iTOP PID Barrel/Mechanical Design Concepts

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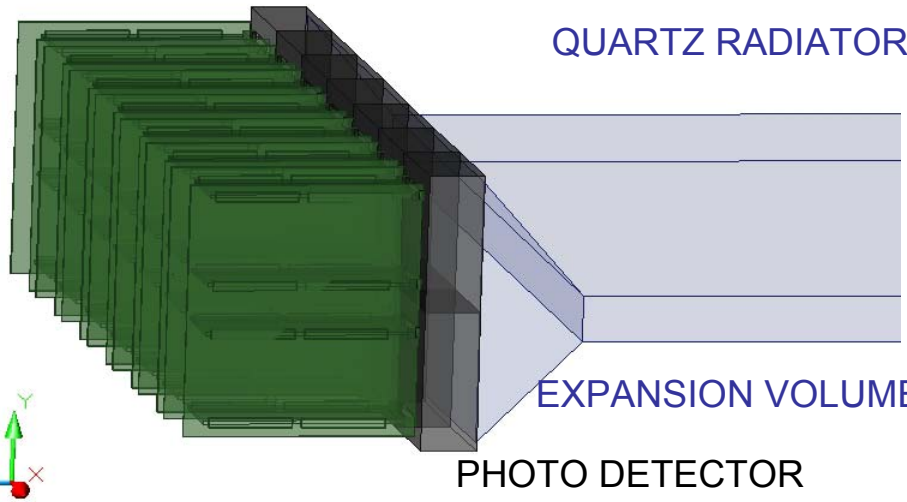
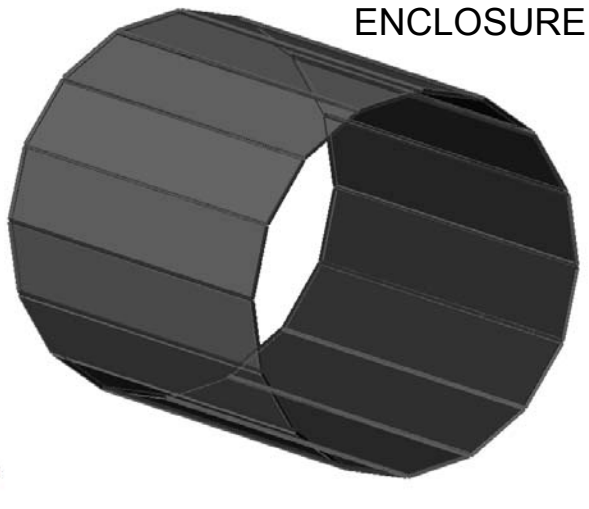
Outline

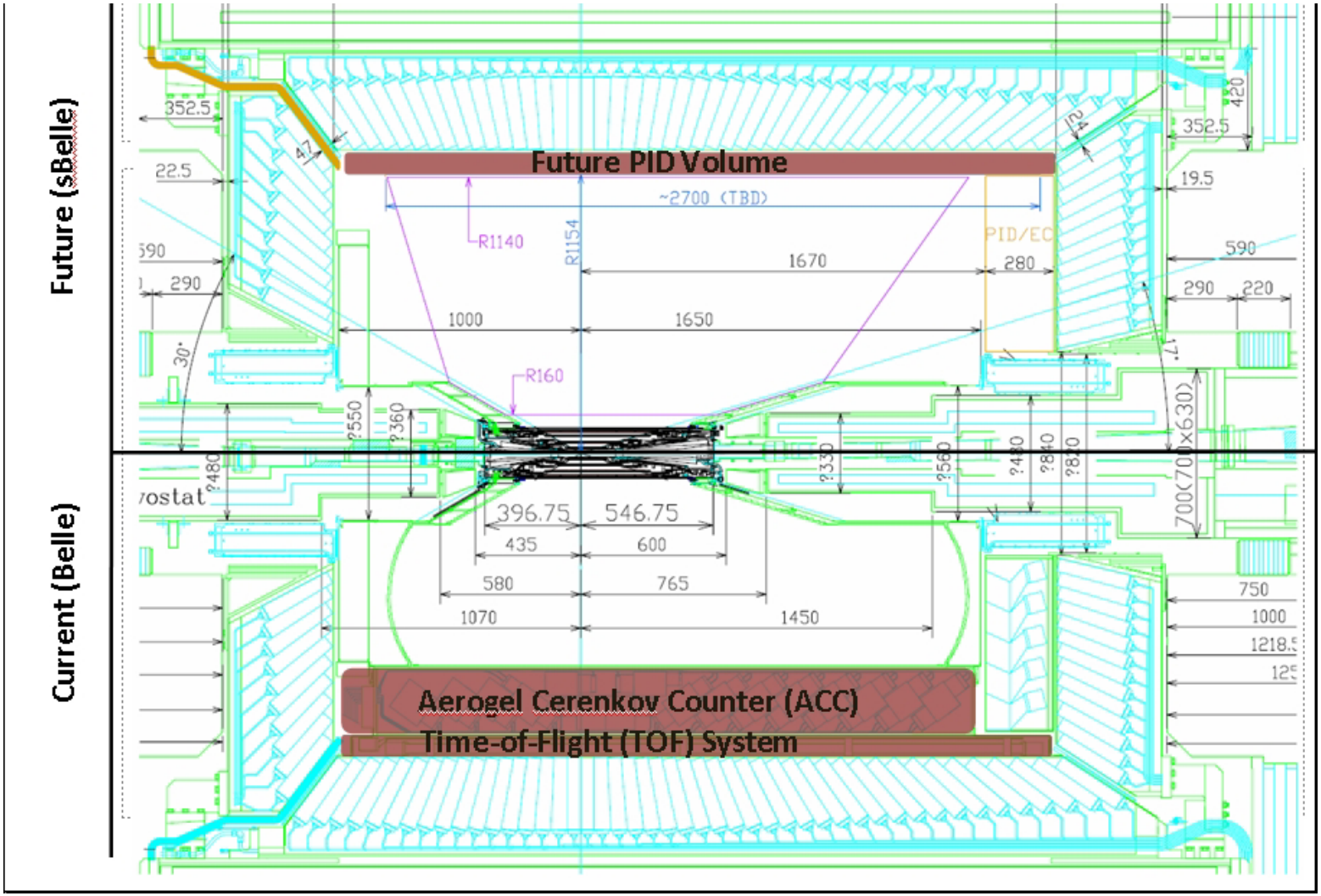
- iTOP concept
- Current radiator design + alternatives
- Expansion block
- Photo Detector and Read-out
- Barrel design options
- FEA modeling
- Mounting the Barrel PID in sBelle
- Summary and Comments

