SiD Outer Tracker Disks and Barrels

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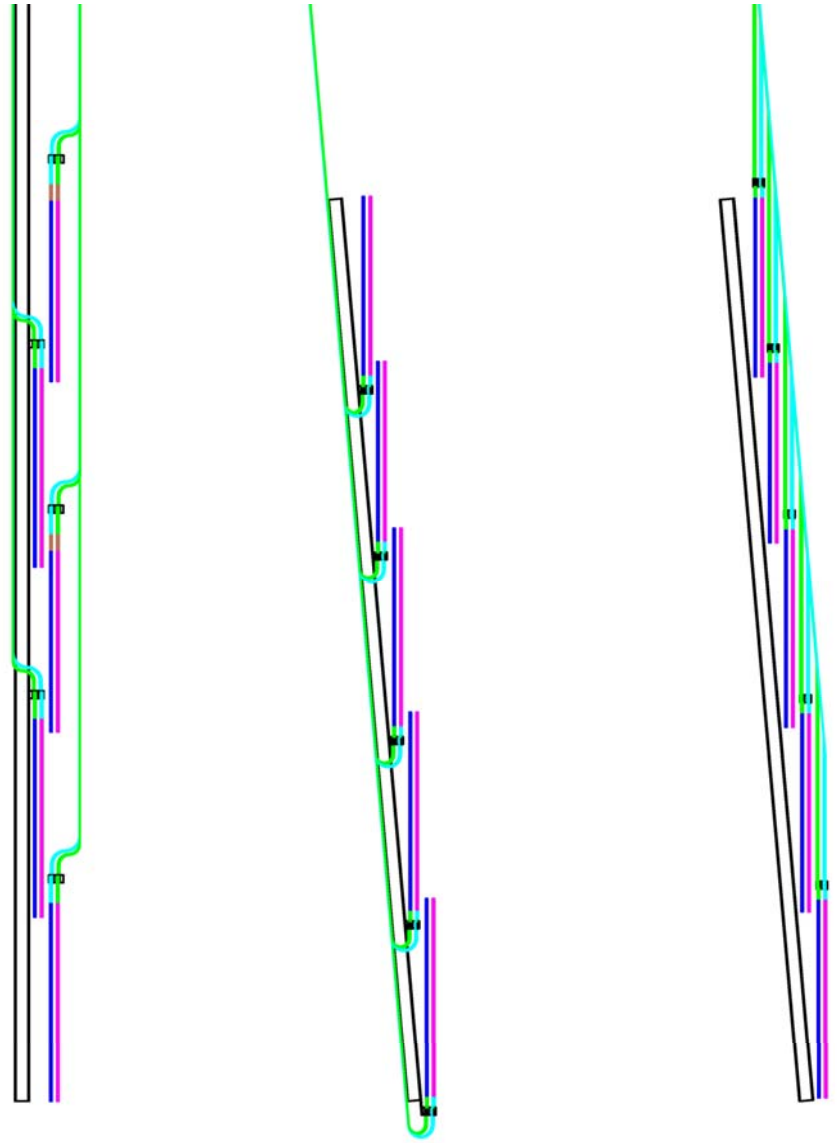
Proposed Disk Geometry

- The tracking software group urged that sensor surfaces be normal to the beam line.
  - That simplifies equations.
  - Hit finding and track reconstruction may be faster.
  - Designs satisfying that preference are relatively straight-forward.
- Sensors of a disk could alternate among four z-locations to obtain r and phi overlap in an arrangement similar to that of the barrels.
  - Spiral geometry seems less desirable in the disks and would not satisfy the desire that sensors be normal to the beam line; hence the four z-locations.
- Alternatively, sensor z-locations could be stepped with r.
  - That is what is proposed.
  - Such an arrangement provides greater support structure stiffness in z for a given amount of support structure material.
  - To obtain stereo, back-to-back sensors are proposed.

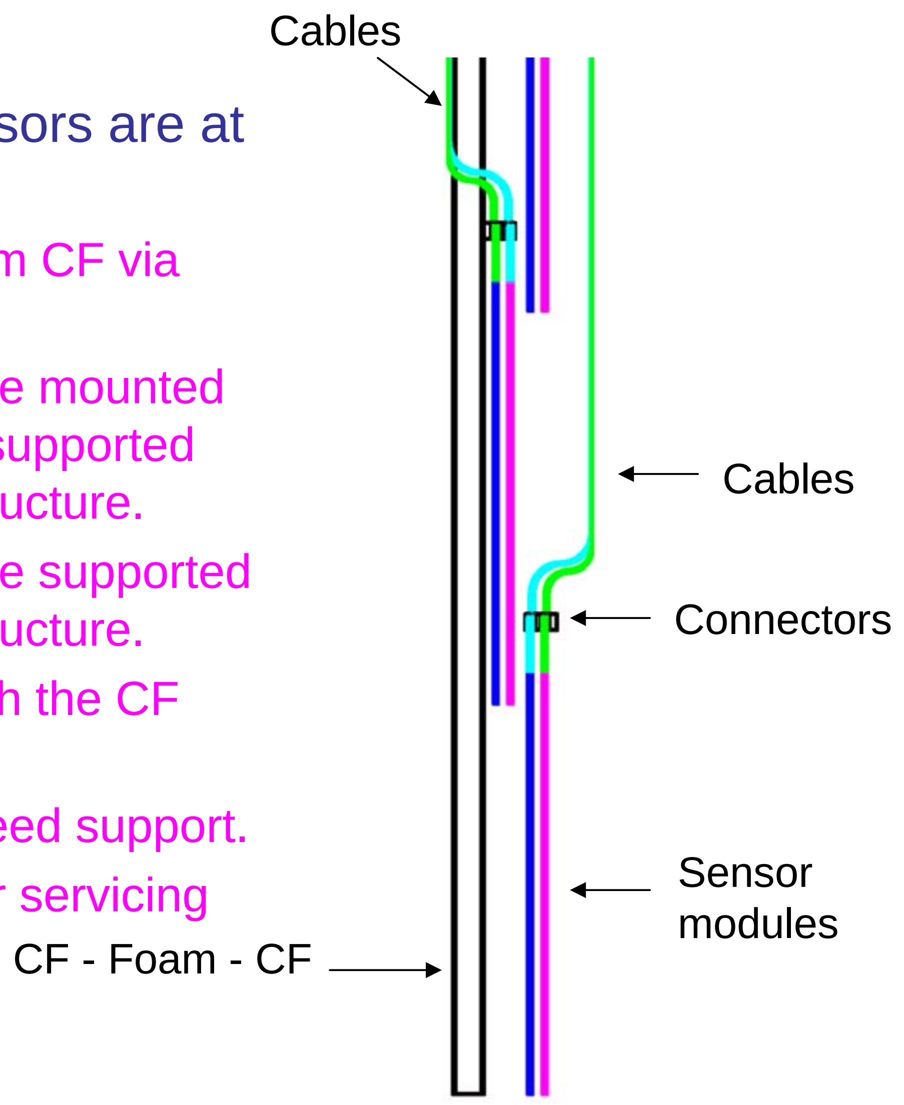
Sensor / Cable Arrangements

- No doubt there are other possible arrangements, but I’ve thought of three⁺:
  - Flat disks, alternating cable paths
  - Conical disks, cables toward IR
  - Conical disks, cables away from IR.
- Three more options with silicon on the CF surface which faces the IP
  - Less PR value, less access to silicon, but better silicon protection
- Conical disks allow a thinner support structure than do flat disks.
  - For convenience, all support structures are shown with a thickness = 7.275 mm.



