Alternative L0 layout

12 sided version

C H Daly 25 Sept 2003

Main Points:

1. Maintains 12 sided layout.

2. Yields a 10 strip overlap between the A and B sensors.

3. Radial beam pipe clearance is 0.62 mm and the outer radius clearance is at least 0.37 mm. We can use 0.2 mm of this for an outer shell.

4. No additional R&D needed for carbon fiber structure. Experience with Run2b L0/L1 allows going straight to final mandrel production.

This requires:

1. Gang readout of pairs of sensors to analog cables.

2. Hardwire digital cable to hybrids (no connectors).

3. Transition section in structure from sensor to hybrid regions.

These options maintain a 12-sided layout. The layer A sensors have 128 traces and the layer B sensors have 256. the coverage overlap at the A-B junction is 10 traces on the silicon. The 6 sensor cooling tubes have an individual area of 9.25 mm^2. It is assumed that the cooling tubes will extend completely through the N and S parts of the L0 structure. Given the low heat load from the sensors and our experience with the Run2b thermal calculations, no problem is foreseen with the thermal gradient from the sensors to the coolant.

The design uses analog cables with a width of 8.24 mm in layer A and 13.95 mm in layer B. The outer radial clearance is set by the edges of these cables at 0.37 mm from an available clearance radius of 22.8 mm. A second option shows that improvements can be made e.g. with cable widths of 7.1 and 11.9 mm for the A and B sectors, the clearance is increased to 0.67 mm.

At the inner radius the radial clearance from the beam pipe is 0.62 mm. In view of Jim's message about the straightness of the pipe, we will have to look at this carefully and will probably need a survey of the beam pipe. In order to control the sagitta of the L0 structure we will probably need to provide supports between the pipe and the carbon structure. E.g. using two optimally placed supports, the sag is reduced by a factor of 250 for a uniform beam.

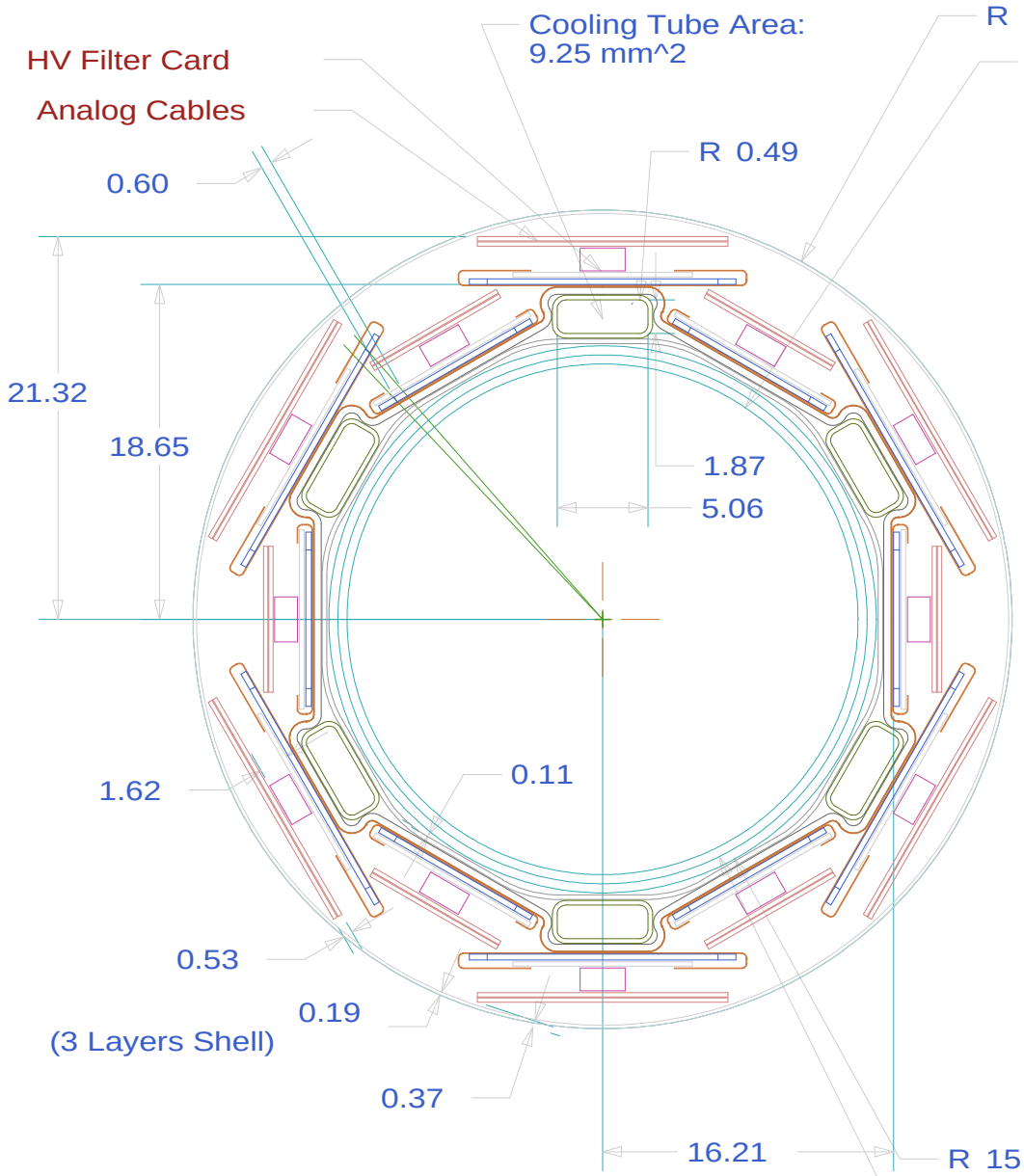
In the hybrid region, the hybrids are mounted only in the troughs at the A-layers. This requires that the analog cables from the B layer sensors have a jog between the ends of the B sensors and the start of the first B hybrid. The A hybrids are placed further out in Z. All of this requires that we gang the sensors in pairs with 2 sensors being serviced by one hybrid. We also need to do without connectors for the digital cables – these need to be wire bonded.