iTOP PID CONCEPT

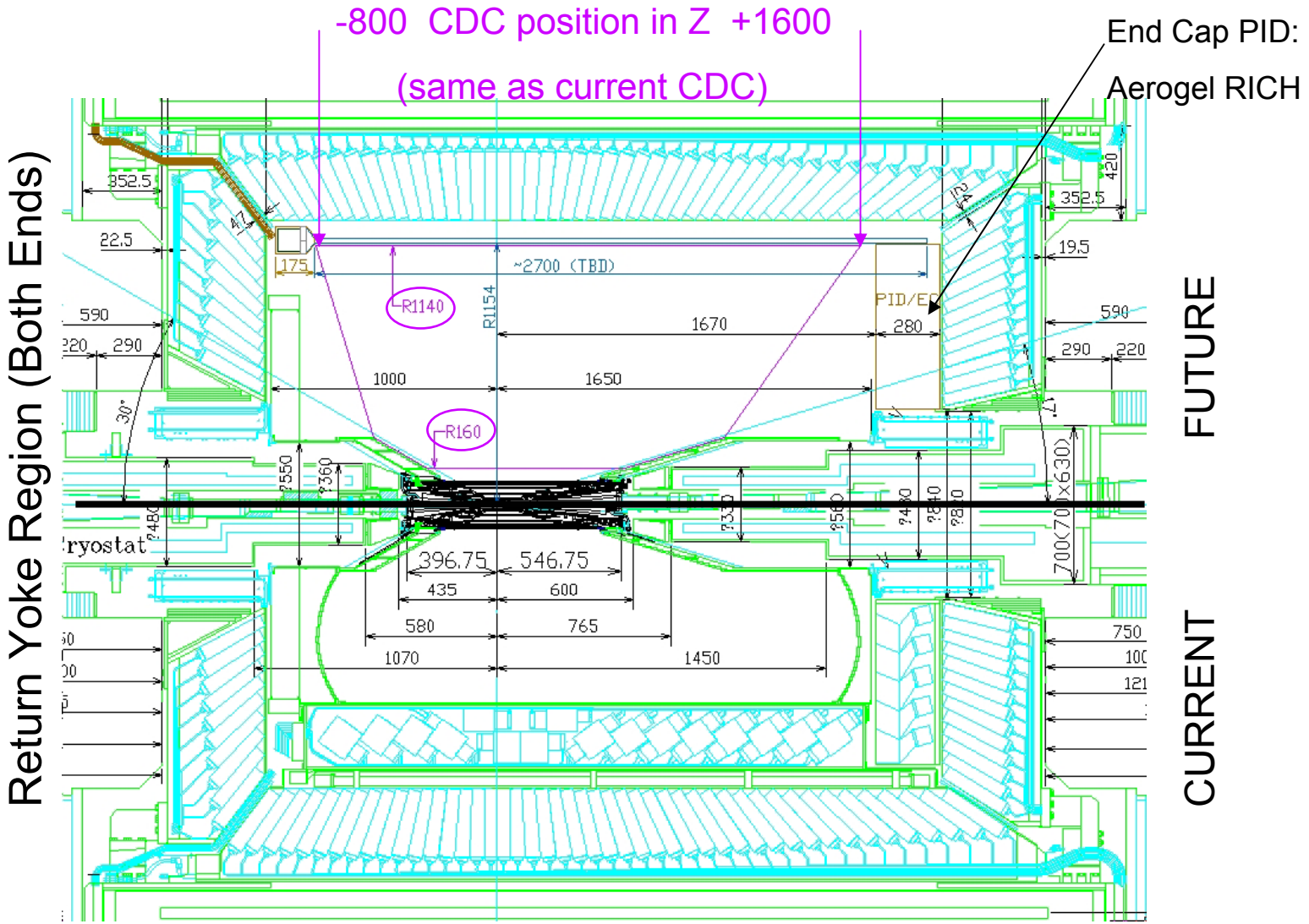




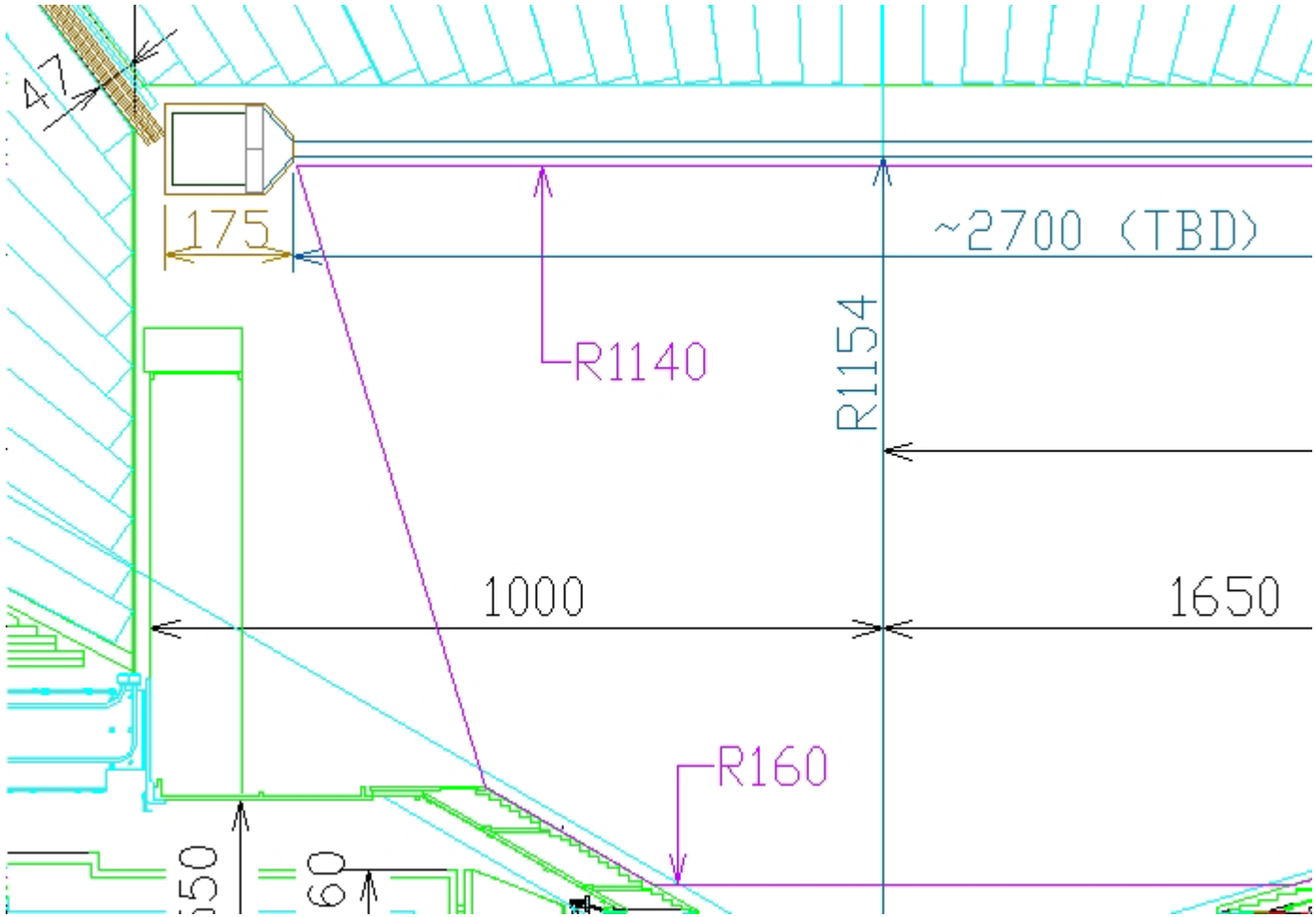
Belle Before/After Upgrade



Current radiator design in top view of Belle + sBelle

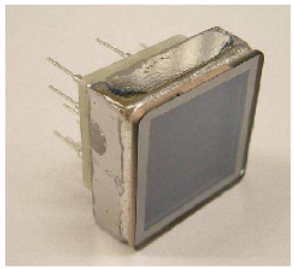


Current radiator design:
Close-up view of iTOP Concept & CDC @ backward end
THIS WILL FIT!



Current radiator design: Gary Varner's Group Has Considered Three MCP/PMT Photodetector Options

1) Hamamatsu SL-10
2) Hamamatsu 8500
3) Photonis XP85013



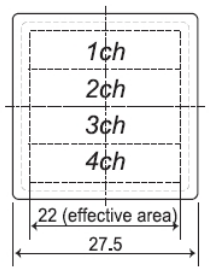


Fig. 1. Picture of SL10 and the anode layout.

Table 1
SL10 characteristics.

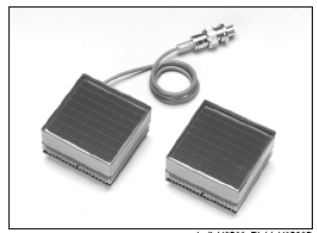
PMT size	$27.5 \times 27.5 \times 15.6$ mm^3
Effective area	22×22 mm^2

HAMAMATSU

FLAT PANEL TYPE MULTIANODE PHOTOMULTIPLIER TUBE ASSEMBLY
H8500, H8500B

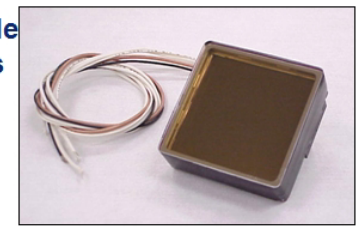
52 mm Square, Bialkali Photocathode, 12-stage,
8 × 8 Multianode, Small Dead Space, Fast Time Response

APPLICATIONS
- Small Animal Imaging
- Compact Gamma Camera
- Scinti-mammography
- 2D Radiation Monitor