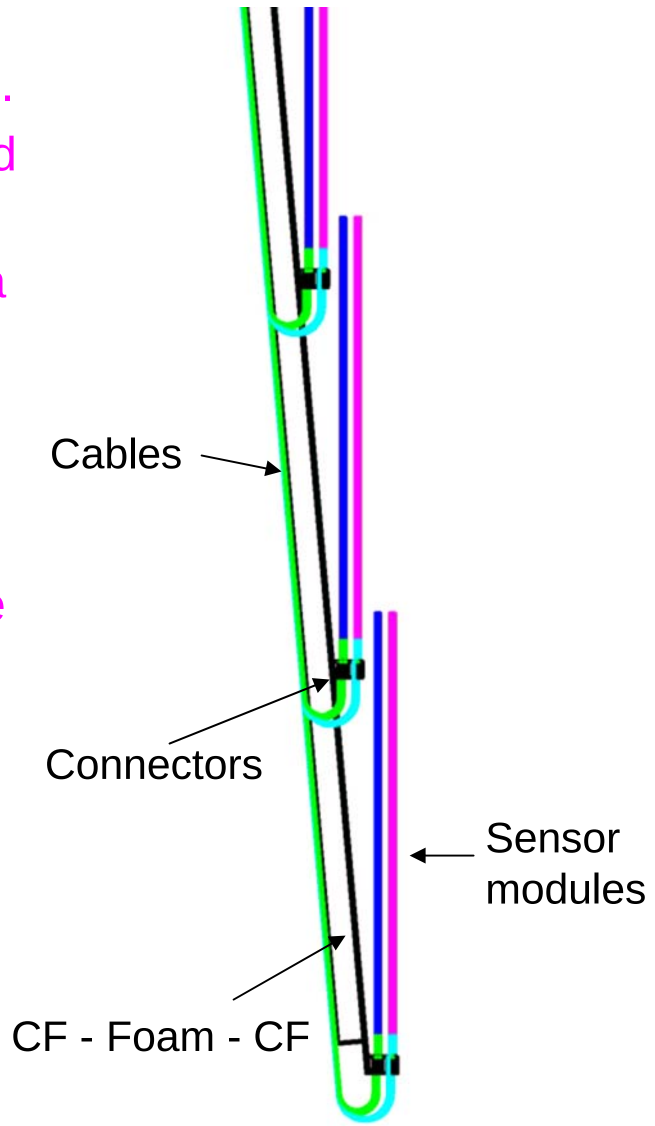
Sensor / Cable Arrangements

- Flat disks, alternating cable paths
- Reminder: blue and magenta sensors are at different sets of azimuths
  - All sensors could be mounted from CF via spacers.
  - Layer 1 and 2 connectors could be mounted from CF via spacers or could be supported from extensions of the module structure.
  - Layer 3 and 4 connectors could be supported from extensions of the module structure.
  - Half of cables are dressed through the CF support structure.
  - Half the cables are not and will need support.
  - These cables also limit access for servicing sensor modules.



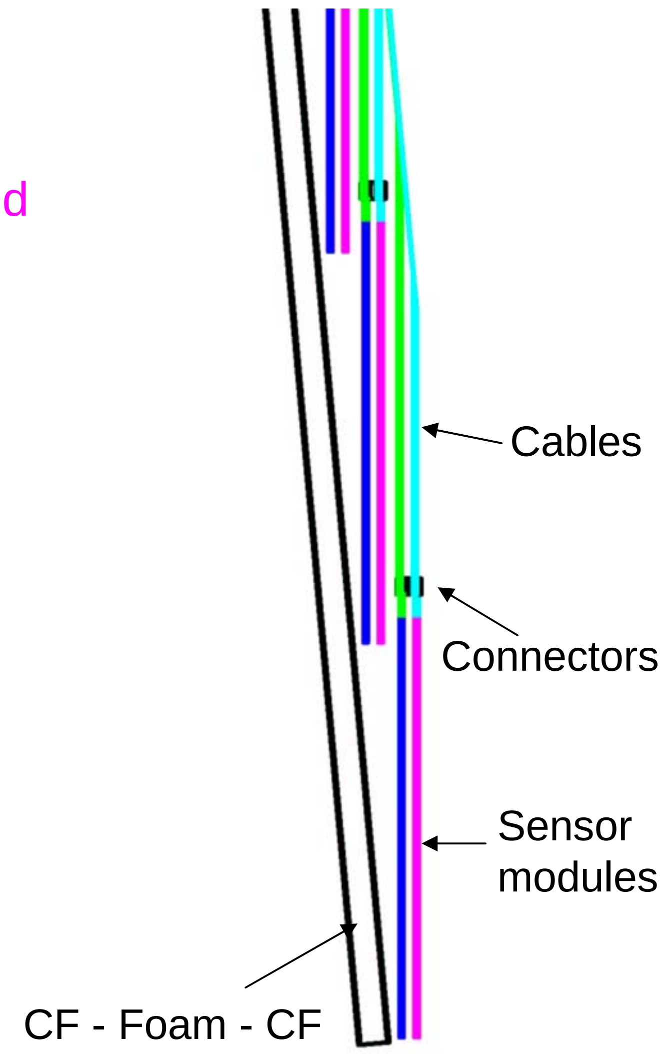
Sensor / Cable Arrangements

- Conical disks, cables toward IR
  - All sensors could be mounted via connectors.
  - Additional locating features for modules could be provided.
  - All connectors could be mounted from CF via short spacers.
  - All cables are dressed through the CF support structure.
  - Cable support is straight-forward.
  - Radial overlap covers connectors, so module servicing is done working from small to large radius.
  - Connectors and cable paths at the smallest radius take radial space.
- This is the option on which I've spent the most time.
  - We should also hear what others have done.