Using an unmodified carbon structure in the hybrid region results in a radial clearance at the outer radius of 0.55 mm between the digital cable stack and the outer clearance radius. Modifying the carbon structure to replace the inner shell with short straps that close the inner side of the castellation allows an increase to 0.78 mm in this clearance.

The hybrid cooling tubes have an area of 7.07 mm2. Jim gives the temperature rise in the coolant as it flows through the hybrid region and this shows that the coolant temperature entering the sensors region will be well below 0 C (depending on he supply temperature). The sensor temperature should not then be a problem. Finding the hybrid temperature will require FEA.

This configuration requires different dimensions in the carbon structures of the sensor and hybrid regions. There is enough room in Z to accommodate a connector piece at this point. This also allows a change in the coolant tubes at this point if necessary.

Cross section at sensor location. Normal width analog cables shown.



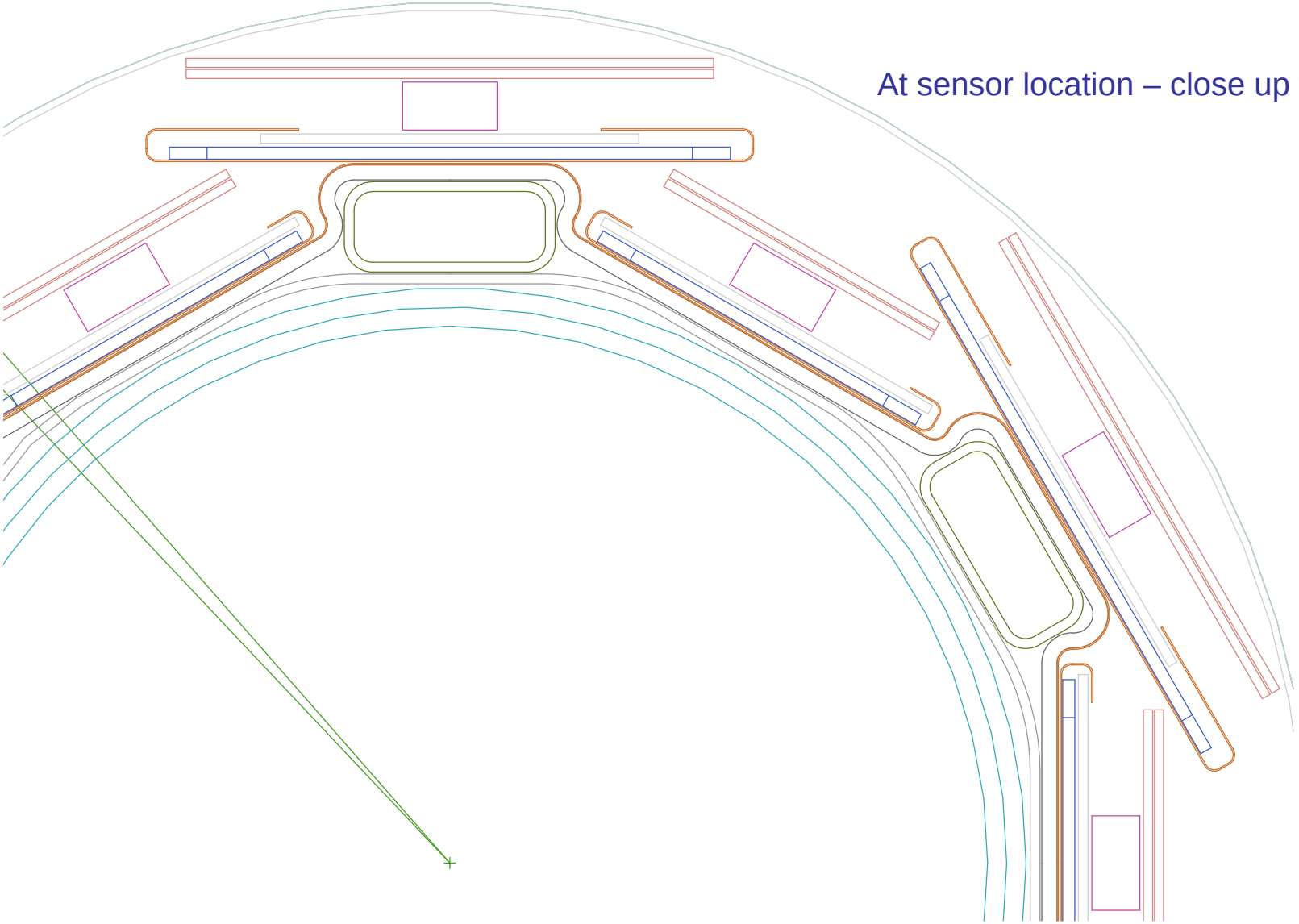
New Layer 0 for Run IIb Up
Layout Drawing
Option 1 - Sensor Region