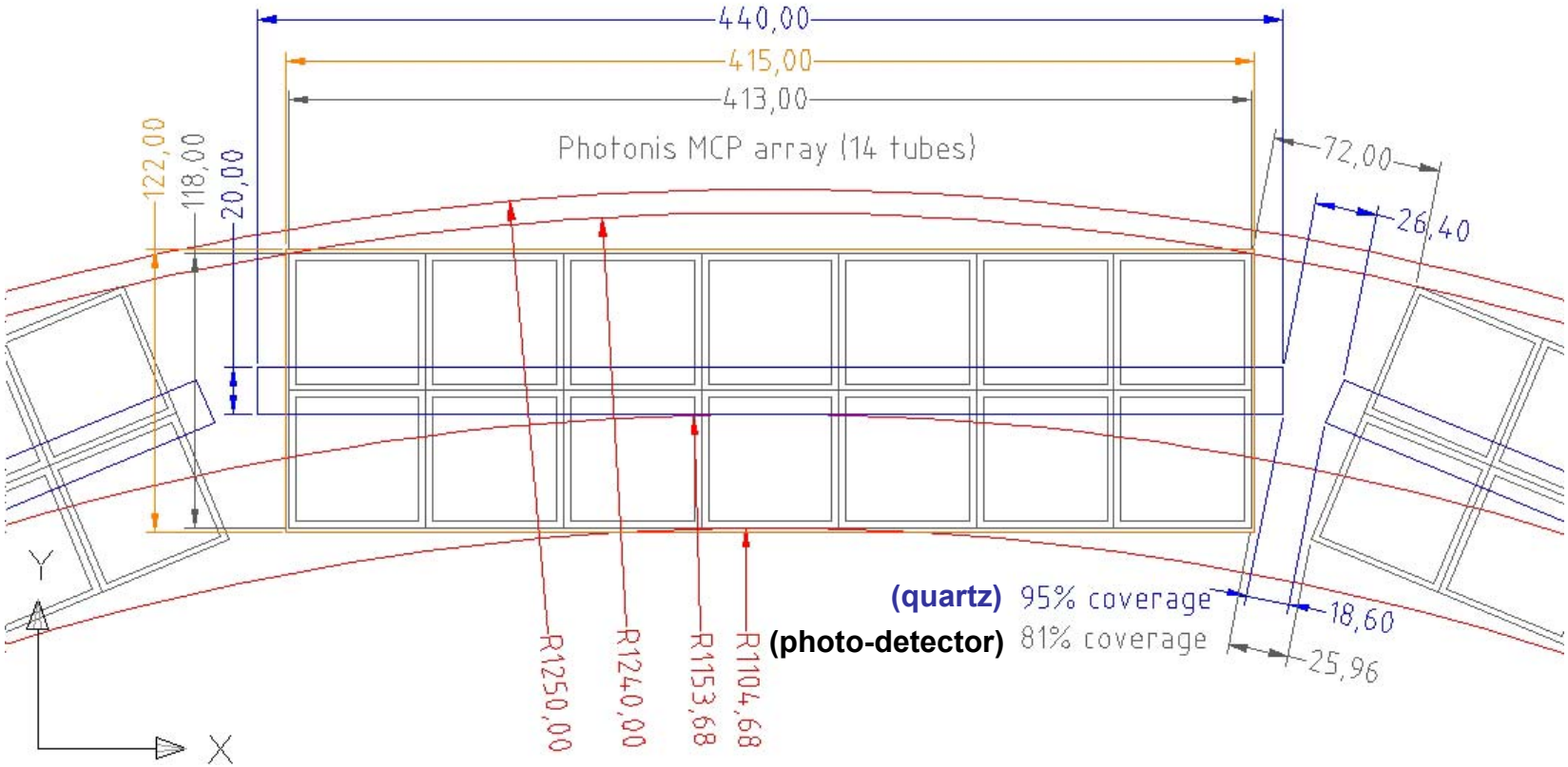


53 mm Square, 8x8 Anode MCP-PMT, Flying Leads

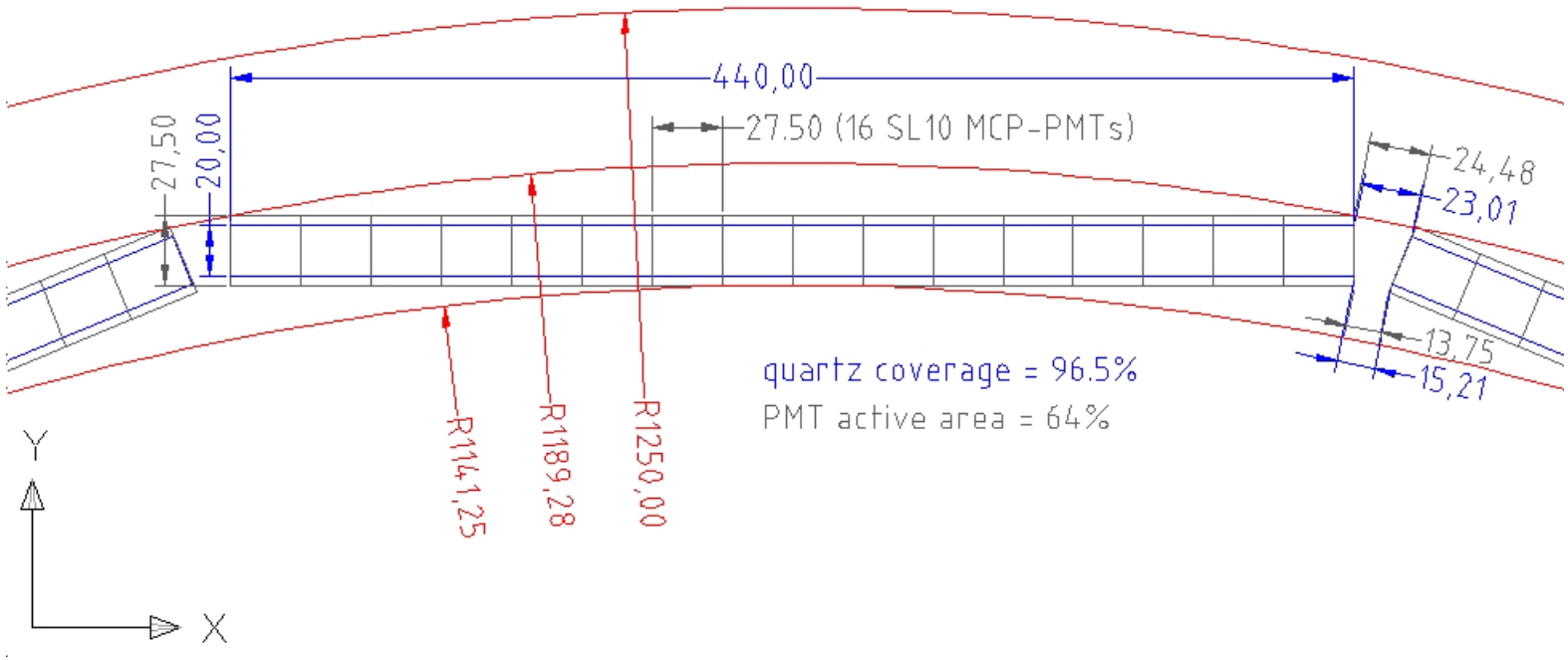
Applications
- ✓ Specialized Medical Imaging
- ✓ Ring Imaging Cherenkov
- ✓ High Energy Physics Detectors



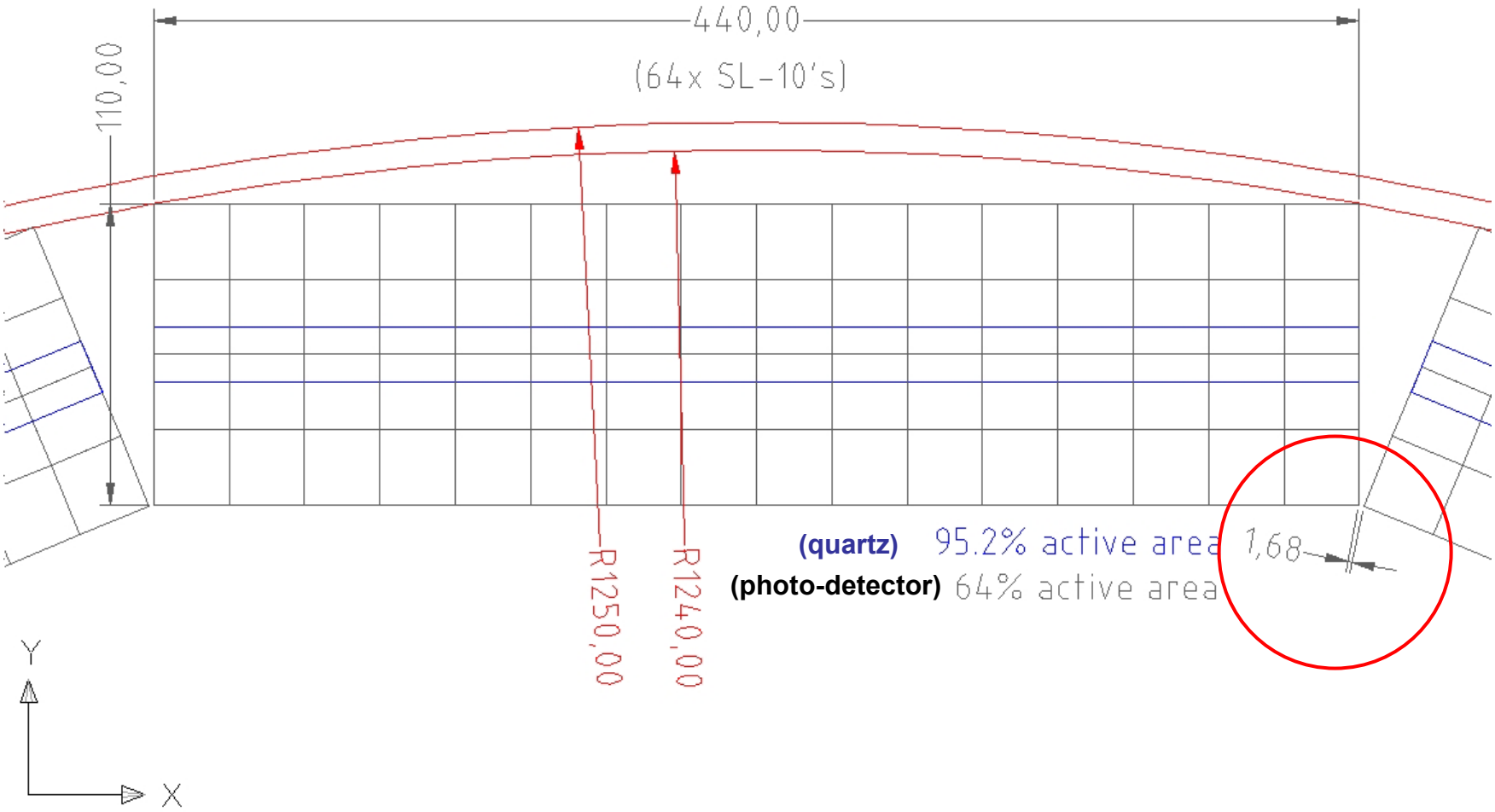
Current radiator design:
Optimized for 14 Photonis MCP/PMTs
(radial view)