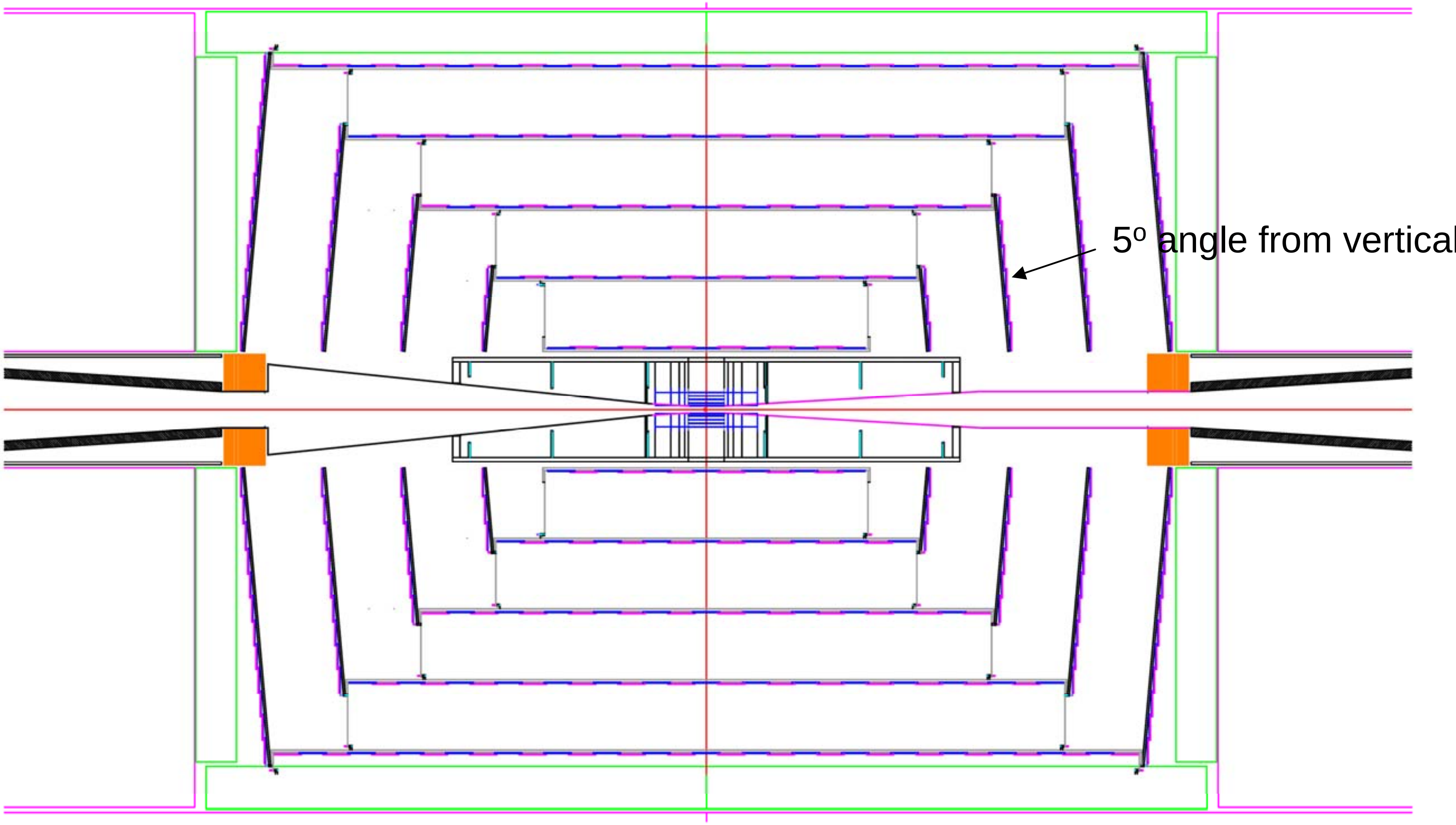
Sensor / Cable Arrangements

- Conical disks, cables away from IR
  - All sensors could be mounted from CF surface.
  - Additional locating features for modules could be provided.
  - All connectors could be mounted from extensions of the module structure, in which case, modules support the connectors.
  - All cables run across sensor surfaces and limit access during servicing.
  - Connectors are readily accessible, except to the extent cables cover them.
  - Connectors at the largest radius must be placed to avoid disk mounts (or vice versa).



Side elevation

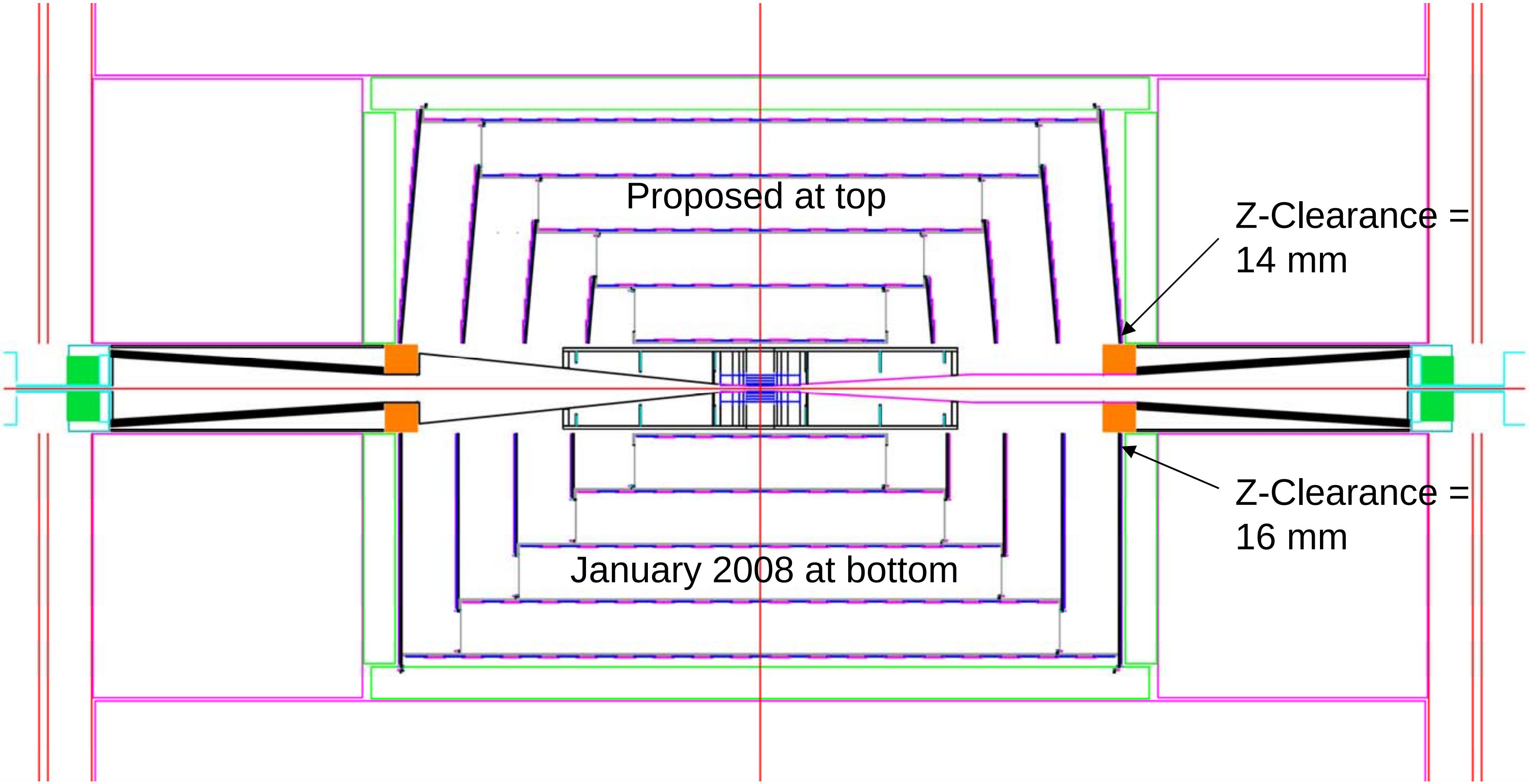
- Based upon 8/13/08 detector geometry from Marco Oriunno



- Note that the Lumi-Cal's protrude into the silicon region and that two different beam pipe geometries are shown.

Comparison with Older Geometry

- Number of sensor locations in z reduced by two in barrels 2, 3, 4, 5



- Z-clearances look tight if there is to be an FSI alignment system or a beam pipe positioning system.