Joshua Wang
September 23, 2003

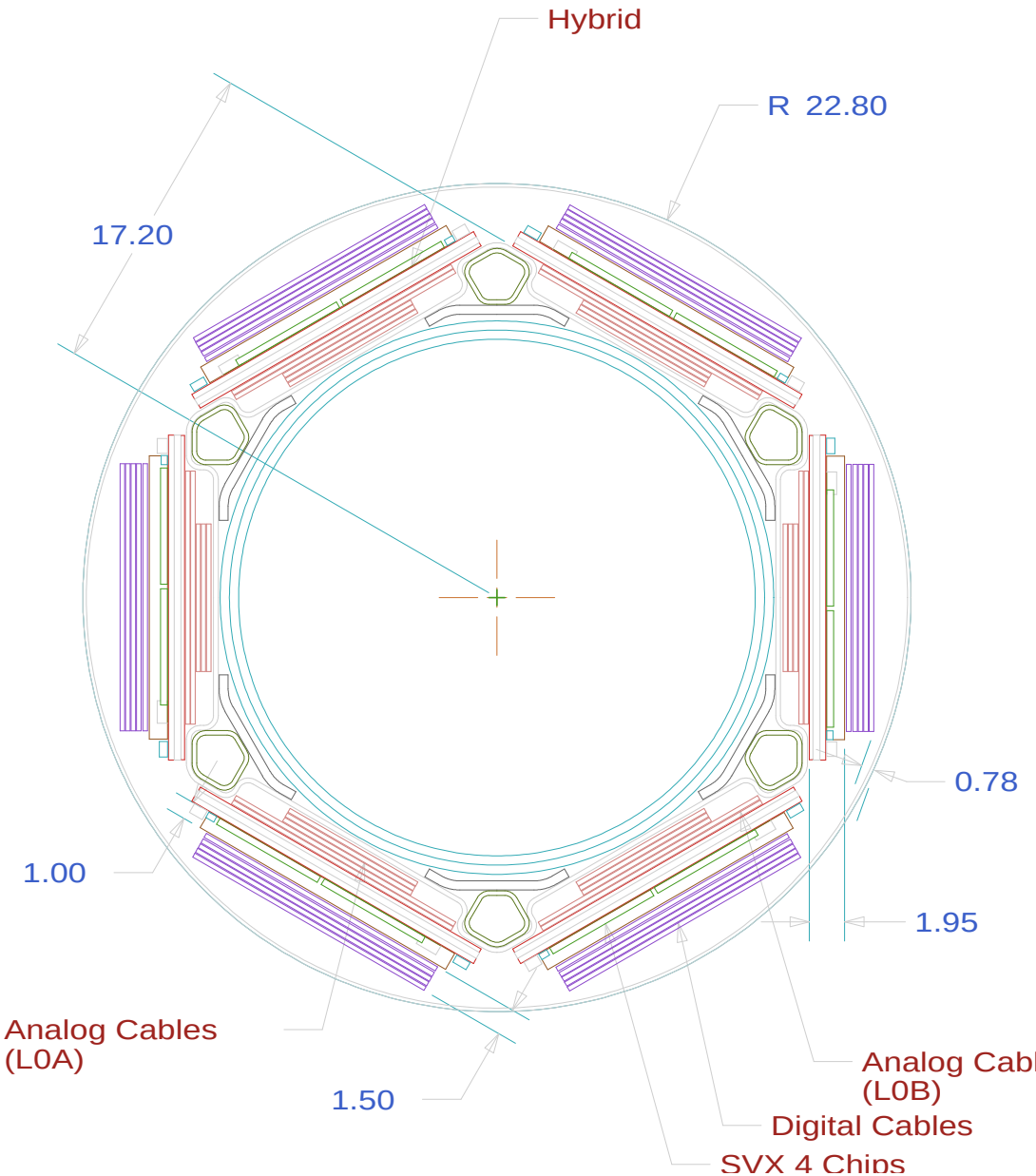
Notes:

1. Layer 0A:
   - 128 readout traces
   - 60 micro-m trace pitch
   - 7.68 mm active width
   - 9.72 mm cut width
   - 80 mm sensor length
   - 12 sensors in z
   - 8.124 mm cable width
   - Every 2 sensors are daisy chained and share comm analog cable.
2. Layer 0B:
   - 256 readout traces
   - 50 micro-m trace pitch
   - 12.8 mm active width
   - 14.84 cut width
   - 80 mm sensor length
   - 12 sensors in z
   - 13.95 mm cable width
   - Every 2 sensors are daisy chained and share comm analog cable.
3. Analog Cable:
   - Circuit thickness: 0.07 mm
   - spacer thicknes: 0.05 mm (Solid kapton spacer used instead of foam spacer)
   - Trace pitch: 0.091 mm

At sensor location – close up view.



Cross section at hybrid location with modified carbon structure.
Normal width analog cables shown.