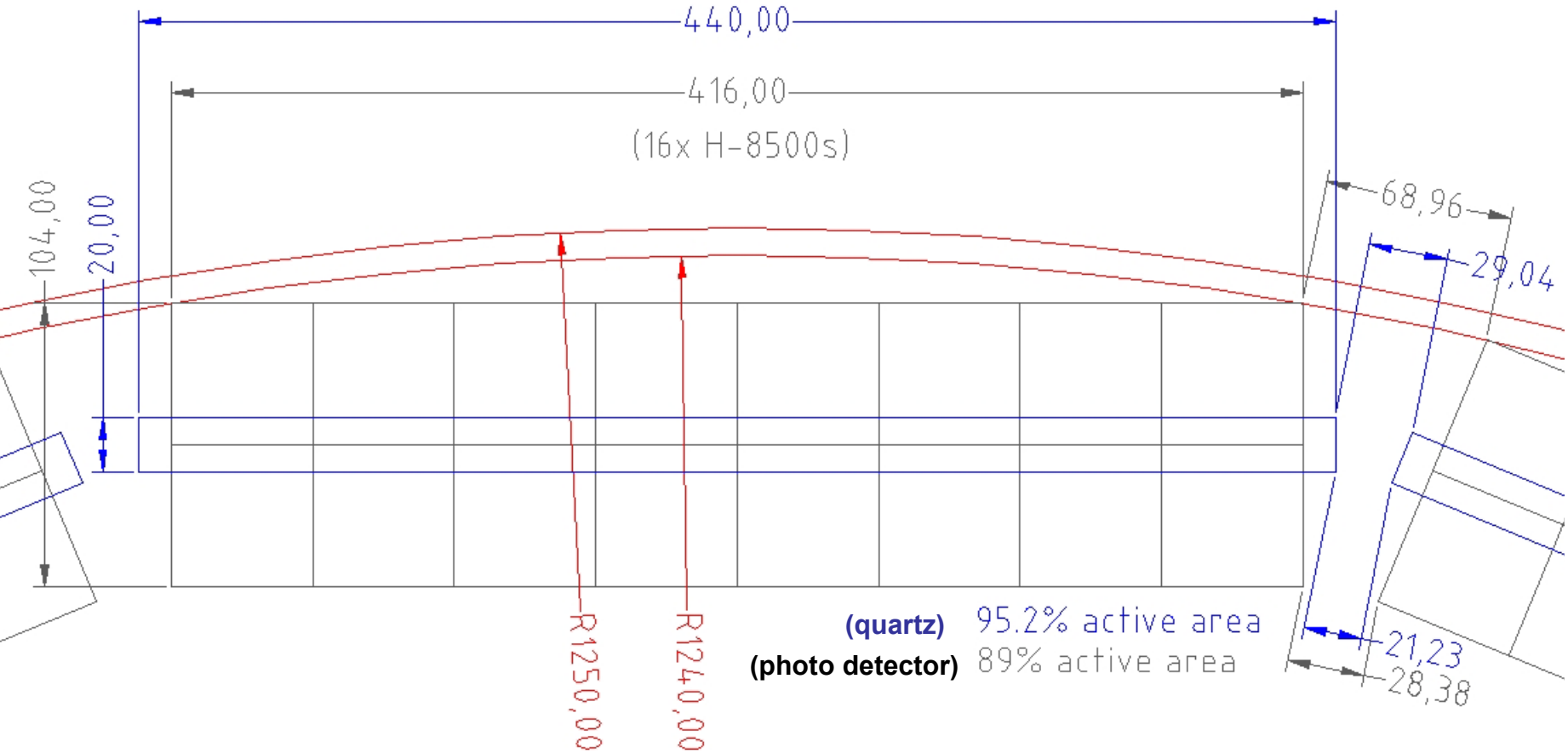
Other radiator designs (1 of 3):
Single row of SL-10 MCP-PMTs => fTOP
(radial view)



Other radiator designs (2 of 3):
Four rows of SL-10 MCP-PMTs => iTOP
(radial view)



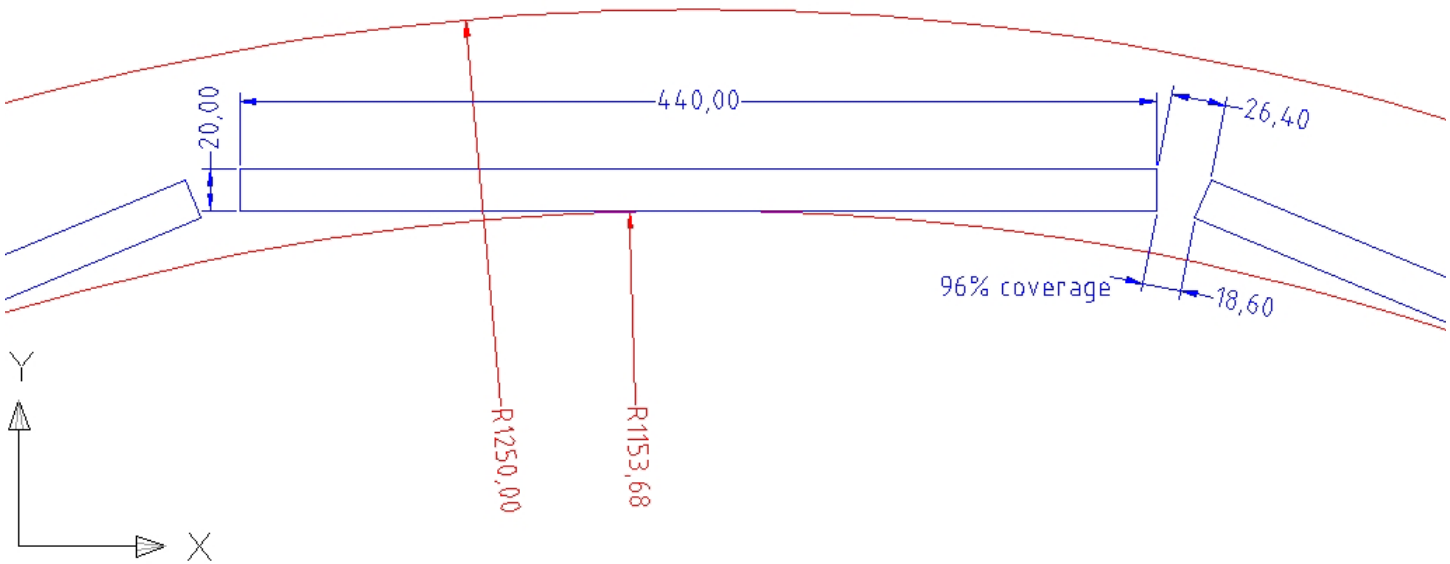
Other radiator designs (3 of 3):
Two rows of H-8500 MCP-PMTs => iTOP
(radial view)



