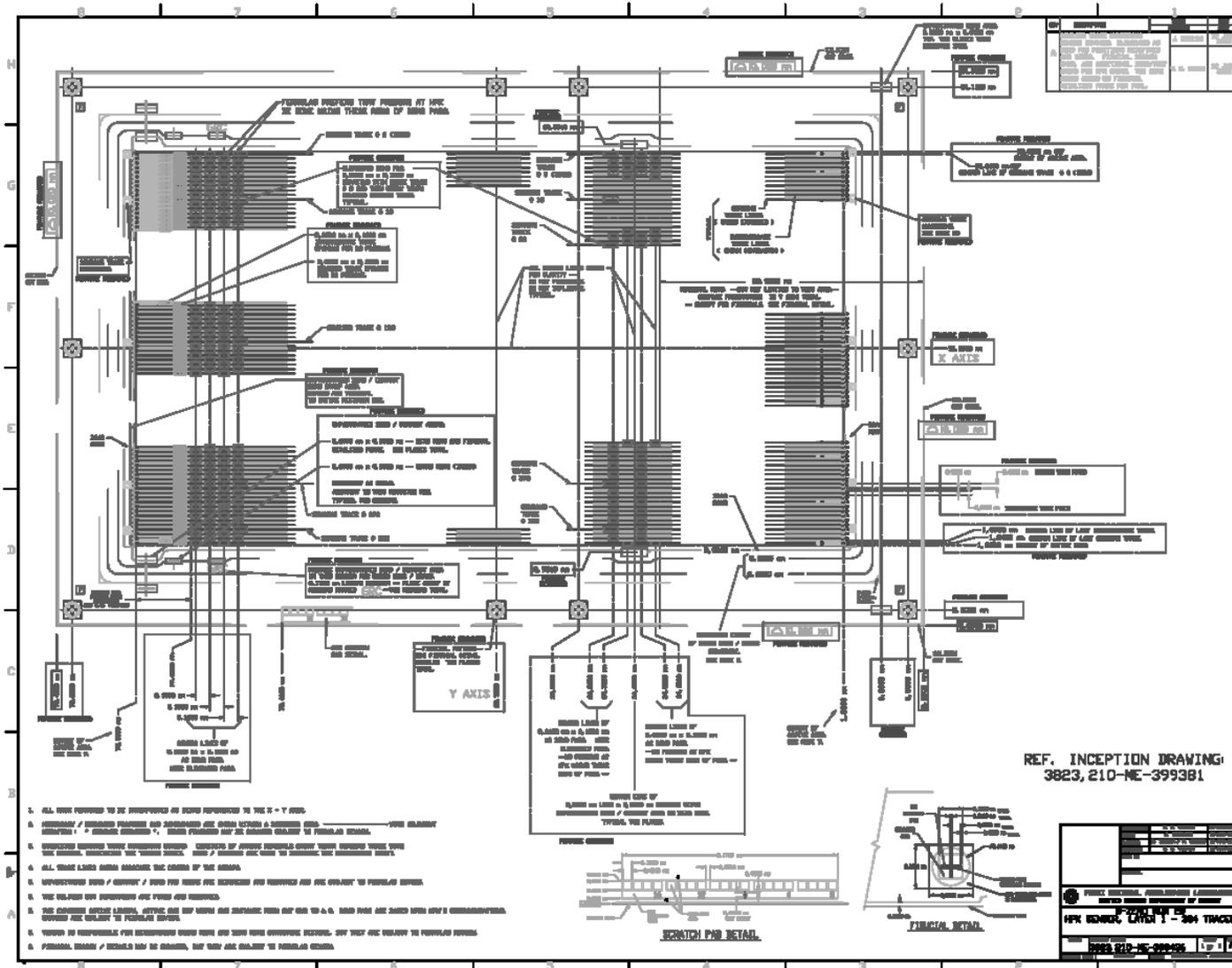


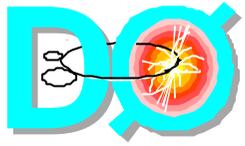
Sensors and Sensor Drawings

- The L1 sensor drawing was submitted to Hamamatsu (HPK) and revised to take into account HPK fabrication requirements.
 - ◆ The cut dimensions are 24.312 mm wide x 79.4 mm long (384 readout traces, 0.058 mm readout pitch, intermediate strips).
 - ◆ L1 has axial readout only.
 - ◆ For comparison, the 3-chip wide sensors of Run 2a have cut dimensions of 21.2 mm x 60 mm, 0.050 mm readout pitch, and no intermediate strips.
- The L2-L5 drawing has been submitted to HPK.
 - ◆ Cut dimensions are 40.34 mm wide x 100 mm long (639 traces, 0.060 mm readout pitch, intermediate strips).
 - ◆ The odd number of traces is needed to allow sensor-sensor bonds.
 - ◆ All L2-L5 sensors are identical. Stereo angles are obtained by rotating sensors.
 - ◆ For comparison, the 5-chip wide sensors of Run 2a have cut dimensions of 34 mm x 60 mm, 0.050 mm readout pitch (axial surface), and no intermediate strip.



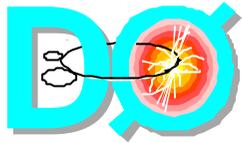
L1 Sensor Drawing



