Magnet, Support and Infrastructure

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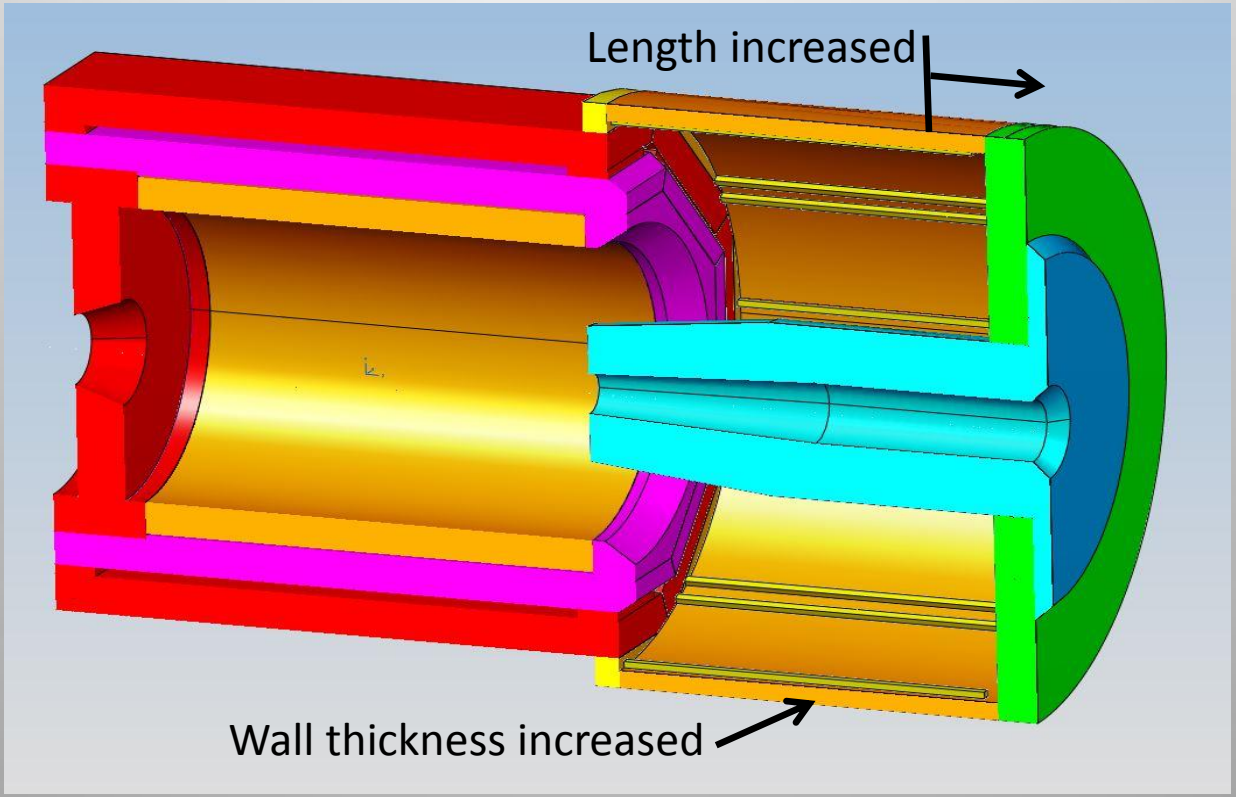
June 29, 2016

Update on Engineering and Design efforts from the Spring of 2017

- Updated iron geometry in CAD model to match Jay's latest study
- Ran a new structural analysis on thicker downstream coil collar
- Completed stress and deflection calculations on detector endcap for PVDIS and SIDIS experiments
- Finished the first pass of stress analysis of complete magnet based on magnetic forces from Jay's study.
- Explored the feasibility of a new concept for supporting the detectors and baffles inside the bore of the magnet.