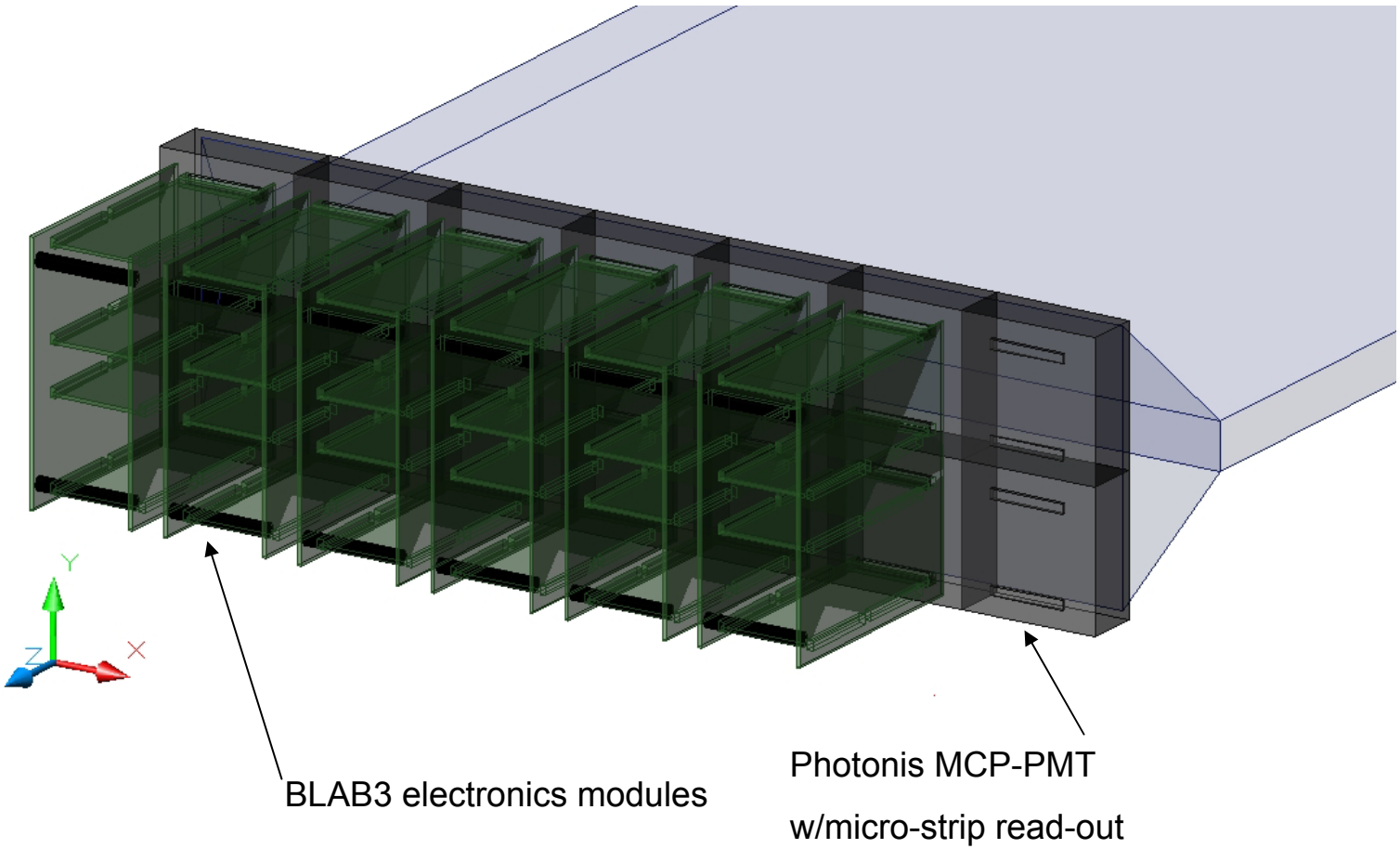
Radiator Design Summary (to date):

Optimized for Photonis MCP-PMT

44cm wide x 2cm high x ~270cm long

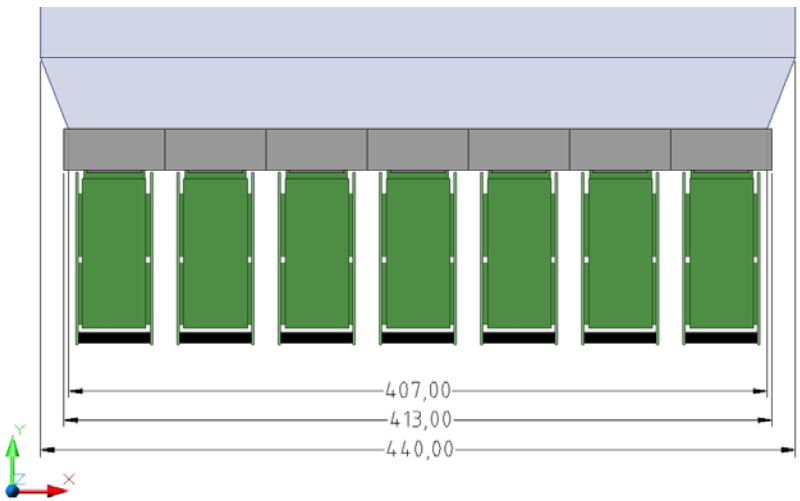


Current radiator design:
Detector and read-out electronics
(Backward End Only)

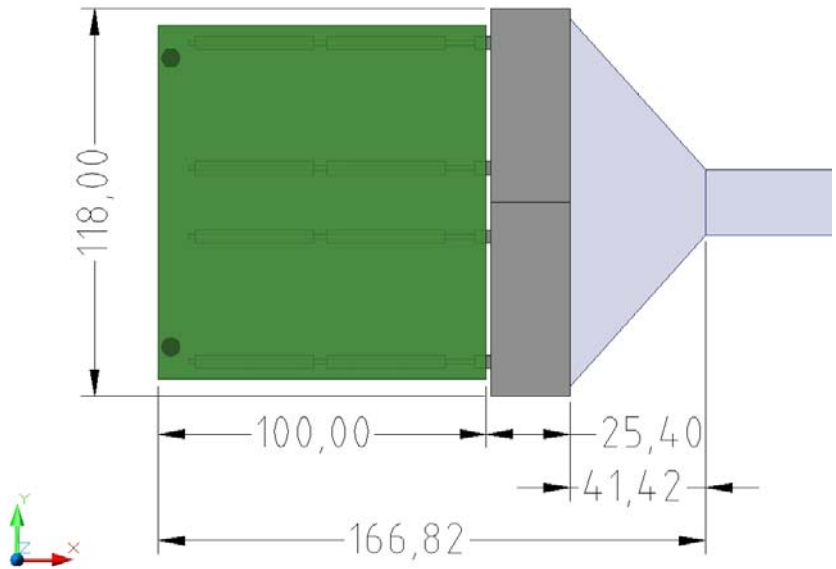


Current radiator design:
Detector and read-out electronics
(14 Photonis MCP-PMTs + 7 BLAB3 modules)

(top view)

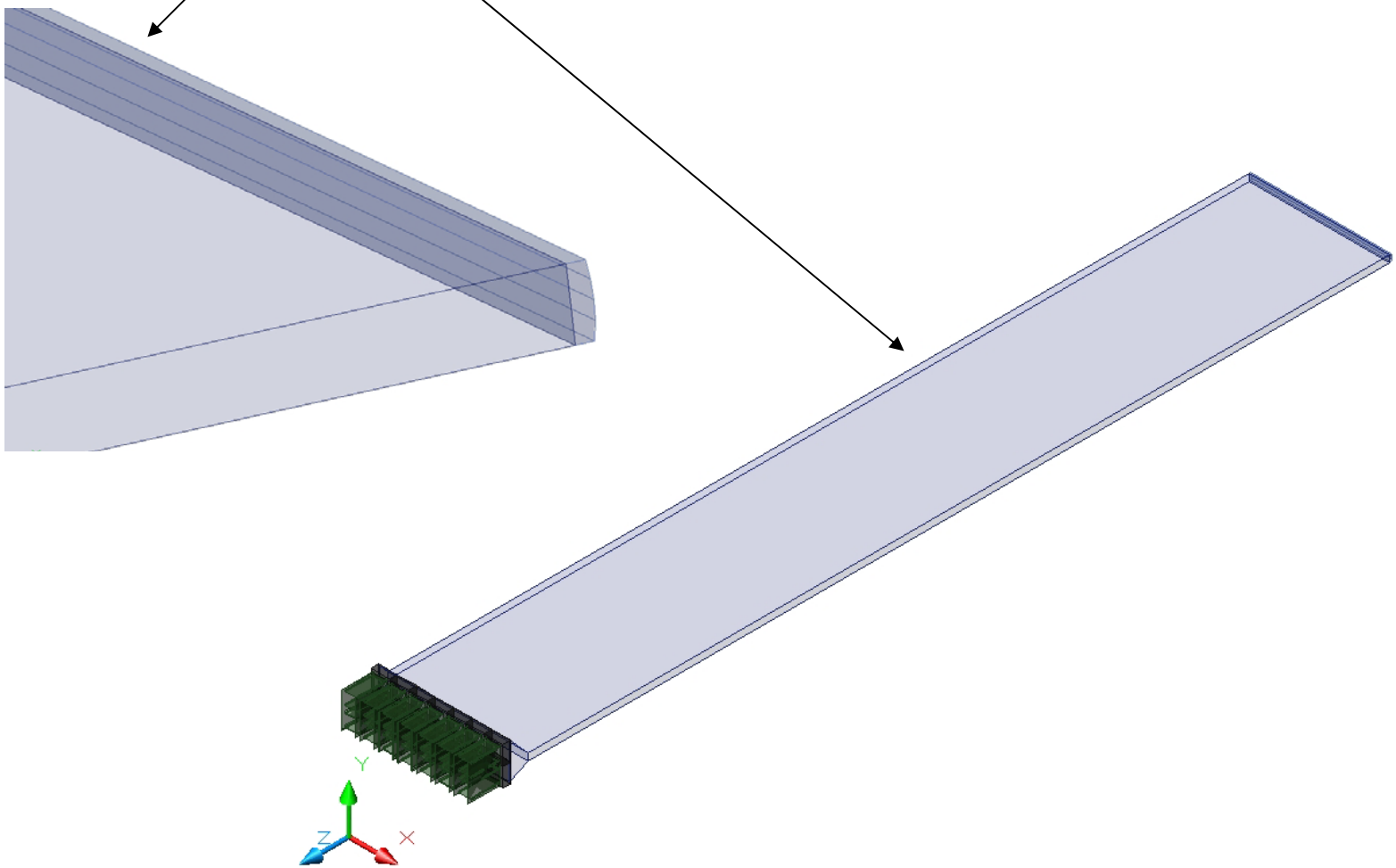


(side view)