Sensor Overlaps

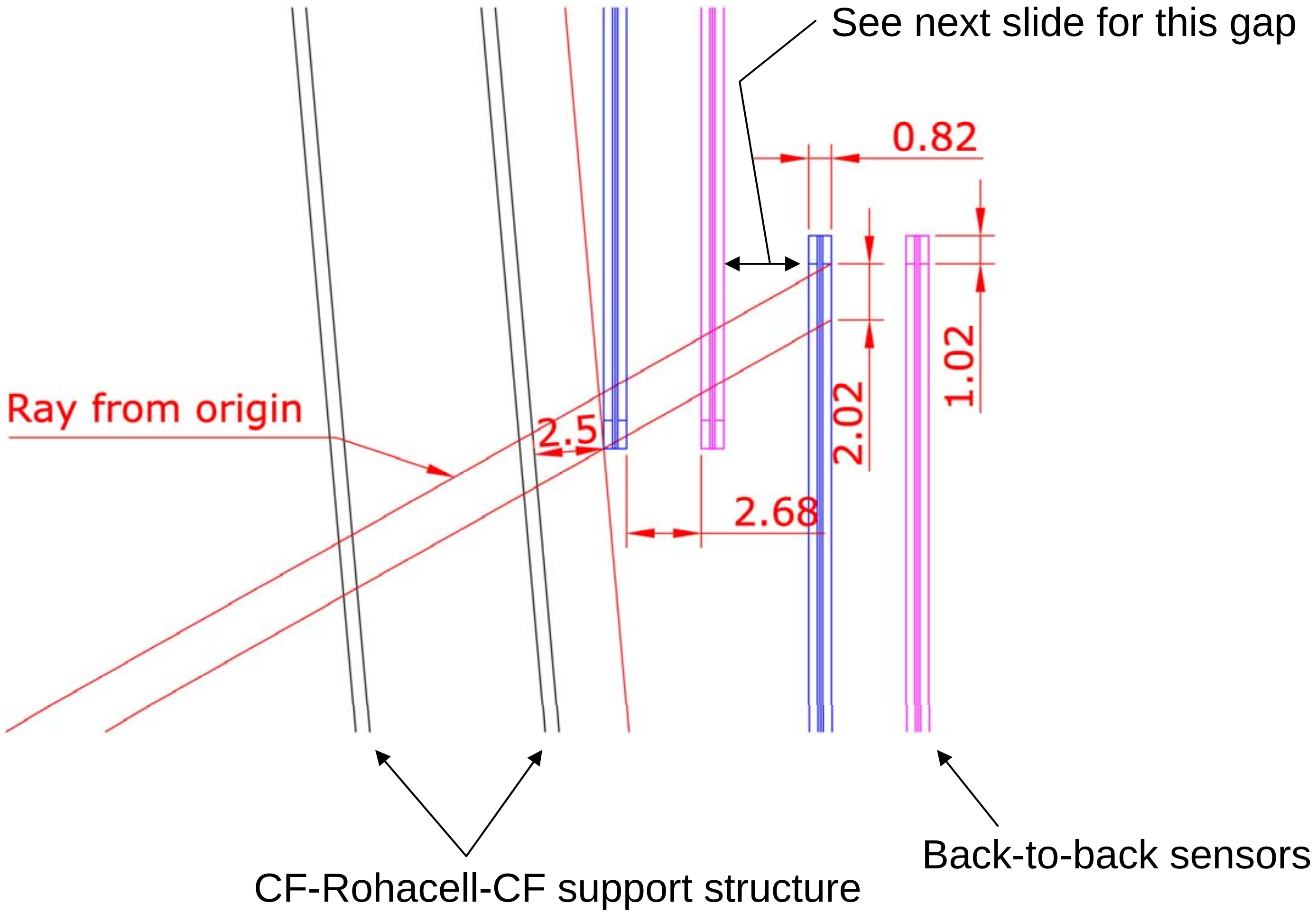
- Consider sensors in a single plane "butted" against one another.
  - Assume sensor dimensions ~ 100 mm x 100mm.
  - Dead band for guard and bias connections ~ 1 mm.
  - Gap between sensors so that sensors can be powered individually ~ 1 mm
  - Then dead area ~ 600 mm^2 per sensor, or 6%.
  - This dead area would apply to all tracks, independent of the extent their helical paths deviate from a straight line.
- Now consider sensors which overlap in R & Phi.
  - If that is done properly, then effective dead area = 0 for tracks that are nearly straight.
  - However, for tracks in which the helical path deviates significantly from a straight line, z-separation between adjoining sensors introduces gaps in coverage.
  - As in the barrels and vertex detector, we need to choose how hermetic the tracker should be for low momentum tracks.

Sensor Overlaps

- Initial cone design
  - As a starting point, I've assumed minimum phi overlap should equal the z-separation between central planes of adjacent modules (3.5 mm).
  - I've taken minimum overlap in r to be 1 mm for straight tracks from the origin.
  - The result for hexagonal sensors is an overlap area of ~ 24%, i.e., sensor active area / cone area = 1.24.
- That suggests reconsidering butted sensors with an additional disk.
  - Provided disks were clocked in azimuth from one disk to the next, that could work.
  - To provide good trace-back towards the IP, the additional disk should be reasonably close to disk 1.
  - That should work with sensors glued into place, but is difficult to realize with a modular design or with anything but flat disks.
  - Since sensors represent only ~ ½ the material budget, it looks like cones remain a better choice.