A Few Notable Dimensions of the Endcap

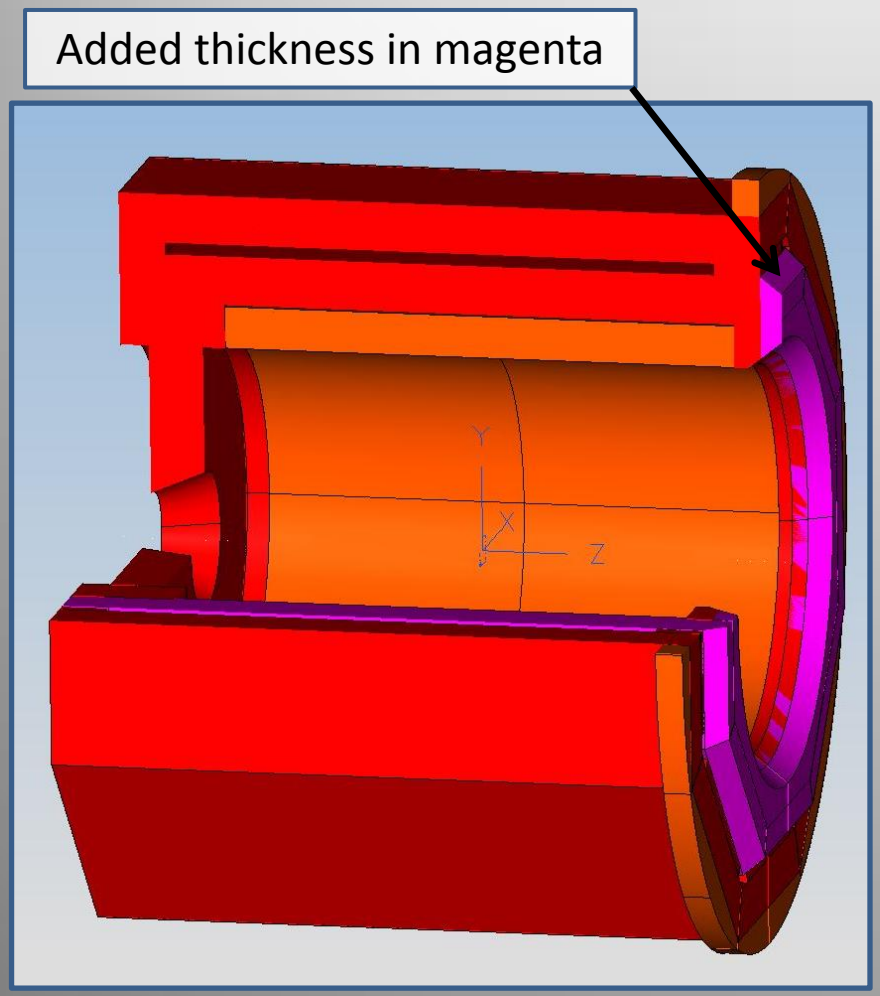
Jay's extended version

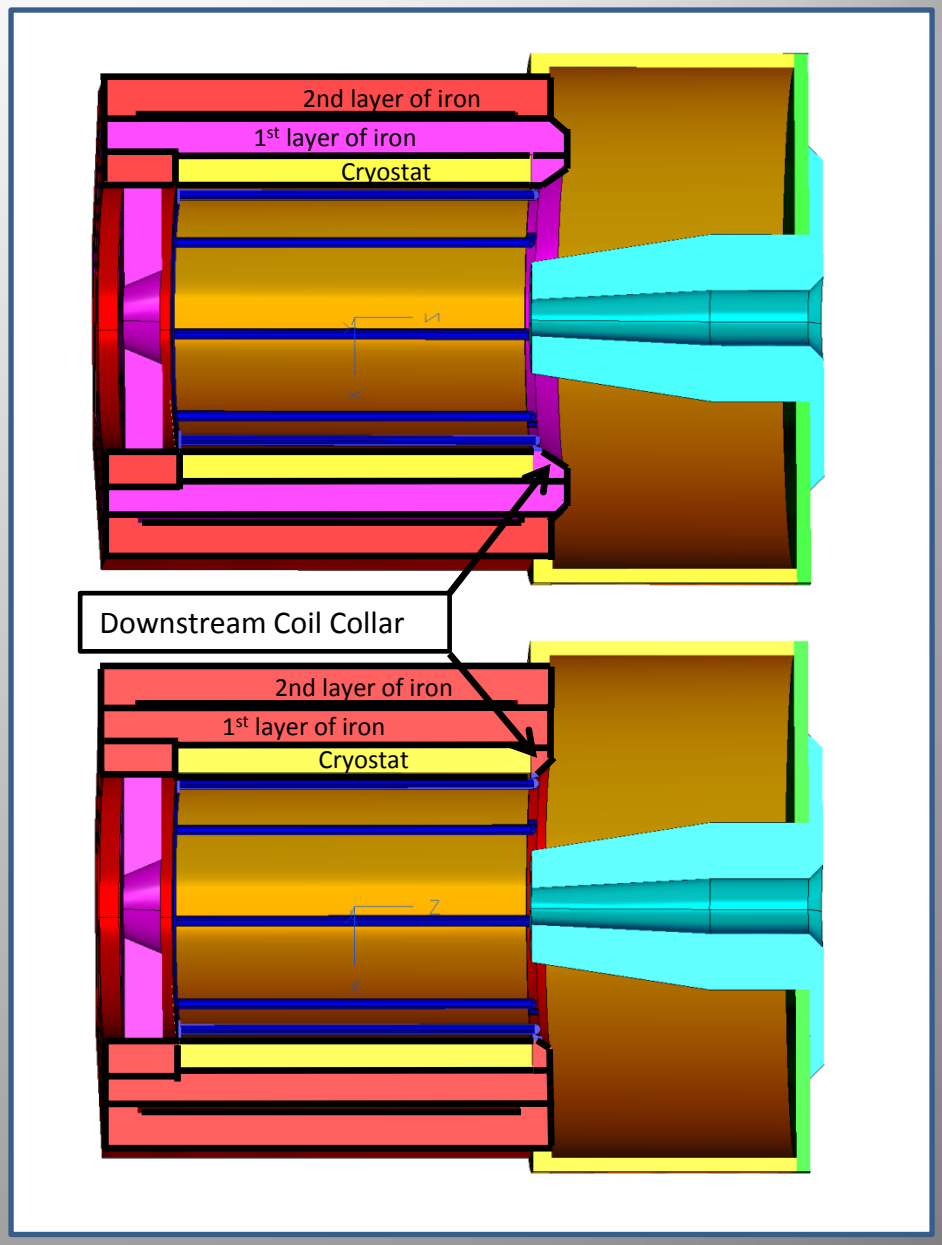


- Length of endcap increased by 59.2 cm for additional detector and cabling space
- Wall thickness increased to 6.5" – I.D. remained the same