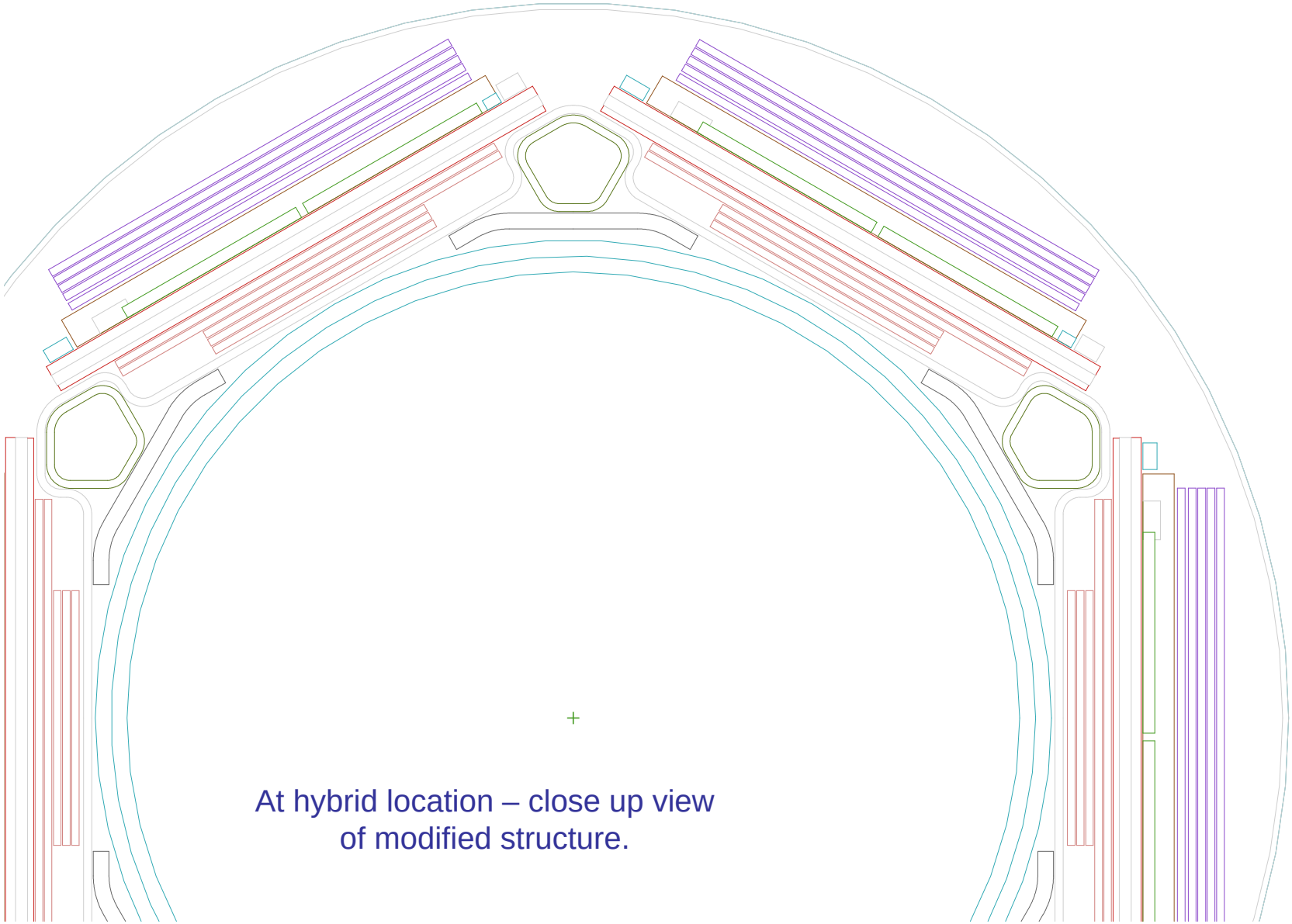


New Layer 0 for Run IIb Upgr
Layout Drawing
Option 1.1 -
Modified Hybrid Region

Joshua Wang
September 23, 2003

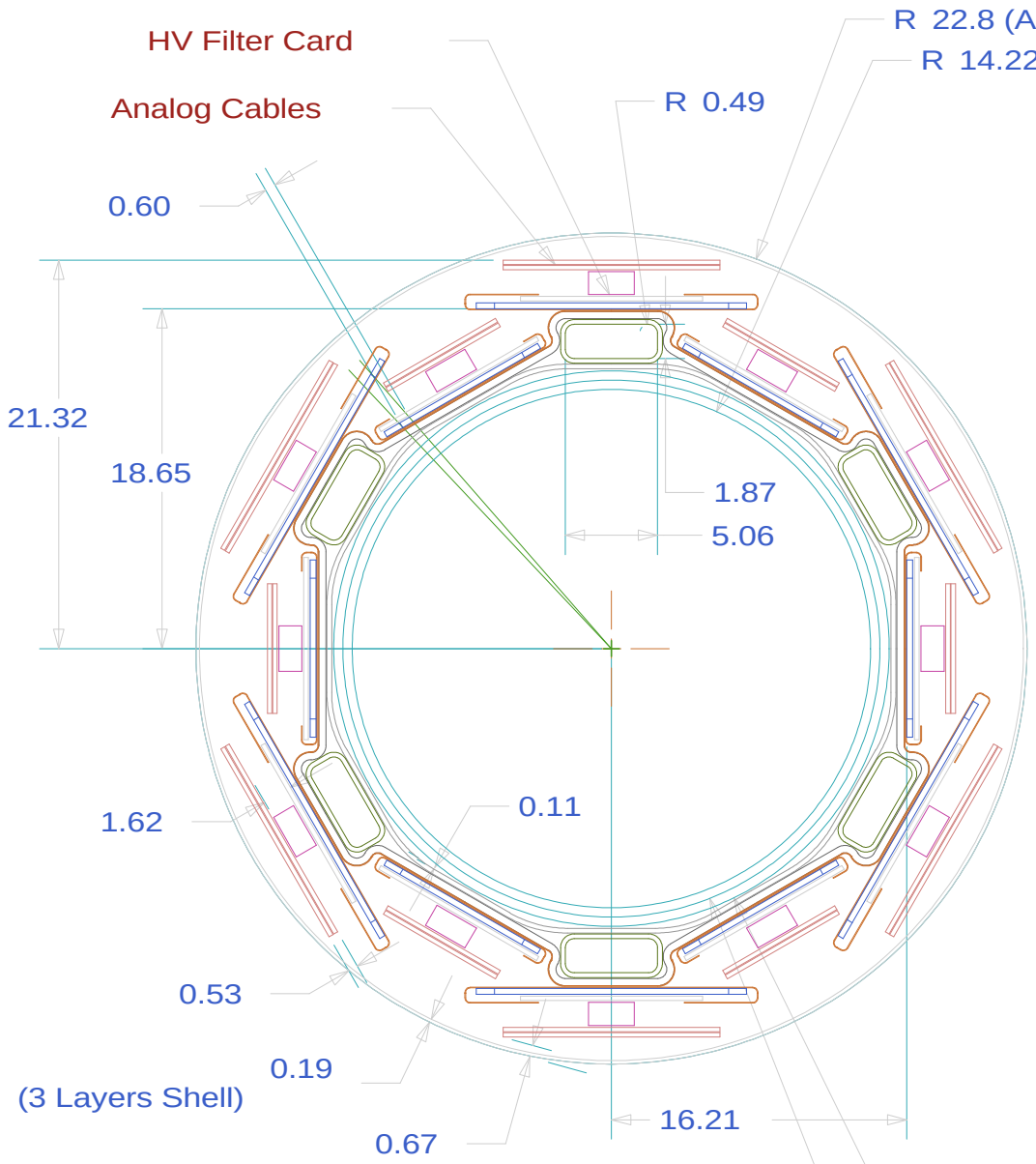
Notes:

1. Inner Shell removed and replaced with 6 stiffner pieces to allow the hybrids, analog cables to move in radially while still keeping the structure stiff.
2. An intermediate structure v be used to connect the sen region castellated and inne shell to the hybrid support shell and the stiffners. The structure will also be used t transition the sensor coolin tubes to hybrid cooling tube
3. Layer 0 Run IIb hybrid sho A 1 mm spacer replaces th connector in current design of hybrid.
4. Layer 0B analog cables wi need to have a jog to move from 0B sector to the 0A sector.
5. Digital Cable:
   Width: 14.7 mm
   Thickness: 0.25 mm



At hybrid location – close up view
of modified structure.

Cross section at sensor location. Narrow width analog cables shown.