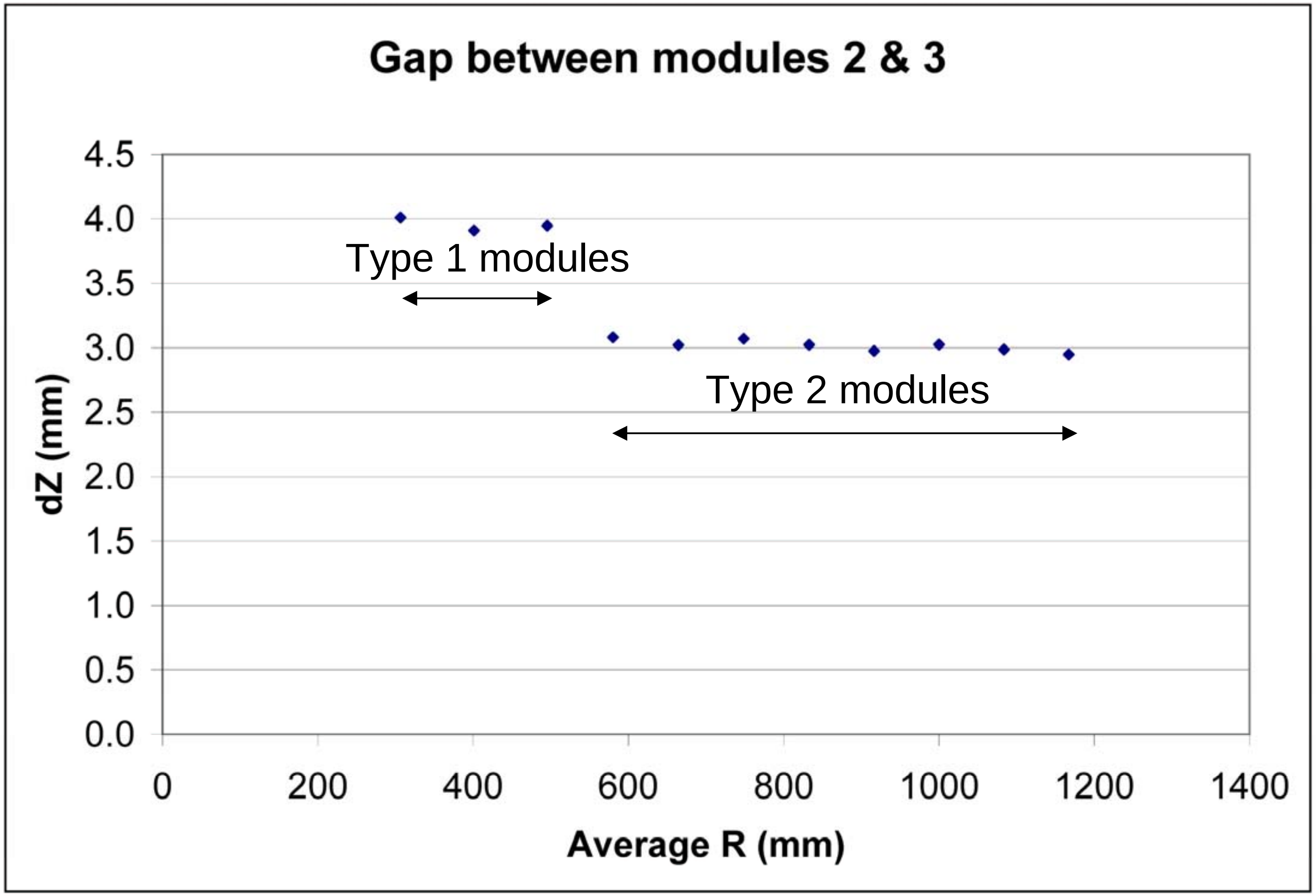
Parameters for R-overlaps

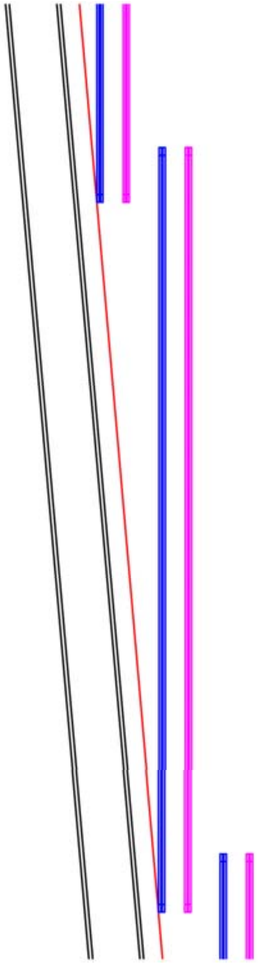
- Please note that blue modules are at one set of phi's, magenta modules at another.



Module-to-module gap

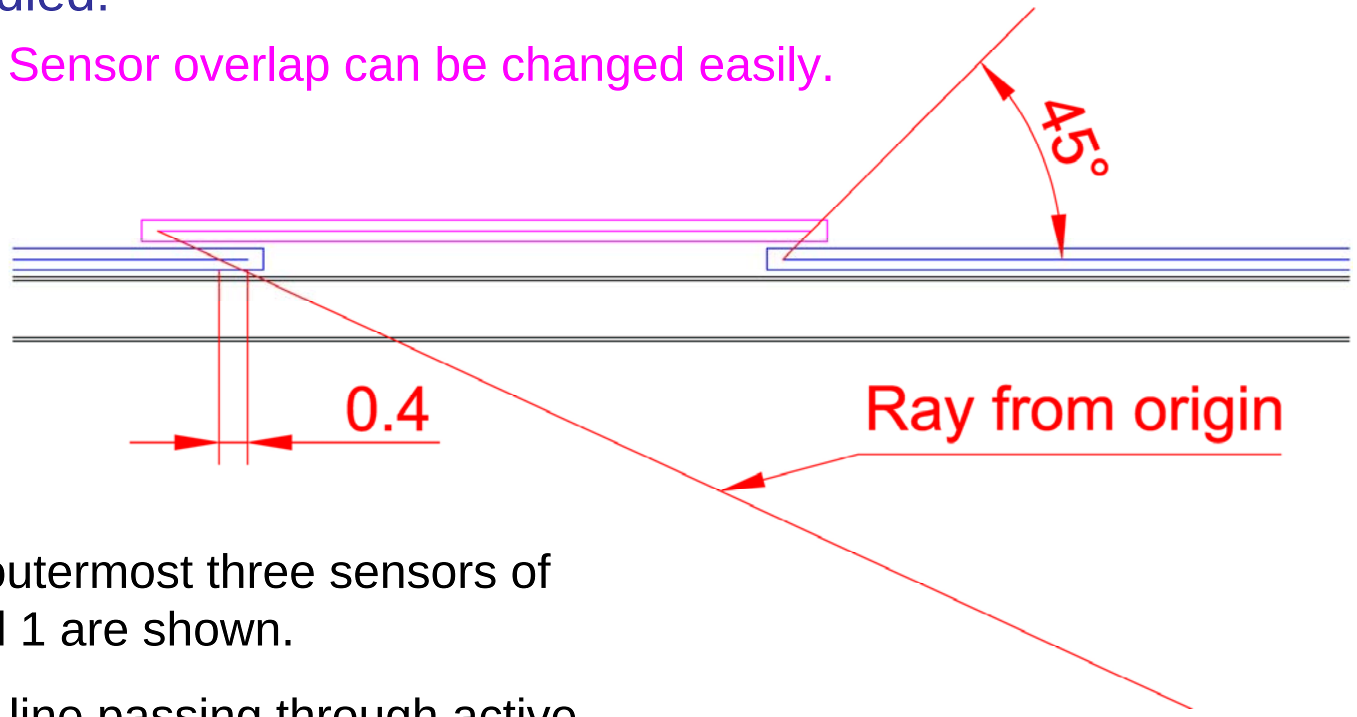
- Z-gap between modules 2 &3 depends primarily on the module height (dR_module), and to a lesser extent on incidence angle.





Outer Tracker Barrel: R-Z View

- Tracker review: Beijing 2007
- Typical A-layer to B-layer overlaps (all layers)
- Hermeticity for separated vertices versus material remains to be studied:
  - Sensor overlap can be changed easily.