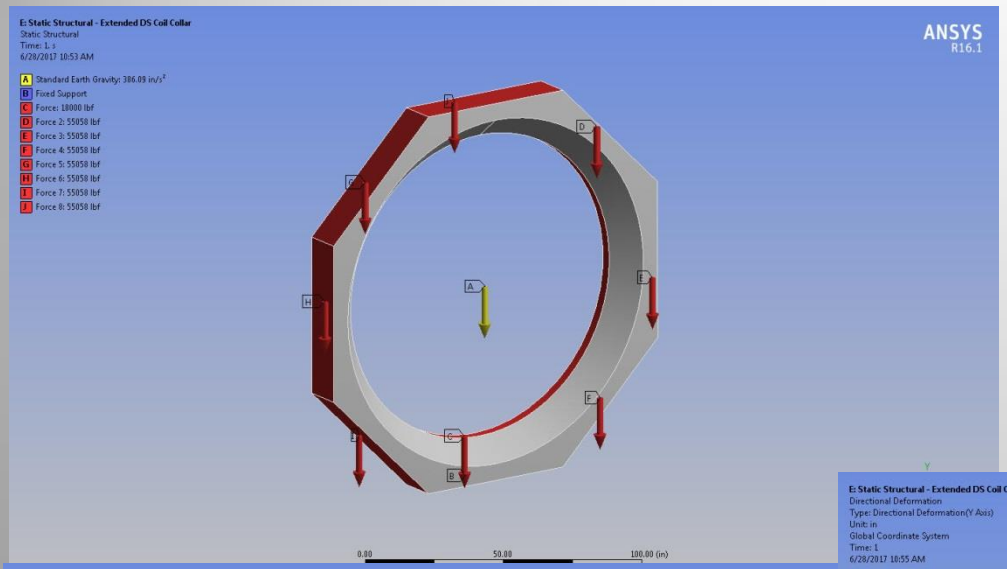
Thicker Coil Collar and Extended 1st layer of Iron

Thickness of DS coil collar increased from 20 cm up to 35.6 cm. 1st layer of iron's length increased by same amount with a 38.6 deg chamfer added at the top.