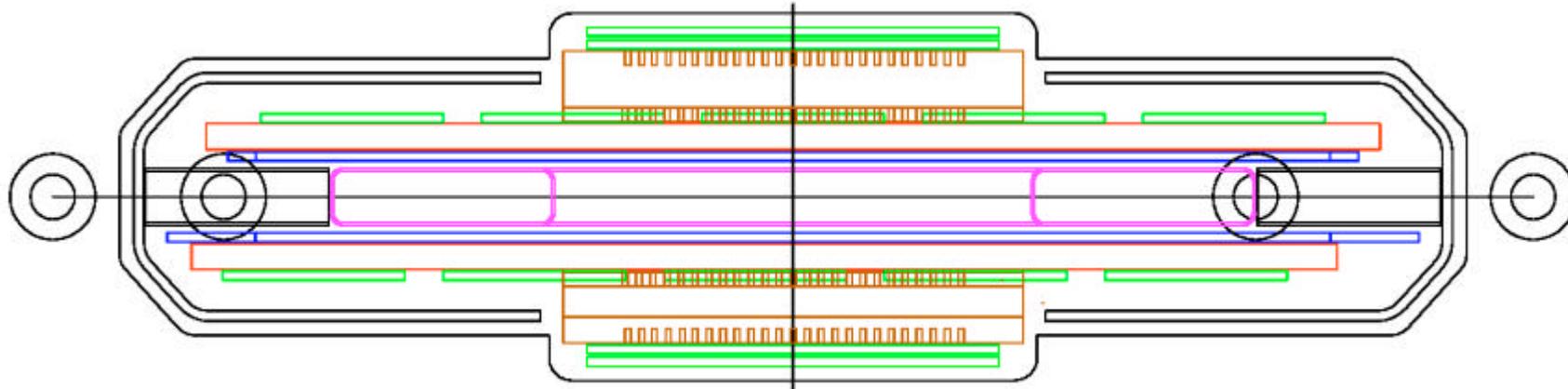


Sensors and Sensor Drawings

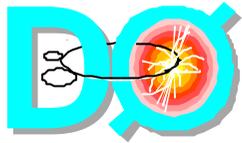
- A L0 sensor drawing is in preparation following the format of the L1-L5 drawings.
 - ◆ The proposed cut dimensions are 14.84 mm wide x 79.4 mm long (256 traces, 0.050 mm readout pitch, intermediate strips).
 - ◆ We have verified that CDF L00 masks could be used instead of the L0 sensor layout developed for D0, if one trace of 256 were not read out.
 - ◆ L0 has axial readout only.



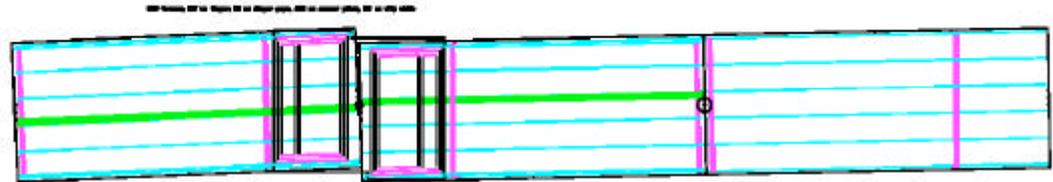
L2-L5 Stave End View



- In this picture (L3 or L5), the axial sensors are on the top surface and the stereo, on the bottom.
- In L2 and L4, the opposite stereo sense is obtained by rotating the staves 180° about their longitudinal axis. L2 and L3 staves are identical as are those of L3 and L5.
- Digital cables run along the stave outer surfaces from connectors on the hybrids to (and beyond) the $z = 605$ end of each stave. All cooling connections are at the $z = 605$ mm end.
- $Z = 0$ pins are offset so that the pins of north silicon miss those of south silicon.