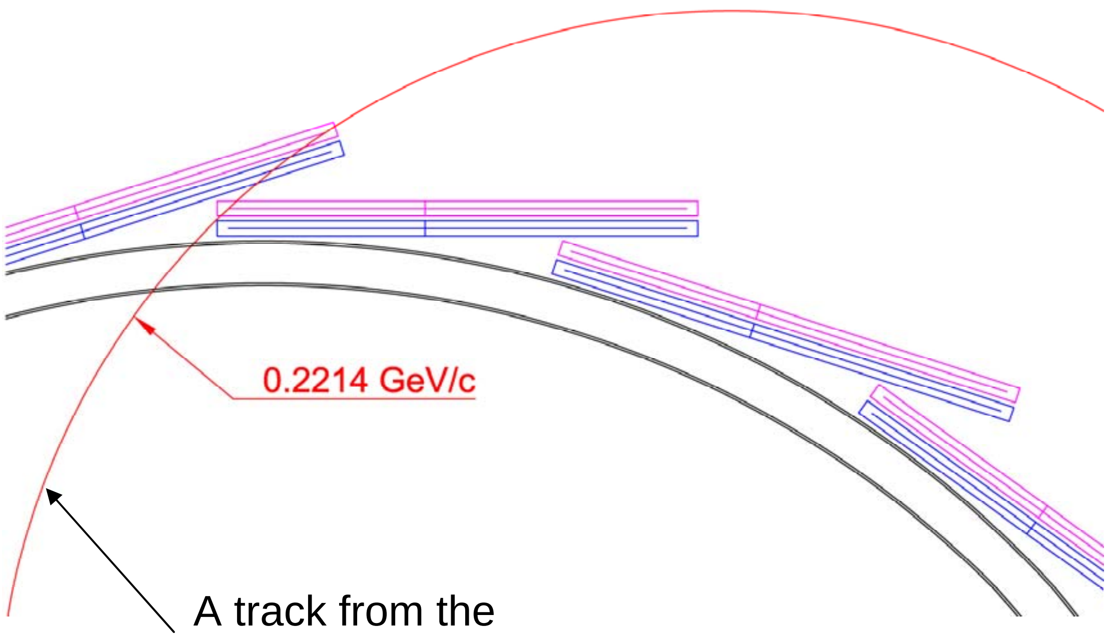


The outermost three sensors of barrel 1 are shown.

For a line passing through active edges of the left two sensors, DCA to origin = 6.7 cm (worst case).

Outer Tracker Barrel: R-Phi View

Barrel 1 is shown.



A track from the origin is shown (unit charge, 5 T field).

What momentum cut-offs do we really want?

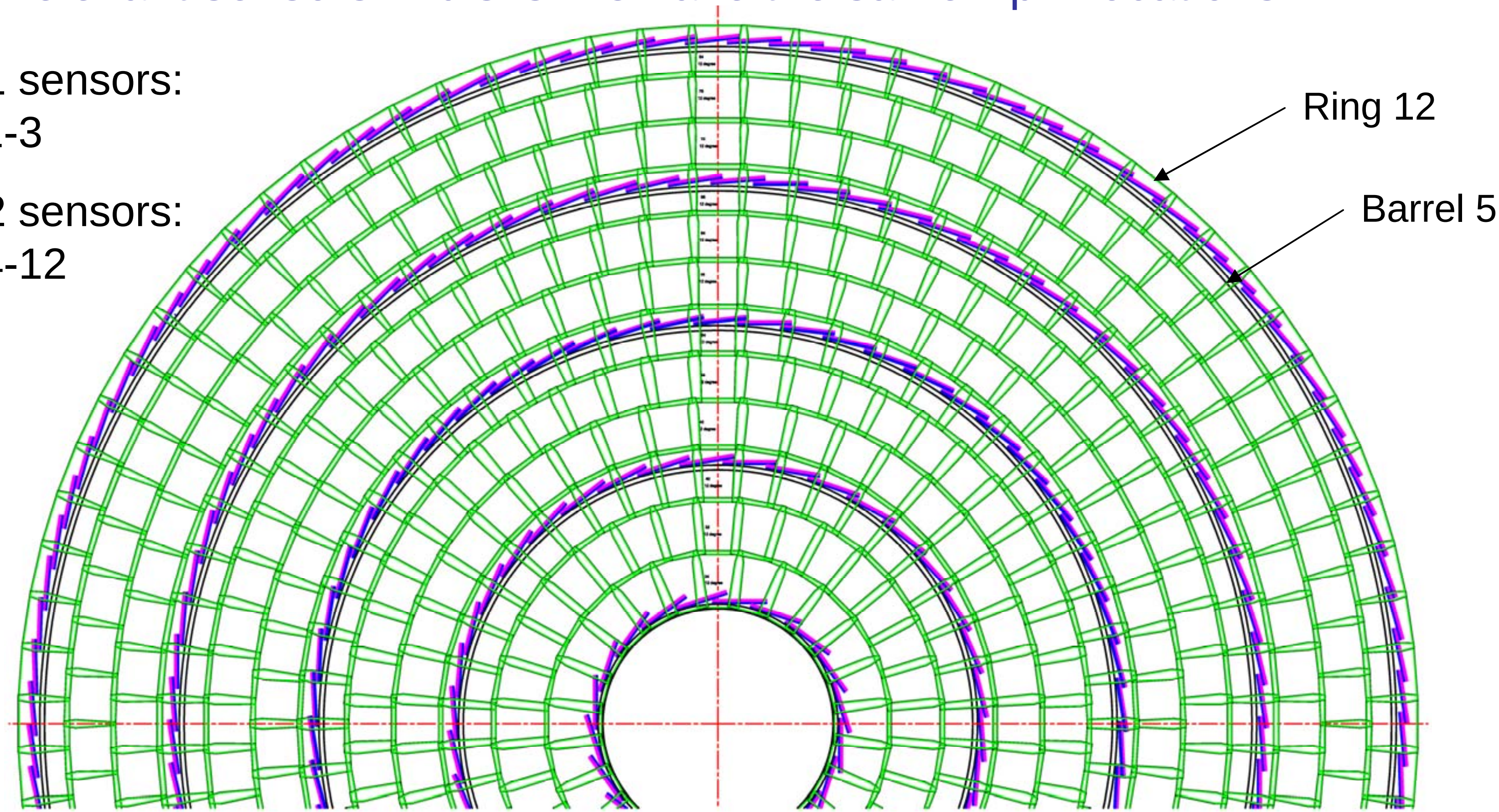
- With a pinwheel geometry, R-Phi coverage for one charge polarity is essentially hermetic.
- For the other polarity, a small fraction of low P_T tracks can pass between sensors.
- Studies will be needed to understand these small effects and the trade-offs between hermeticity and added material.

Disk Geometry in R-Phi

- Disk 4 with two types of sensors is shown.
  - Increasing the number of varieties would allow phi overlaps to be reduced.
- Relevant sensors in disks 1-3 have the same r-phi locations.