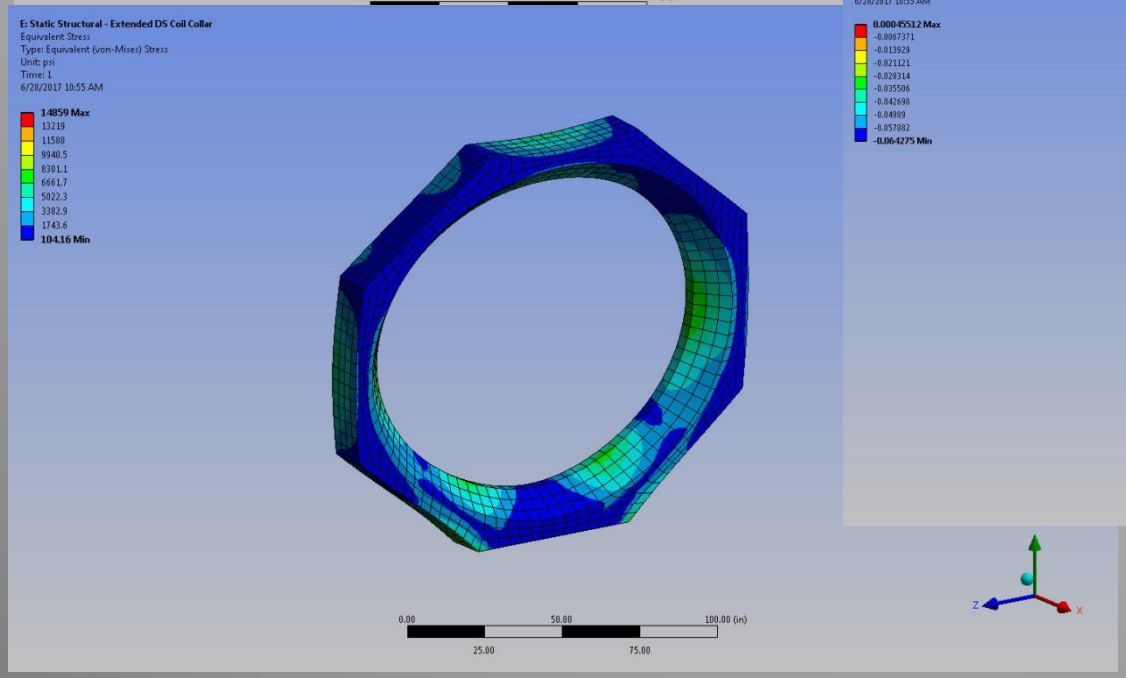


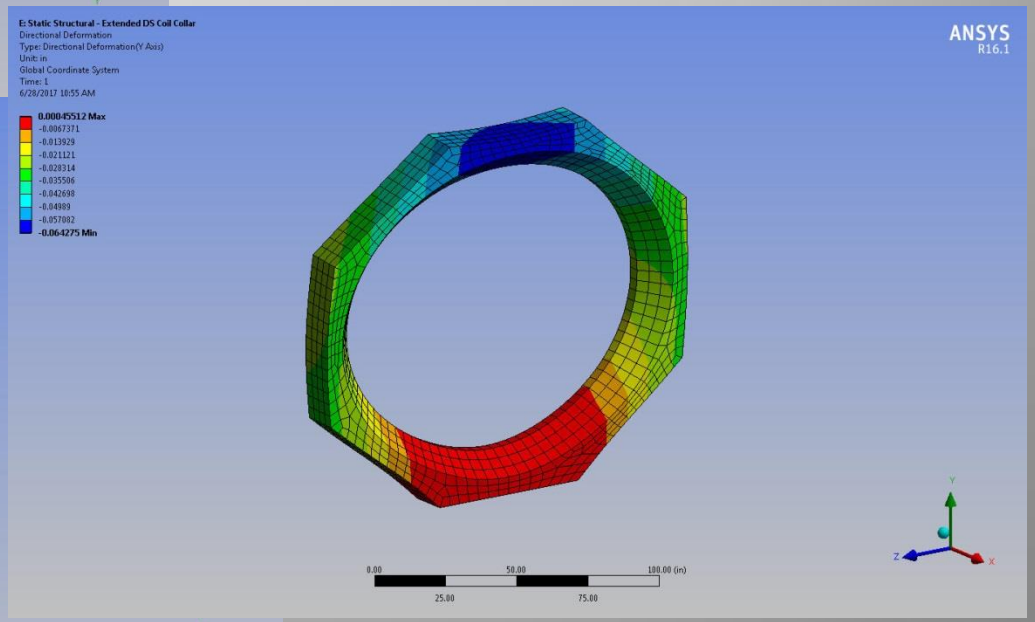


Structural analysis of thicker downstream coil collar



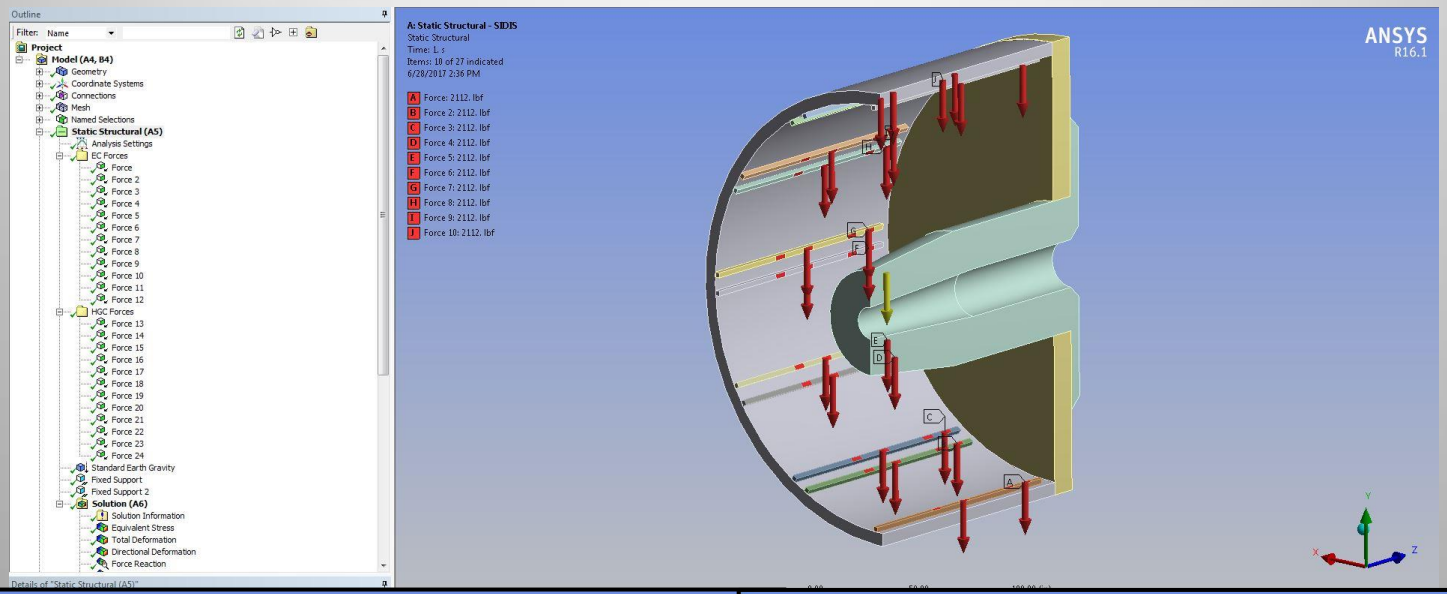
- Loads from iron and detectors applied
- Max stress (non peak stress) 8550 psi
- Max vertical deflection = 0.064”
- Thickness is sufficient to handle loads
- Peak stress of 14.9 ksi occurs at corner node of the rigid constraint