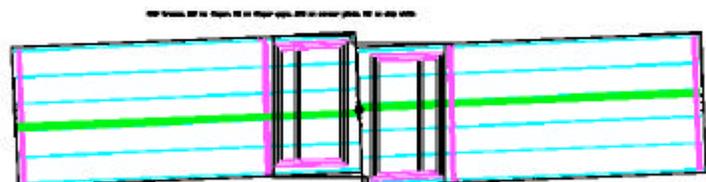
Hybrid - Sensor Layout



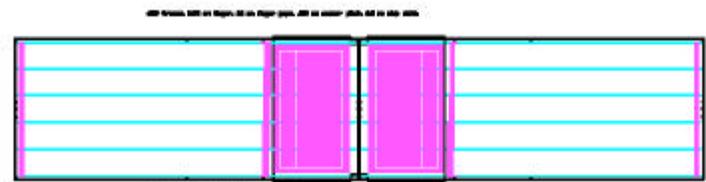
300 mm stereo



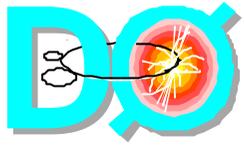
400 mm stereo



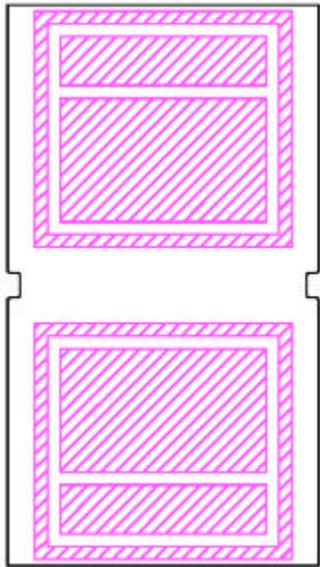
200 mm stereo



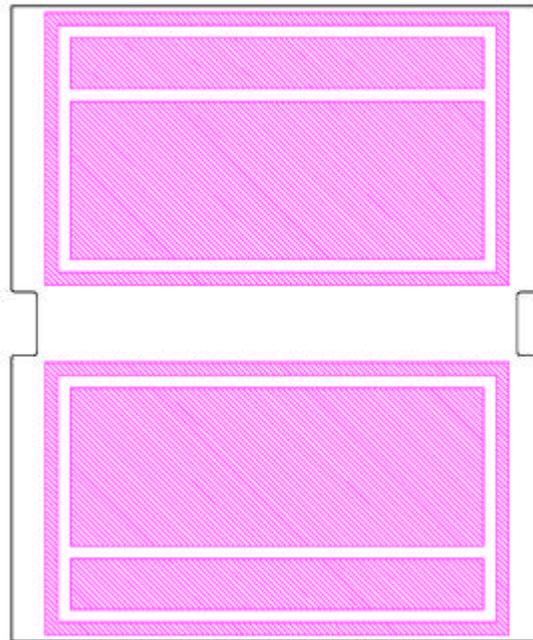
200 mm axial



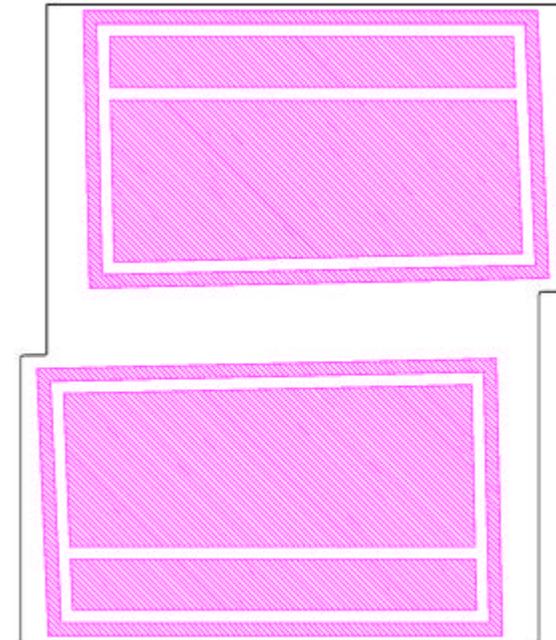
Hybrid Backside Printing



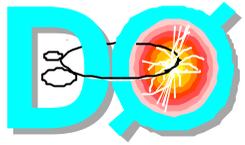
L1



L2-L5 Axial

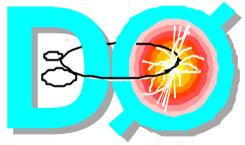


L2-L5 Stereo



Stave Cooling Tubes

- Carbon fiber has been chosen as the cooling tube material in all layers. Four plies are likely in L2-L5. Grounding at hybrids is needed.
- The cooling tubes turn around near $z = 0$.
- Cross-sectional dimensions are 2 mm x 10 mm.
- Because reliability of the cooling tubes is essential, a long-term (6+ month) test of D0 carbon fiber tubes and CDF PEEK tubes has been started at SiDet.

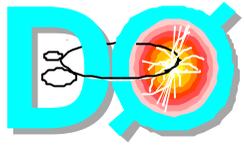


Plan View of Staves

Stave views are with axial surface up.