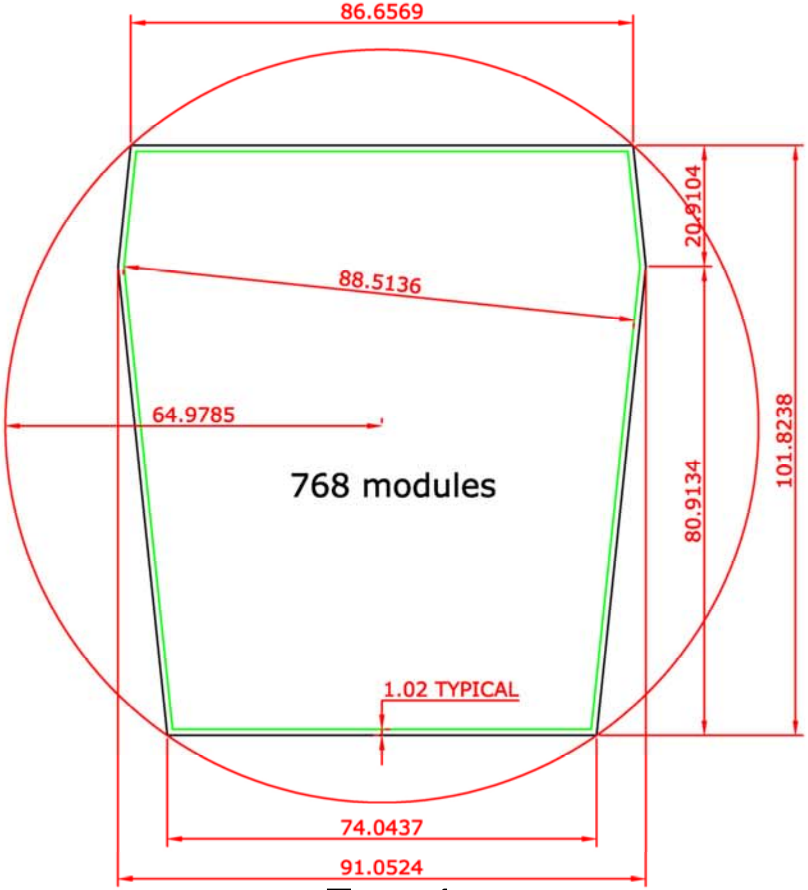
Type 1 sensors:
rings 1-3

Type 2 sensors:
rings 4-12

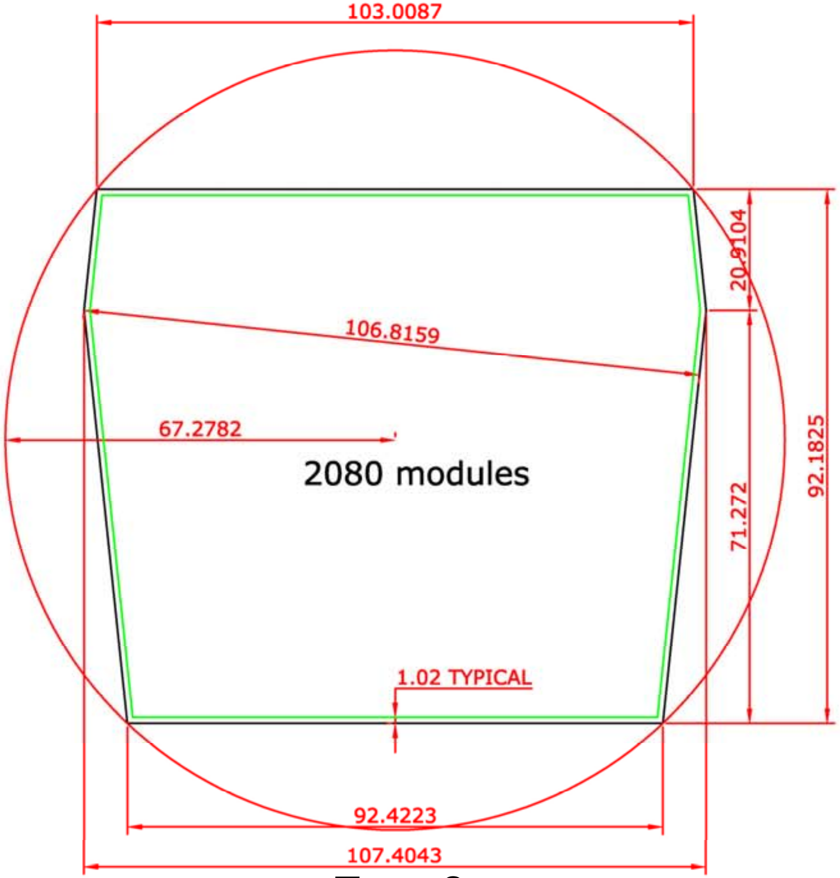


Sensors

- Two types of sensors are shown for 12º stereo: cut area in black, active area in green.
- The sensor to the right is a rather tight a fit on a 6” wafer.



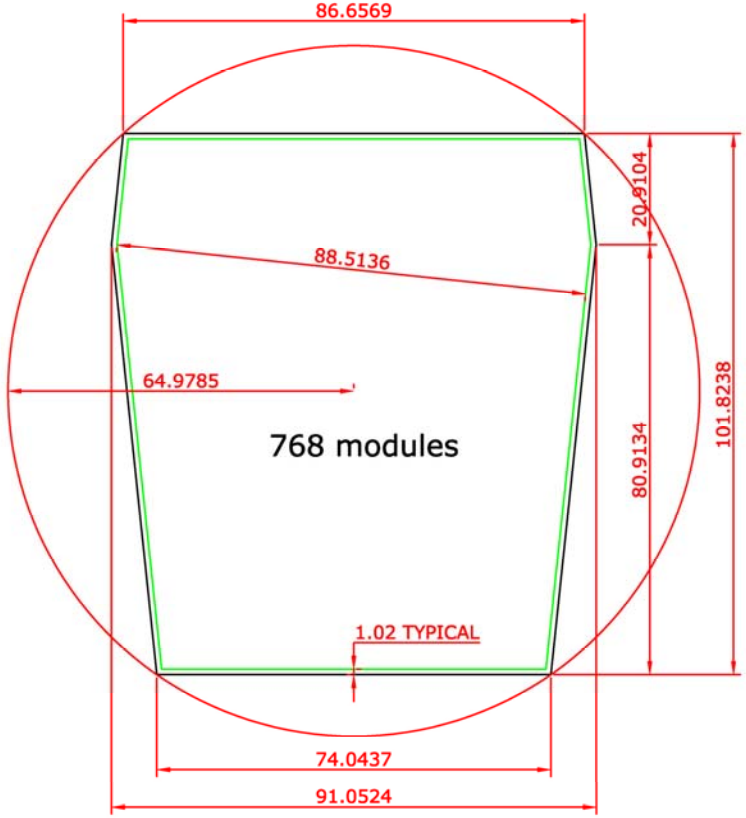
Type 1



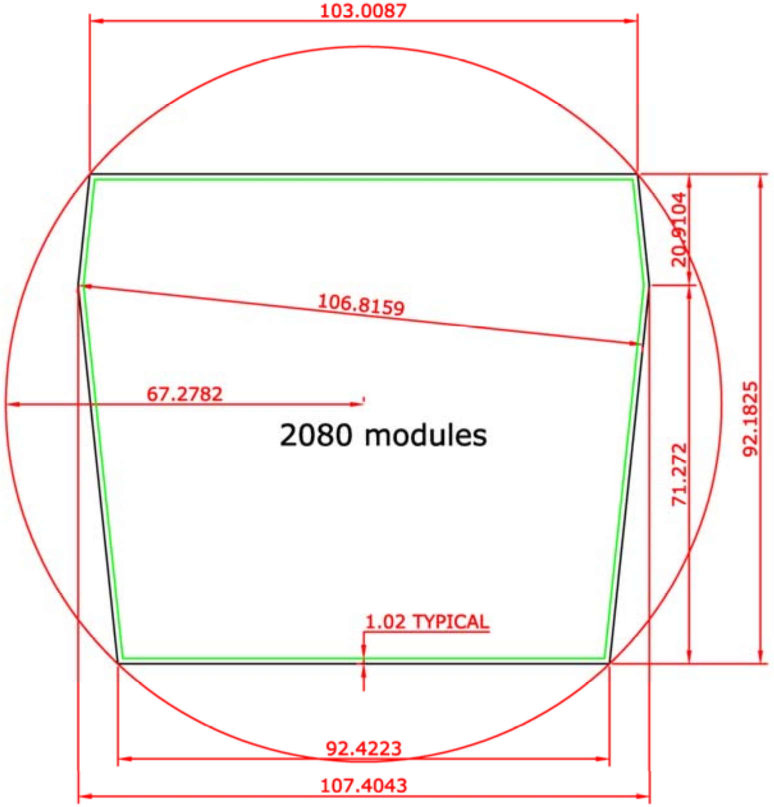
Type 2

Sensors

- Assuming traces run parallel to right long edges, the hexagonal shape ensures a shortest trace length of 20 mm.
  - If that were not necessary, phi overlaps could be reduced.
  - Other choices of method to obtain stereo generally double the number of sensor varieties (assuming sensors are not double-sided).