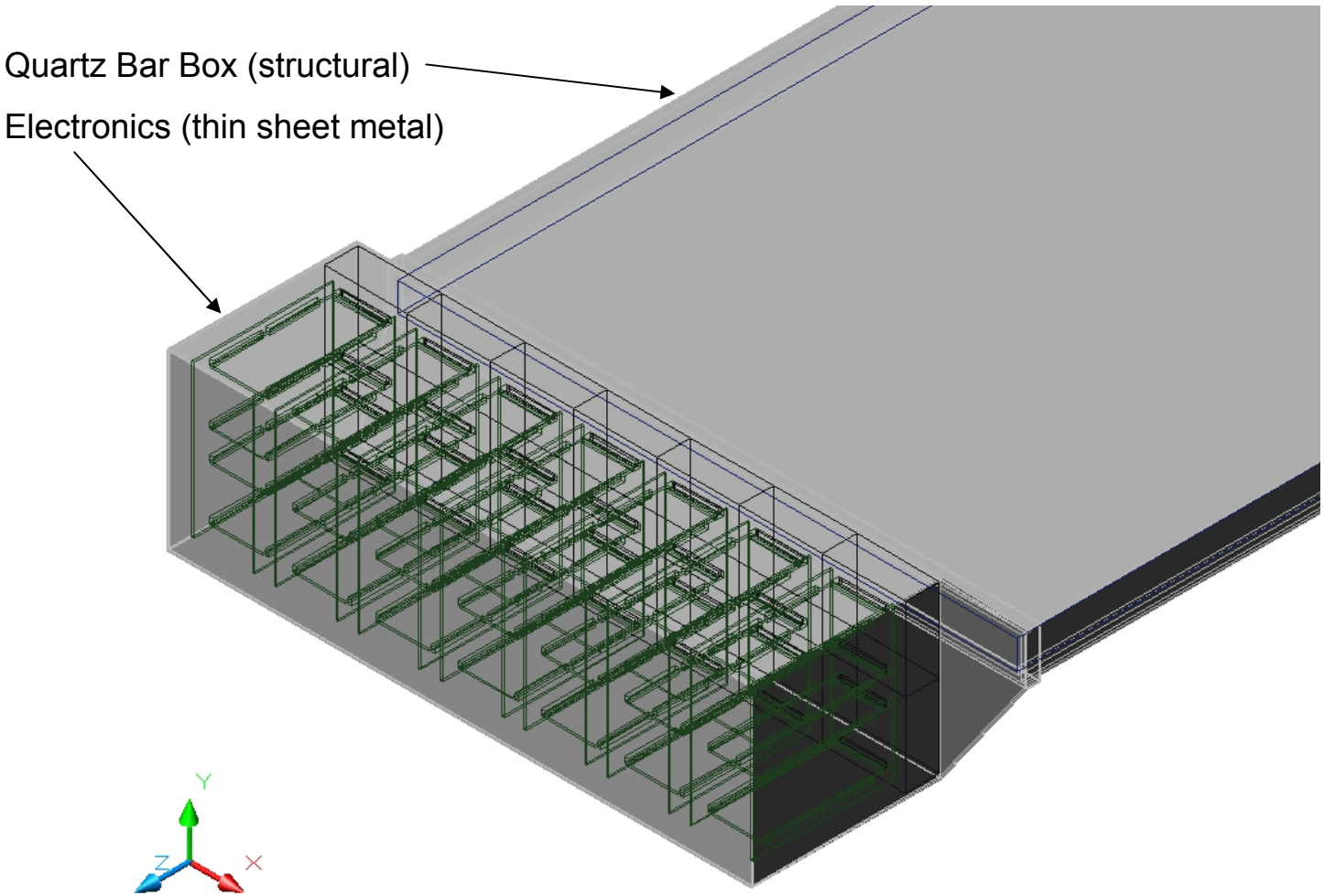


Current radiator design:
Mirror on Forward End (not optimized)

Complete Counter module (1 of 16)



Current radiator design:
Mechanical Enclosures



Two Mechanical Barrel Design Options:

1) Quartz Bar Boxes have overlapping flanges that fasten together to form one contiguous barrel.

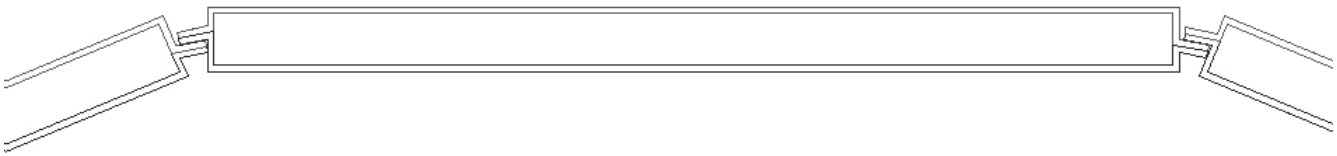
2) Quartz Bar Boxes are individually mounted into circular bulkheads, which have a cut-out for each module.

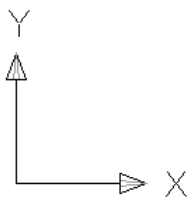
3) These two options have been modeled in 3mm thick solid aluminum. Stiffer/lighter sections such as honeycomb and/or composite core construction are under consideration.

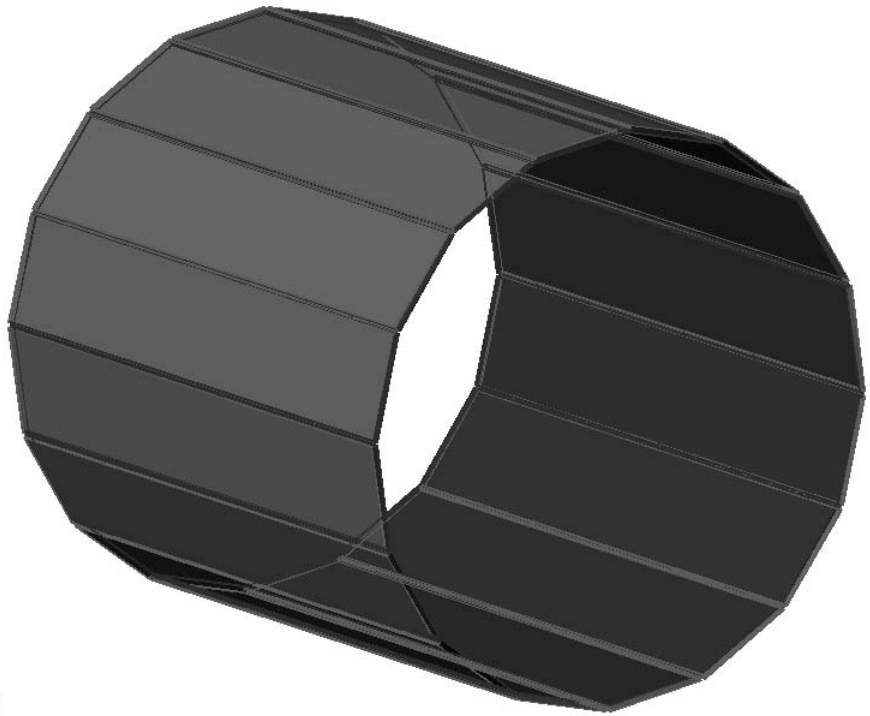
4) We're open to additional suggestions for how to form the barrel.

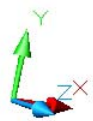
5) Views of the barrel designs will be followed by Finite Element Analysis.

Barrel Design Options: 1) Contiguous Barrel.
QBBs have overlapping flanges that fasten together.