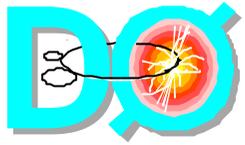
- L4 - L5 at top
- L2 - L3 at bottom



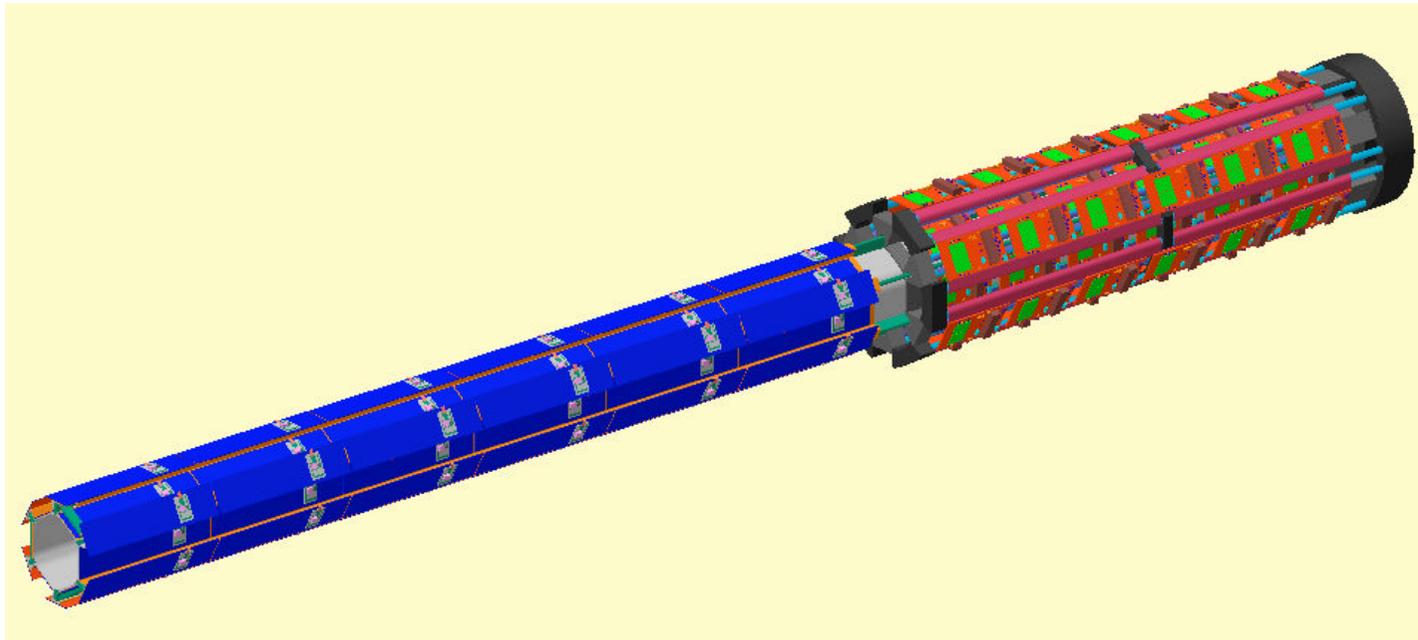
SiDet Cooling Tube Test



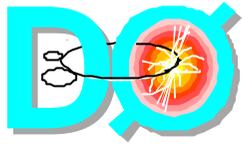
- Sub-atmospheric operation with 41% ethylene glycol in water
- 13.7 psia supply pressure is set by elevation
- 3 psid across tubes corresponds to final operation
- Flow rate is increased due to room temperature operation