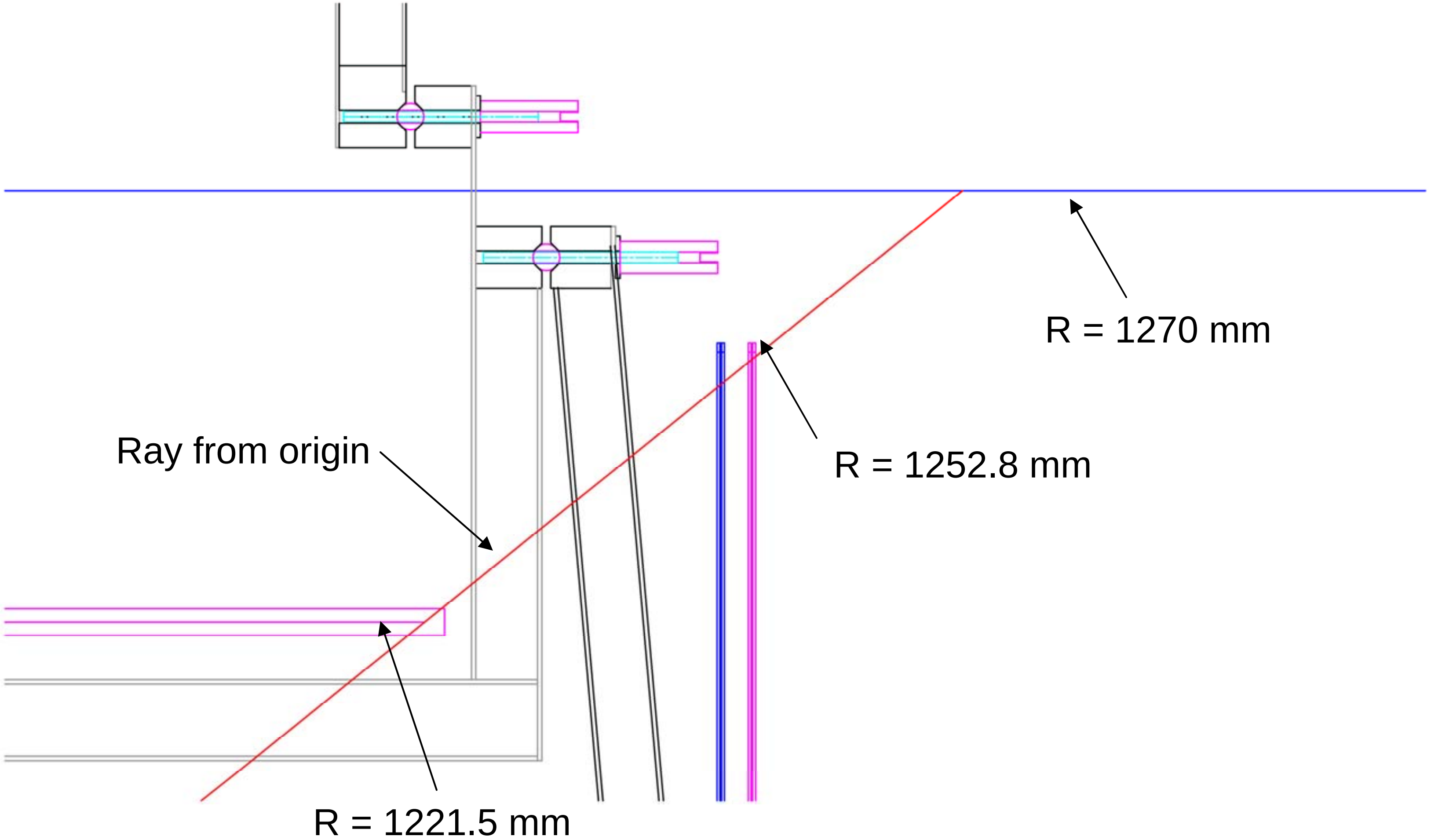
Type 1



Type 2

Disk-Barrel Overlap

- Obtaining adequate overlap leads to a larger disk radius than that of the associated barrel (a known “feature”).



Disk Modules

- To be developed
- Minimal structure
  - Back-to-back sensors would be vacuum laminated.
  - Should remain flat enough
  - Artwork between sensors for backside connections
  - Artwork on outer sensor services for chip connections
  - Connector at the inner radius of each module
  - Cables run through openings in the CF-Rohacell-CF disk structure and are dressed along the CF surface which faces the interaction point.
  - Pins locate each module transversely and guide it into a zif connector.

Possible Connectors

KYOCERA KYOCERA ELCO Global THE NEW VALUE FRONTIER

Home News Products About

Parts No./Product Type Search Series Search

→Japanese

Products > Product Type > FPC/FFC Connectors

FPC/FFC Connectors

pitch(mm): | 0.2 | 0.3 | 0.4 | 0.5 | 0.8 | 1.0 | 1.25 See the cable connection diagram

FPC/FFC Product Search

Click a series No., the product specifications can be seen. Click a catalog drawing, the product drawing and the product drawing and the ordering code can be seen.

▸ Environmental Correspondence

Products

Product Type

FPC/FFC Connectors

- 0.2mm pitch
- 0.3mm pitch
- 0.4mm pitch
- 0.5mm pitch
- 0.8mm pitch
- 1.0mm pitch
- 1.25mm pitch

Board to Board Connectors

Memory Card Connectors

Interface Connectors

Wire to Wire/Board Connectors

Card Edge Connectors

Back Plane Connectors

Automotive Connectors

Shunt Connectors

0.2 to 0.5mm

pitch: mm	Series	Profile Height (mm)	Cable connection See the connection diagram	Contact location	PC.Board mounting method	Rated Current (AC/DC) (Per one contact)	Catalog Drawing
0.2	6246	1.85	ZIF/Right Angle	Dual faced	SMT	0.2A	(208KB) PDF
0.3	6293	0.85	ZIF/Right Angle	Dual	SMT	0.2A	(203KB) PDF
	6840	0.9	ZIF/Right Angle	Bottom	SMT	0.2A	(153KB) PDF
	6295	0.9	ZIF/Right Angle	Bottom	SMT	0.2A	(139KB) PDF
	6296	1.0	ZIF/Right Angle	Bottom	SMT	0.2A	(143KB) PDF
	6283	1.1	ZIF/Right Angle	Top	SMT	0.2A	(119KB) PDF
	6285	1.1	ZIF/Right Angle	Bottom	SMT	0.2A	(171KB) PDF
	6281	1.25	ZIF/Right Angle	Bottom	SMT	0.2A	(150KB) PDF

Possible Connectors

A modern version of Hirose connectors.

Improved latching mechanism.

These connectors appear to be designed for 0.2 mm thick cables (including a cable stiffener).