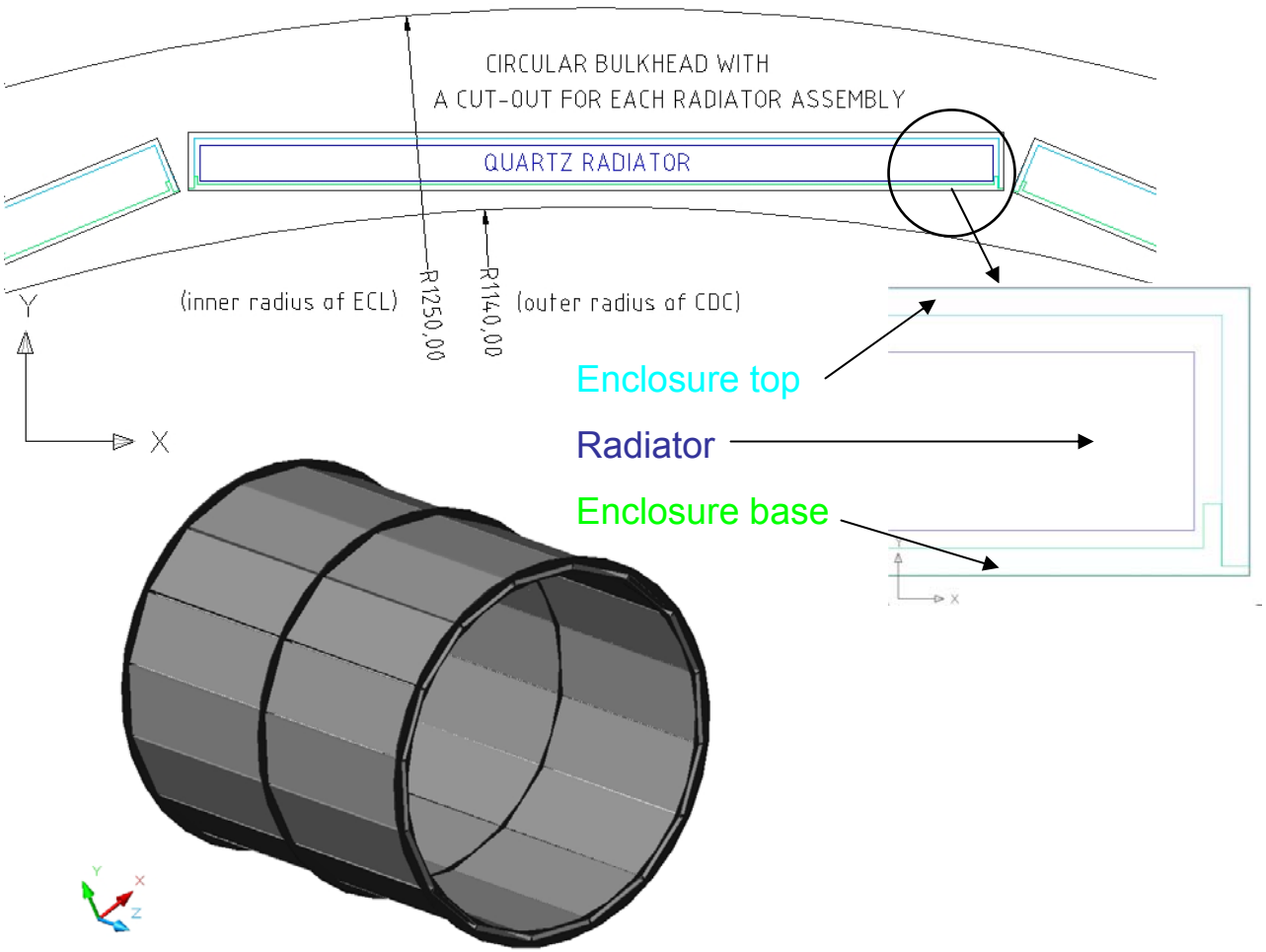




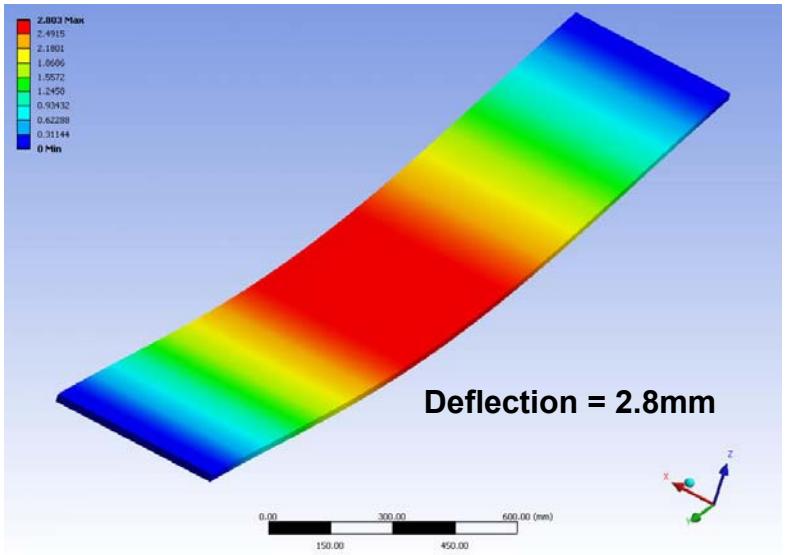


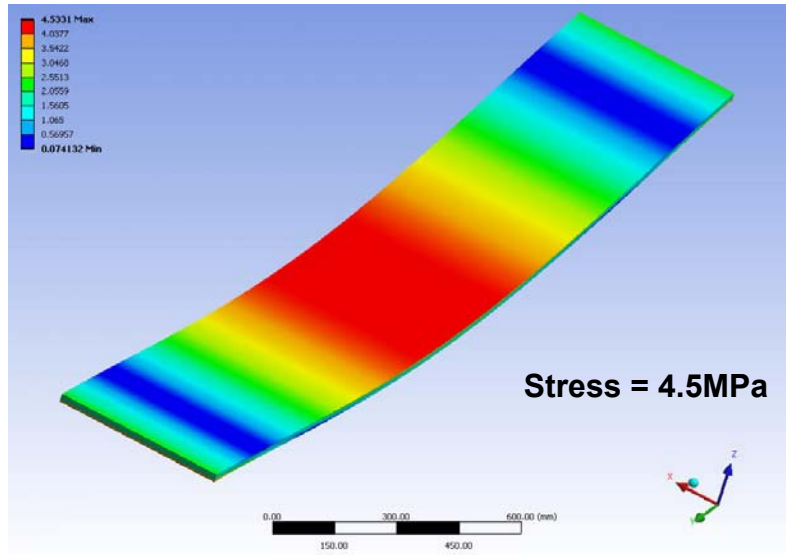


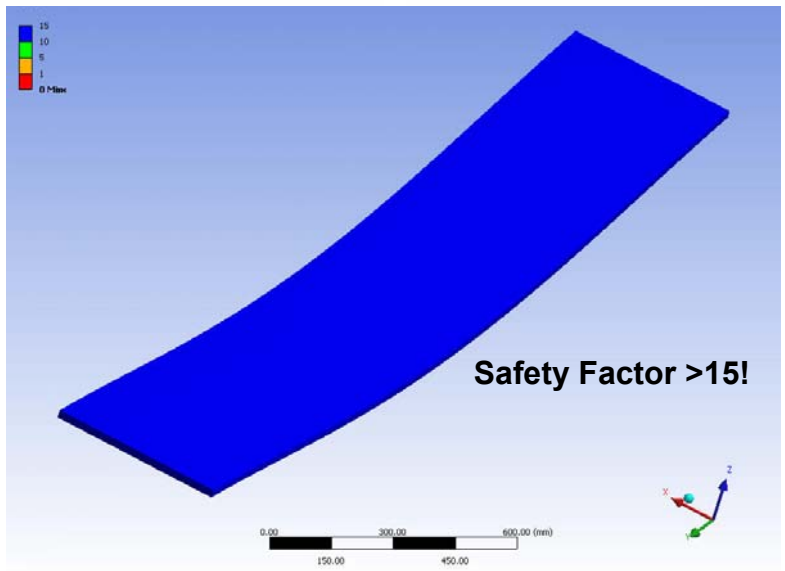
Barrel Design Options: 2) Individual QBBs supported via 1cm thick Circular Bulkheads.



FEA: Single Radiator with Simply Supported Ends (52.3kg)