- Test system configured to accept both a heater and a chiller



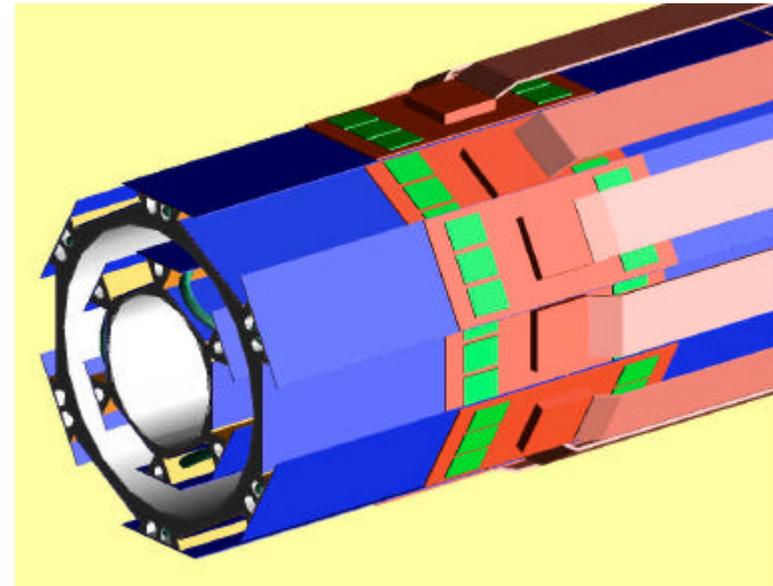
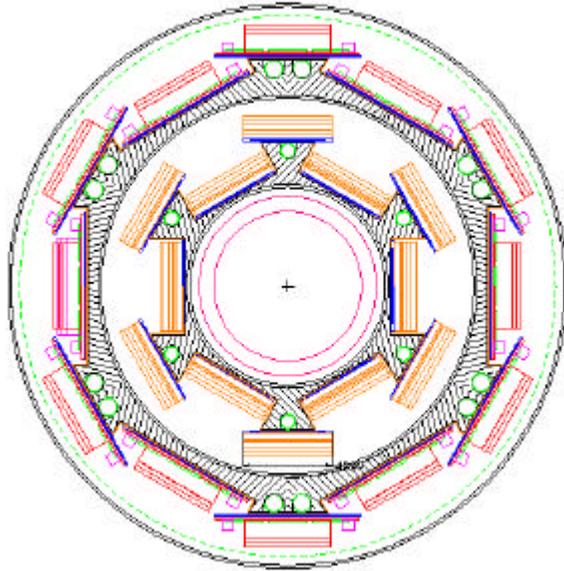
L0 (University of Washington)



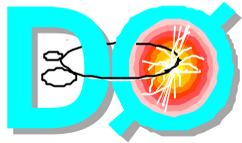
- Hybrids are located at the end of the sensor region and connected to the sensors via analogue cables
- Independent cooling is provided for the sensors and the hybrids to simplify heat removal from the silicon.