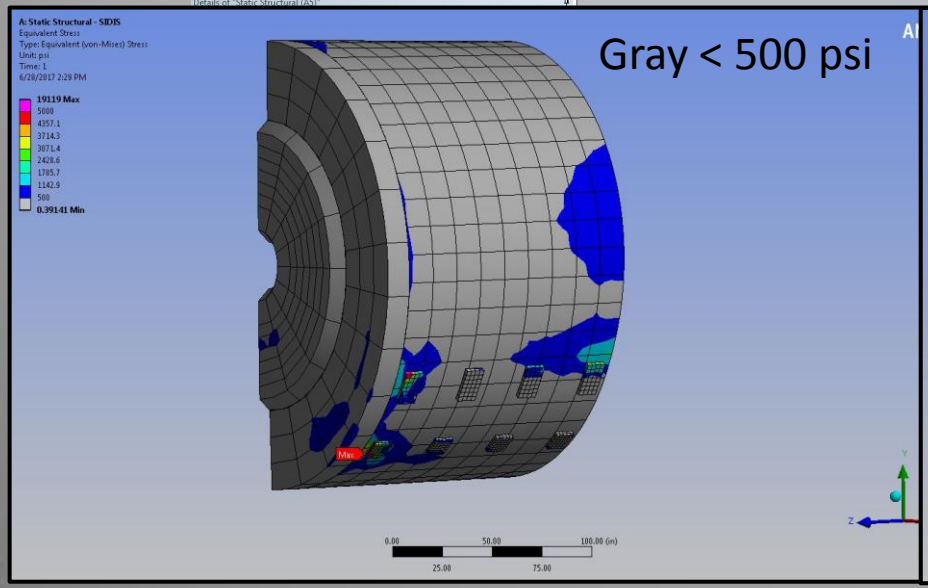




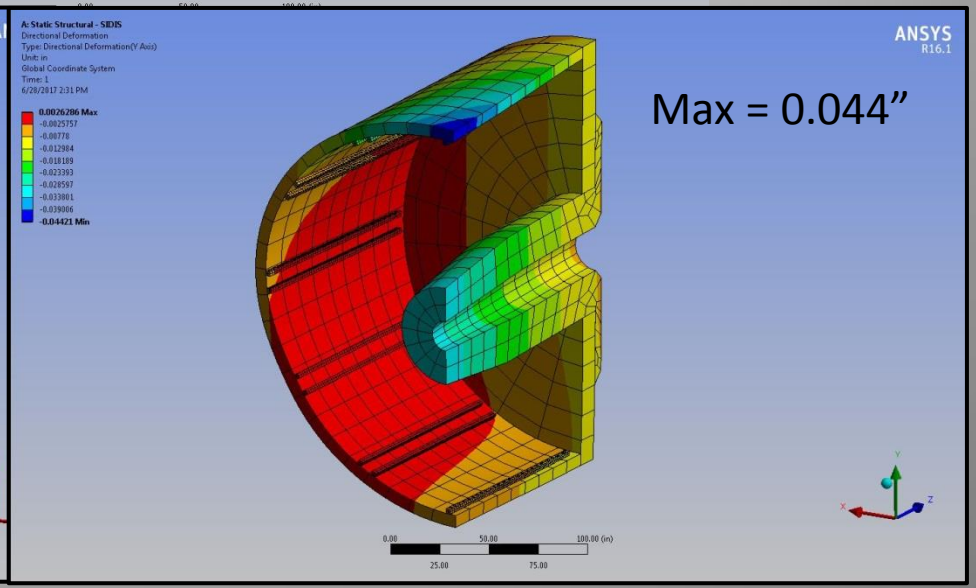
Stress analysis of freestanding endcap half - SIDIS