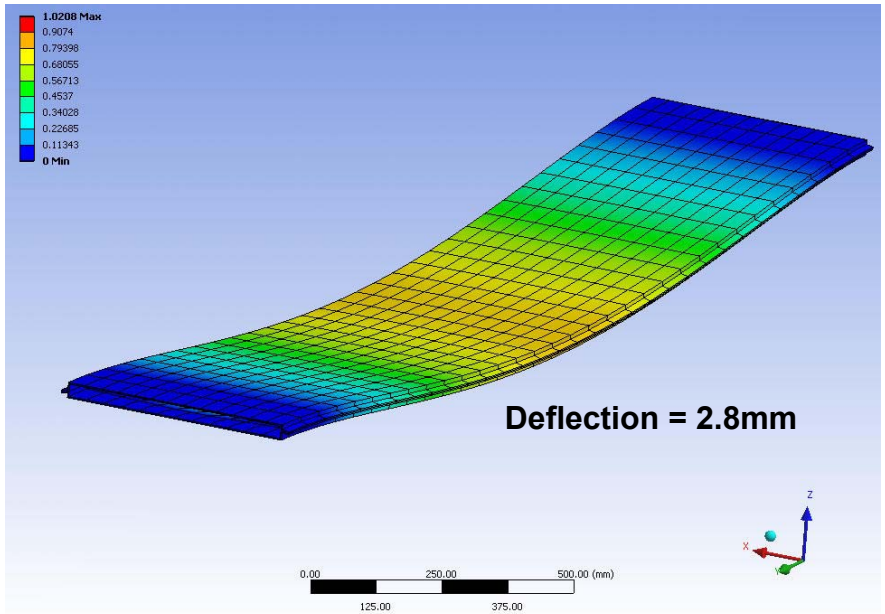




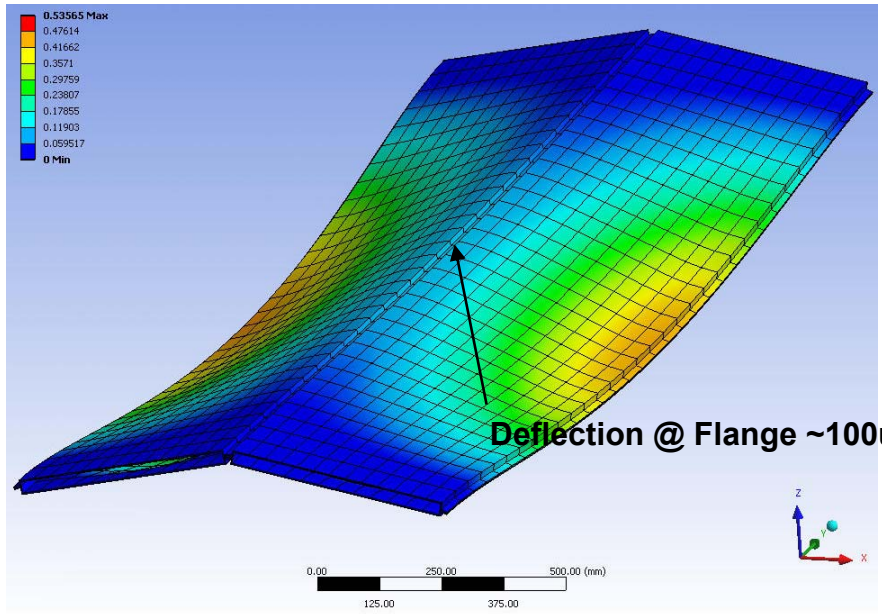


FEA: QBBs with Overlapping Flanges

Single QBB with Quartz Load: 50kg



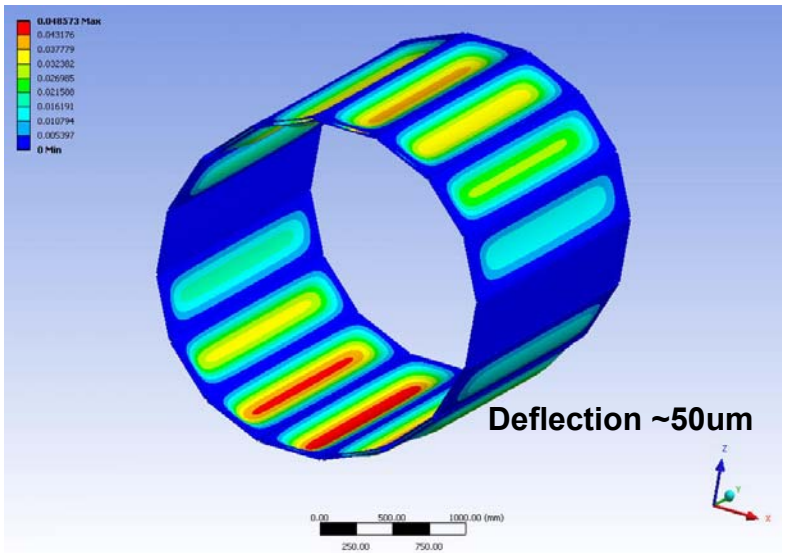
QBB Pair with Quartz Load



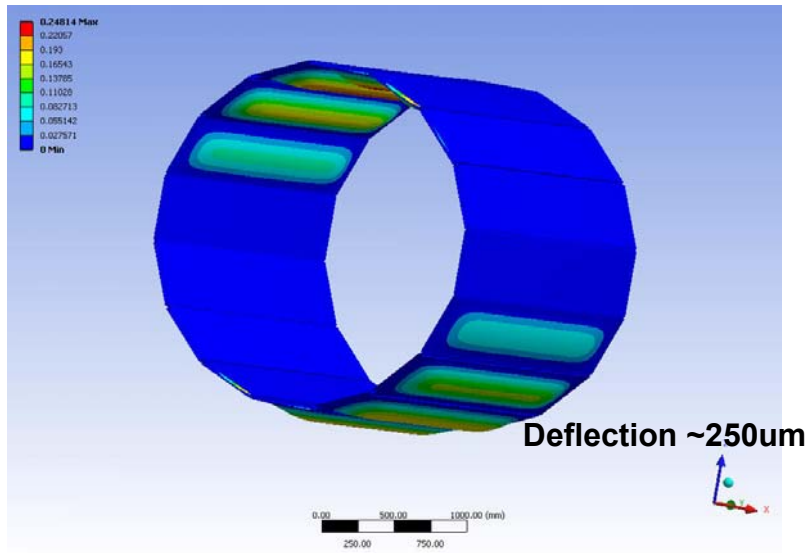
These structures become more rigid when joined.

FEA: Complete Contiguous Barrel

Barrel Deflection due to Gravity ~350kg



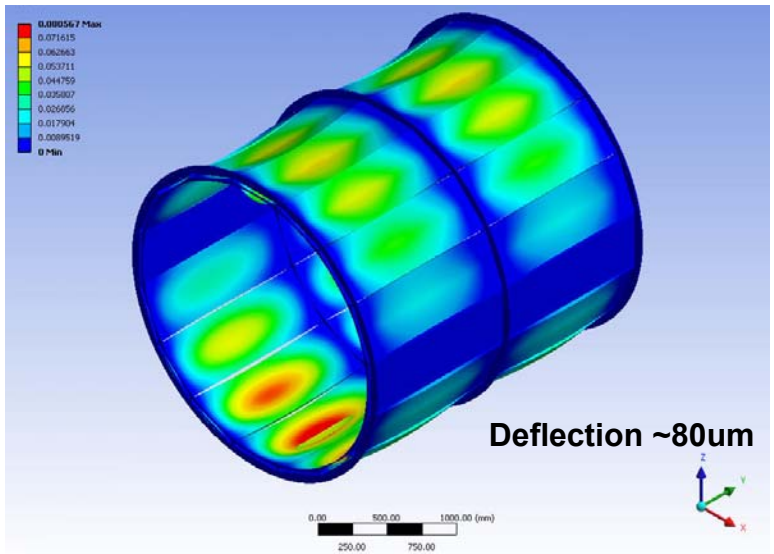
Barrel Deflection with full Quartz Load ~1,150kg



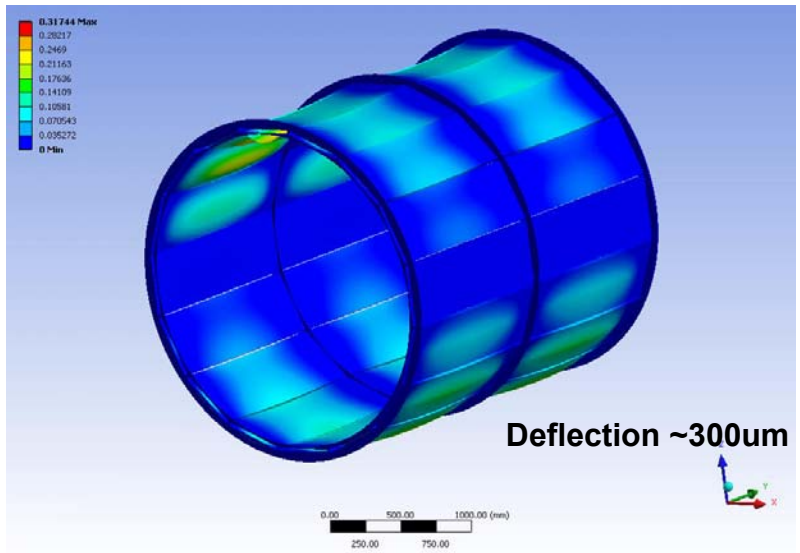
Taller QBBs + stiffer/lighter materials would improve this model.

FEA: Barrel Model with Circular Bulkheads

Barrel Deflection due to Gravity ~395kg



Barrel Deflection with full Quartz ~1,230kg



Taller QBBs + stiffer/lighter materials would improve this model.

Summary of FEA Results

- Two barrel models have been presented with similar results.
- Both models require further optimization.
- The contiguous barrel model is mounted into sBelle as a single unit making it difficult to access individual counter modules.
- The model with circular bulkheads allows for counters to be installed (or removed) individually.
- All modeling to date uses 3mm thick aluminum.
- Additional modeling is desirable to address construction that uses stiffer/lighter materials such as sandwich composites and honeycomb core aluminum.
- The Hawaii Group is open to new ideas re barrel design.

Summary/Comments/and Questions

- **It has been demonstrated that the iTOP concept will fit into sBelle.**

- Sixteen 44cm wide x 2cm thick quartz bars are arrayed into a PID barrel.

- The final length of the quartz needs to be determined.

- The final design of the mirror (forward end) needs further study.

- Two preliminary mechanical barrel design concepts have been presented.

- How will the PID barrel mount into sBelle?

=> Meetings with KEK engineers next week will address this & other Super Belle issues.

Design and Development Environment

From Ushiroda-san (BPAC) re: CAD standards in Super Belle

- 2D CAD will be saved as .dwg files.
- 3D CAD will be saved as .step files.
- All CAD will be in JIS metric units (mm).
- H. Yamaoka will keep archives in wiki.

Hawaii mechanical software environment:

- 2D => AutoCAD: makes .dwg and .dxf files.
- 3D => Mechanical Desktop: makes .dwg, .step, and .igs files.
- FEA Ansys Multiphysics V11 (educational license)
- Hawaii can meet these requirements and has an established history of file sharing with Belle.