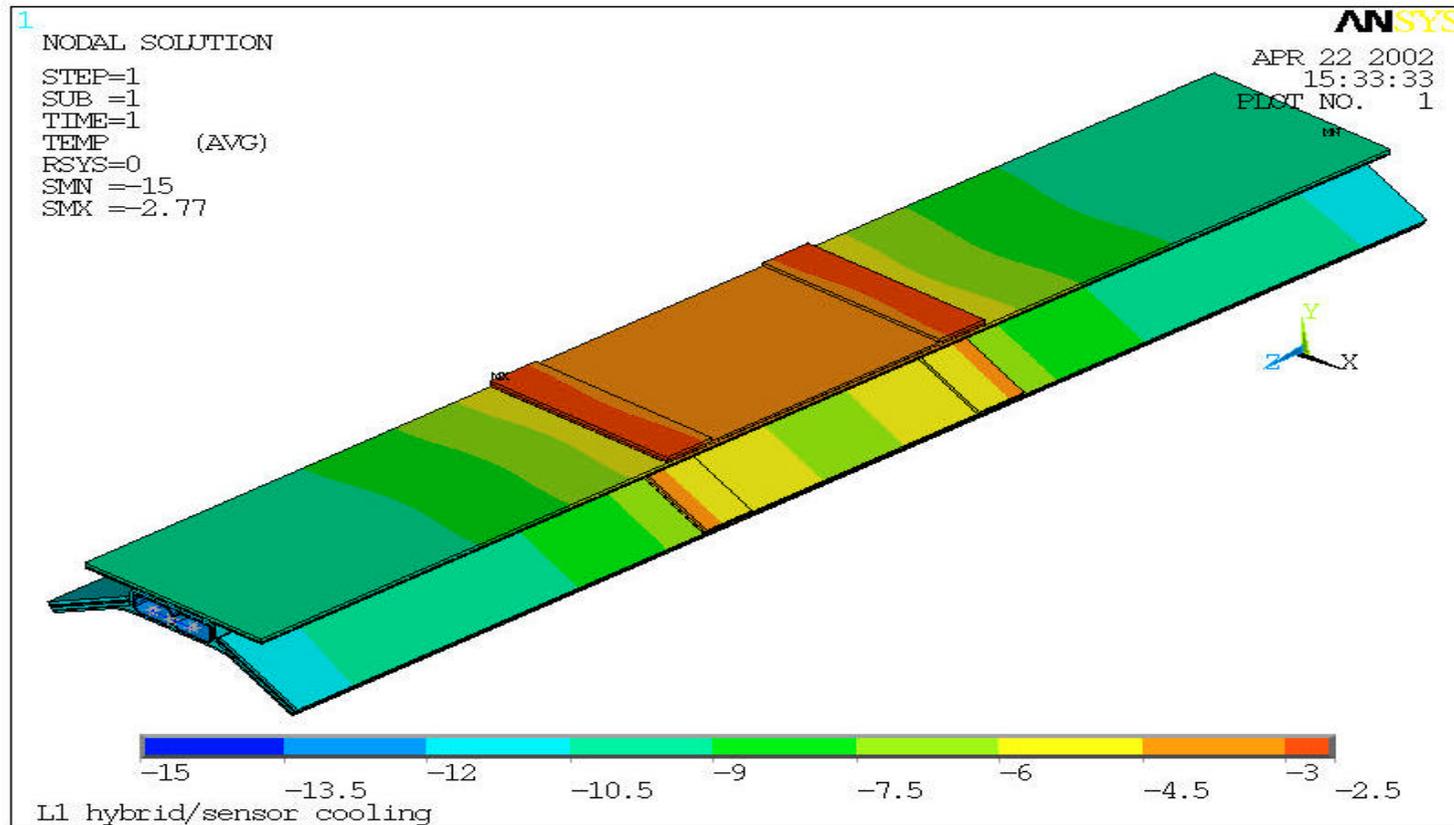
L0 - L1



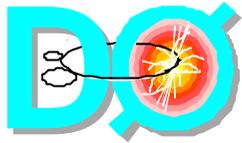
- Sensors at twelve azimuthal positions and two radii for each layer
- Support is via carbon fiber reinforce epoxy cylinders
- The outer cylinder is castellated to provide the two radii
- The inner cylinder is either round or hexagonal
- Support for the cylinders is at $z = 0$ and $z = 61$ cm