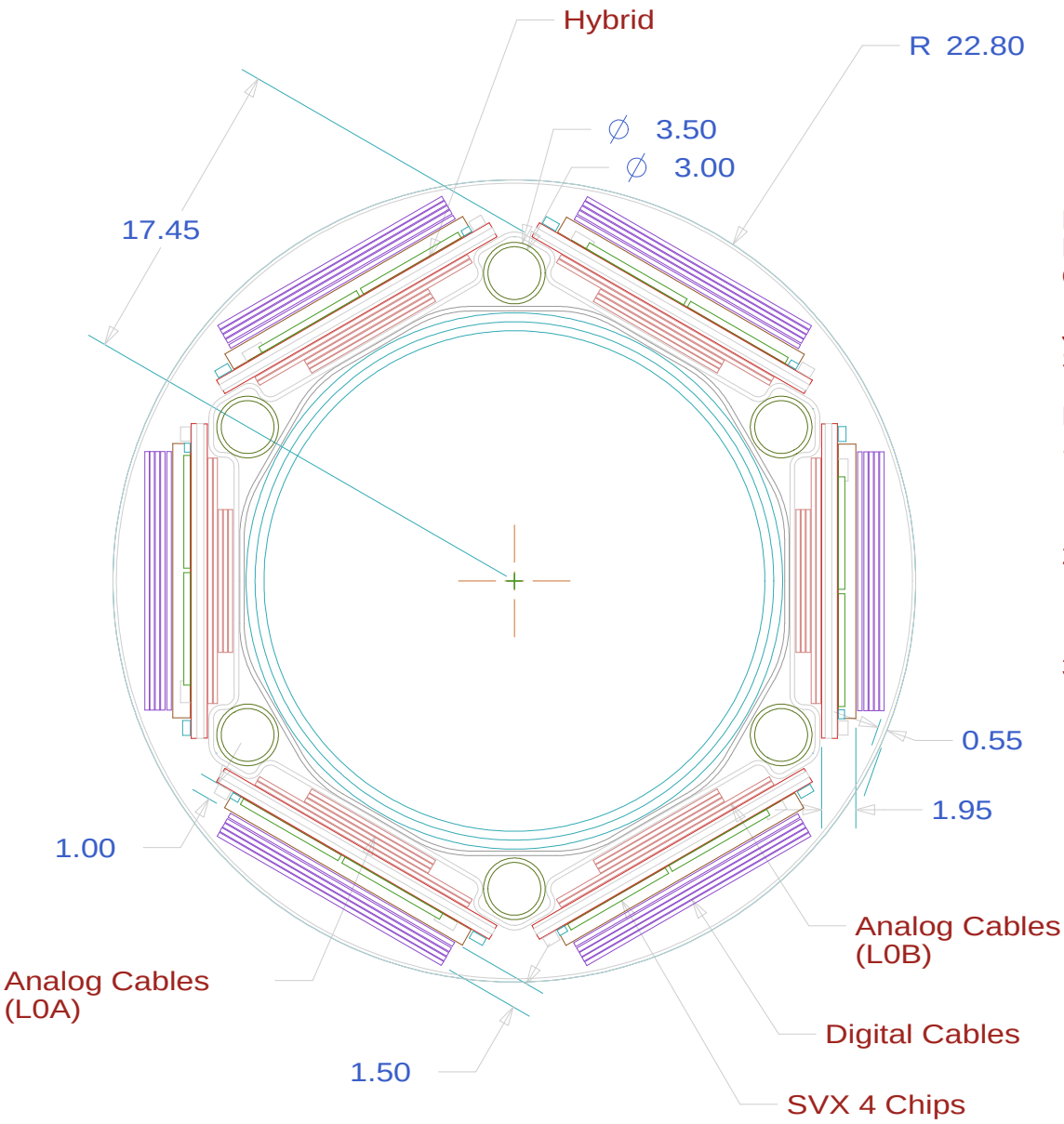
New Layer 0 for Run IIb Upgrade
Layout Drawing
Option 1.1 - Modified Sensor Reg

Joshua Wang
September 23, 2003

Notes:

1. Layer 0A:
   - 128 readout traces
   - 60 micro-m trace pitch
   - 7.68 mm active width
   - 9.72 mm cut width
   - 80 mm sensor length
   - 12 sensors in z
   - 7.1 mm cable width
   - Every 2 sensors are daisy chained and share common analog cable.
2. Layer 0B:
   - 256 readout traces
   - 50 micro-m trace pitch
   - 12.8 mm active width
   - 14.84 cut width
   - 80 mm sensor length
   - 12 sensors in z
   - 11.9 mm cable width
   - Every 2 sensors are daisy chained and share common analog cable.
3. Analog Cable:
   - Circuit thickness: 0.07 mm
   - spacer thicknes: 0.05 mm
   - (Solid kapton spacer used instead of foam spacer)
   - Trace pitch: 0.075 mm