Explores strength of deflection of endcap design under detector loads





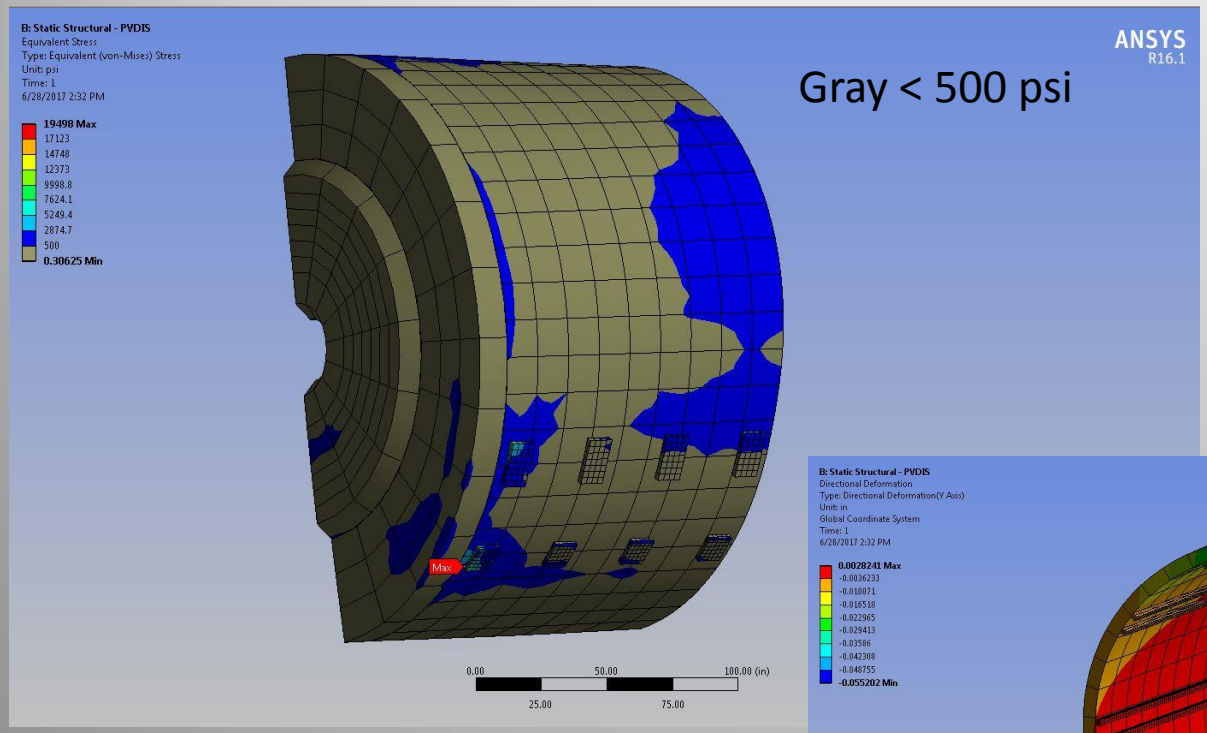
Gray < 500 psi



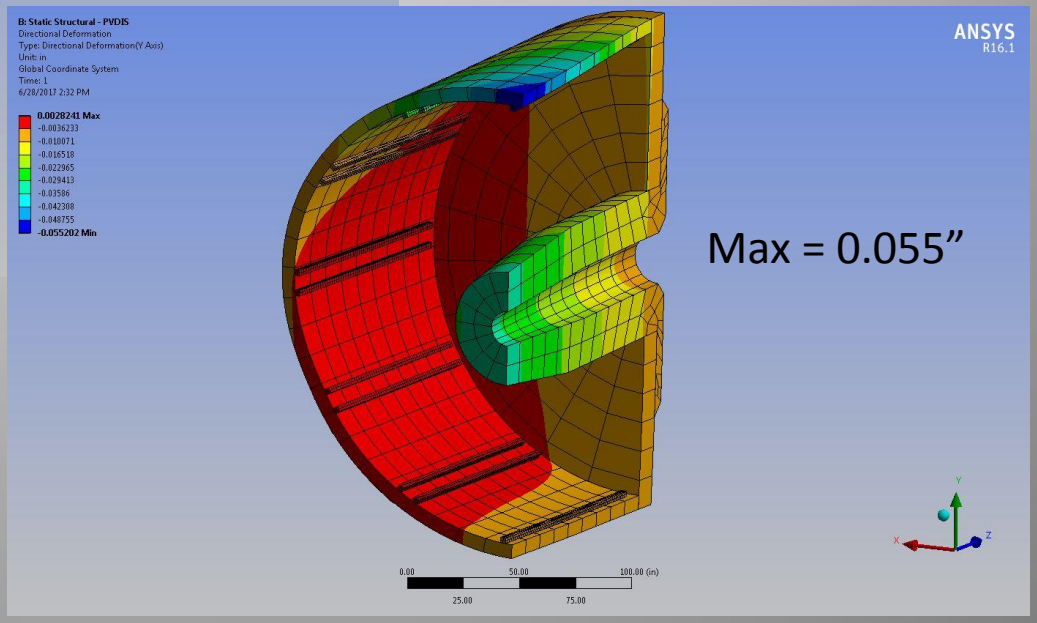
Max = 0.044”

Stress analysis of freestanding endcap half - PVDIS

Explores strength of deflection of endcap design under detector loads



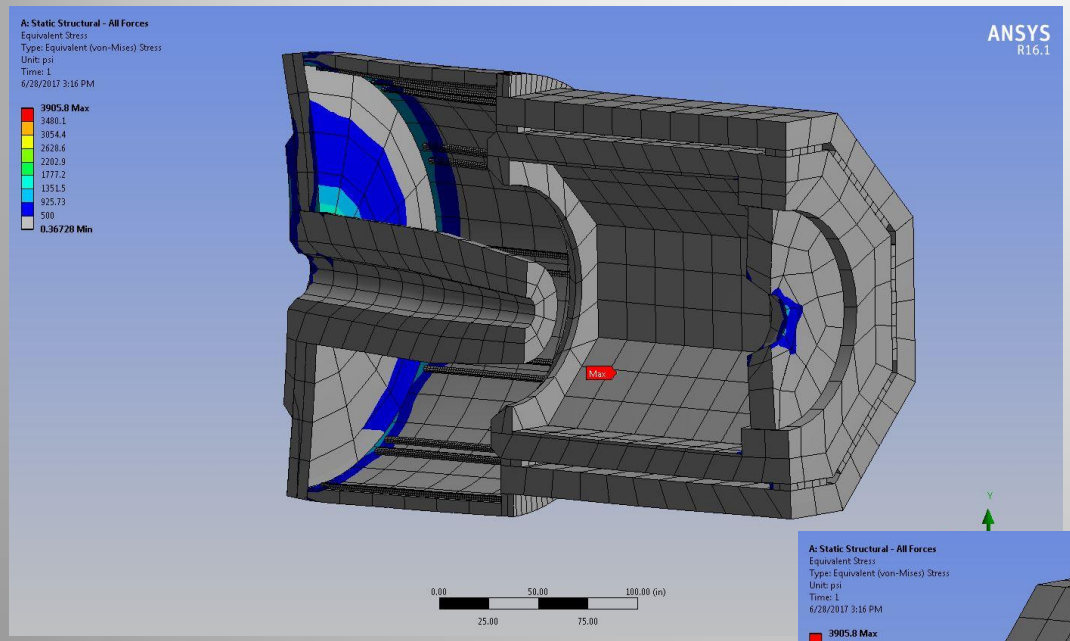
Gray < 500 psi



Max = 0.055”