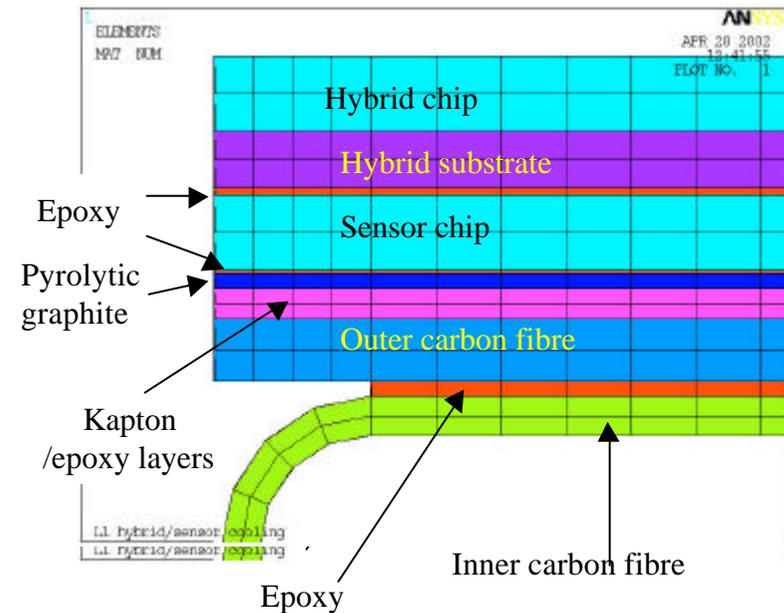
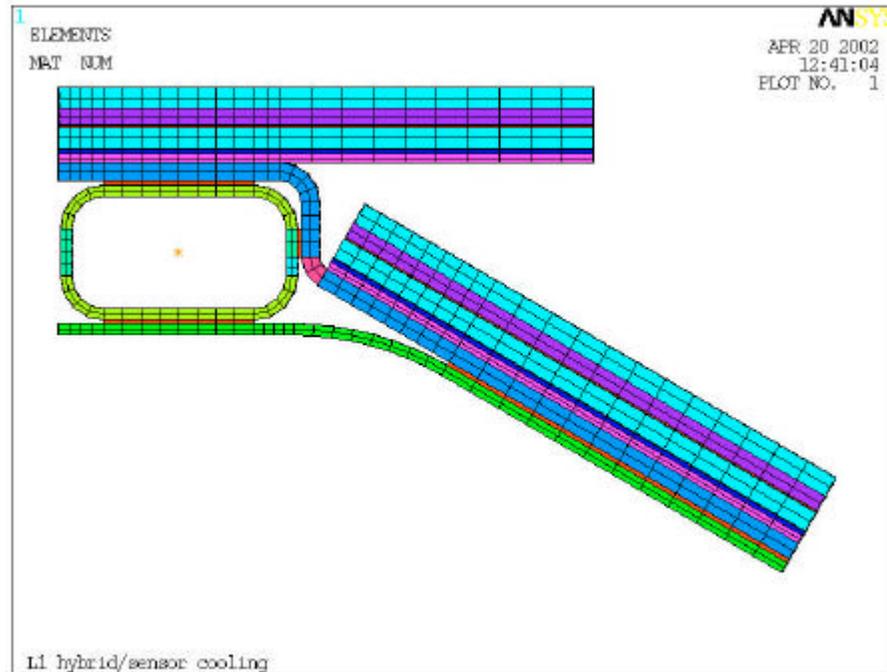
L1 Temperatures (Colin Daly)



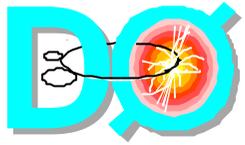
Temperature map for the whole model. The maximum temperature of the hybrid chips is -2.77 C with the inlet coolant temperature at -15 C . Cooling hybrids through the silicon limits options.



L1 Thermal Studies (UW)



- Cross section showing the various layers of materials in the model. Note the use of a layer of pyrolytic graphite sheet under the sensors.



Summary

- The Run II b geometry has been established.
 - ◆ North and South barrels, each with six layers
 - ◆ Independent, but mating, structures for L0-L1 and L2-L5.
 - ◆ 122 cm long silicon region
 - ◆ Support from fiber tracker barrel 1 via extension cylinders
- L1 and L2-L5 sensor drawings have been prepared. L0 drawings are in preparation.
- Stave designs with integrated cooling and positioning features have been developed for L2 - L5.
- Sensor - hybrid module designs have been developed which match the stave designs.
- Designs of support structures for L0 and L1 have been developed, along with matching hybrid designs.
- Finite element studies have been made of deflections and cooling for all layers.
- Prototyping is under way.