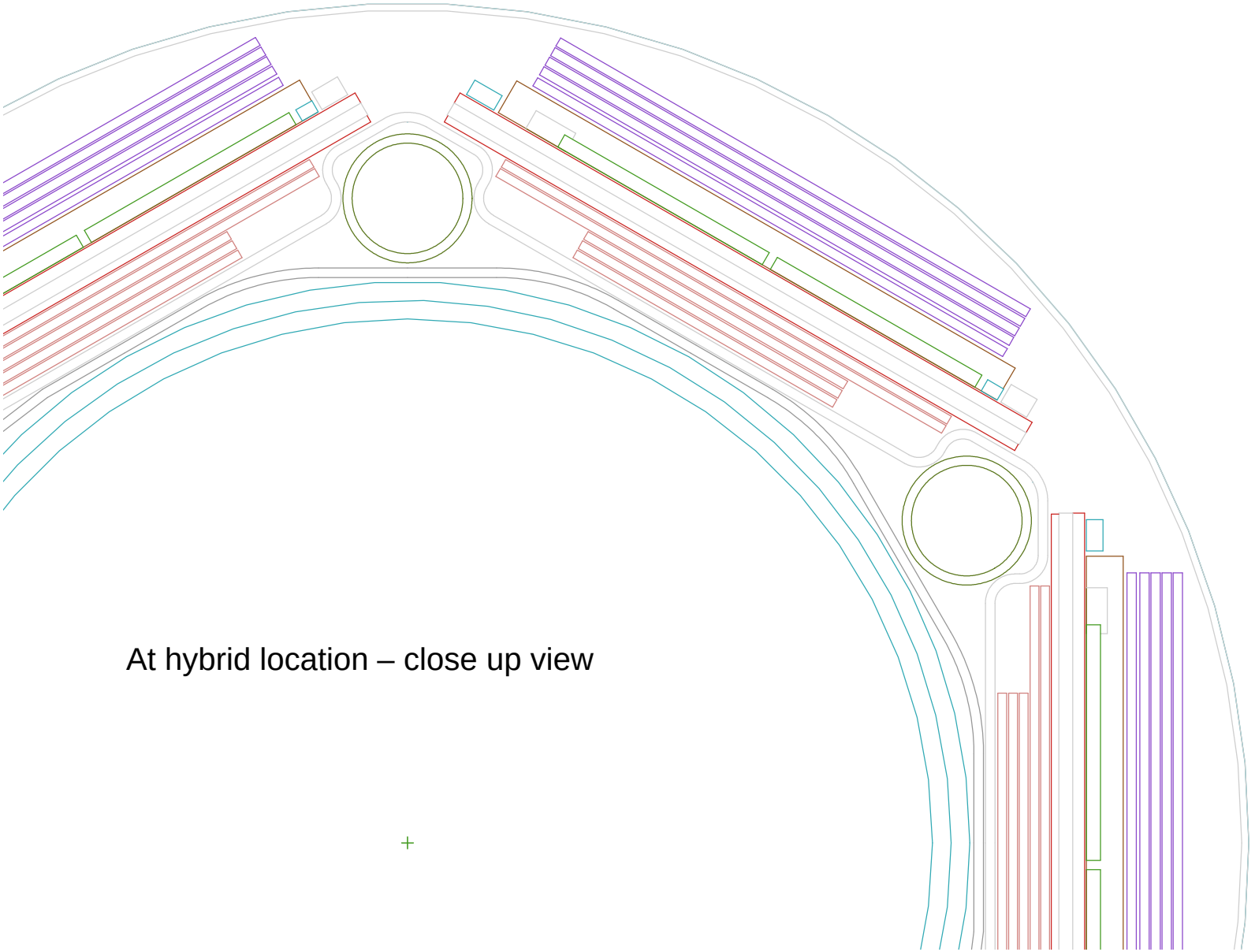
Cross section at hybrid location with unmodified carbon structure. Normal width analog cables shown.



New Layer 0 for Run IIb Upgrad
Layout Drawing
Option 1 - Hybrid Region

Joshua Wang
September 23, 2003

Notes:
1. Layer 0 Run IIb hybrid shown
   A 1 mm spacer replaces the connector in current design of hybrid.
2. Layer 0B analog cables will need to have a jog to move from 0B sector to the 0A sector.
3. Digital Cable:
   Width: 14.7 mm
   Thickness: 0.25 mm



At hybrid location – close up view