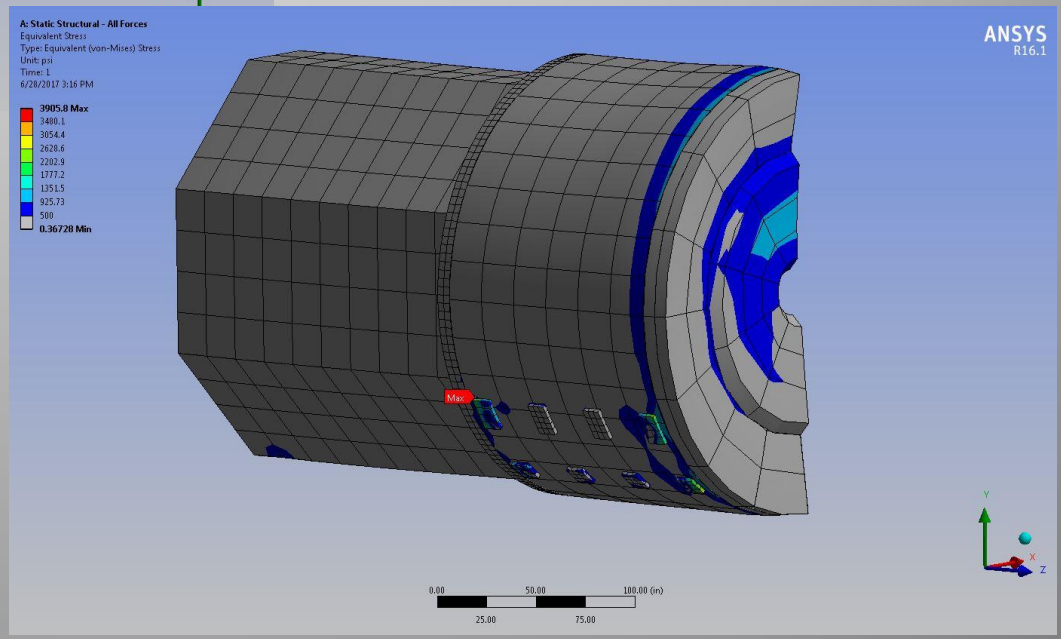
FEA analysis of SoLID iron

Magnetic, detector and gravitational forces - STRESS



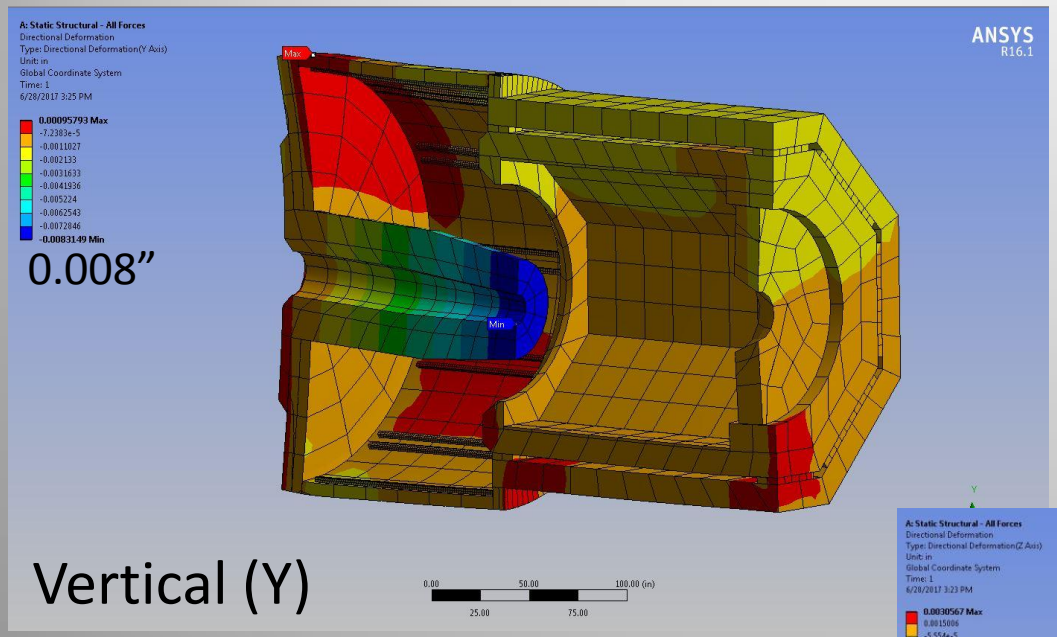
Stresses are low!

Max = 3900 psi



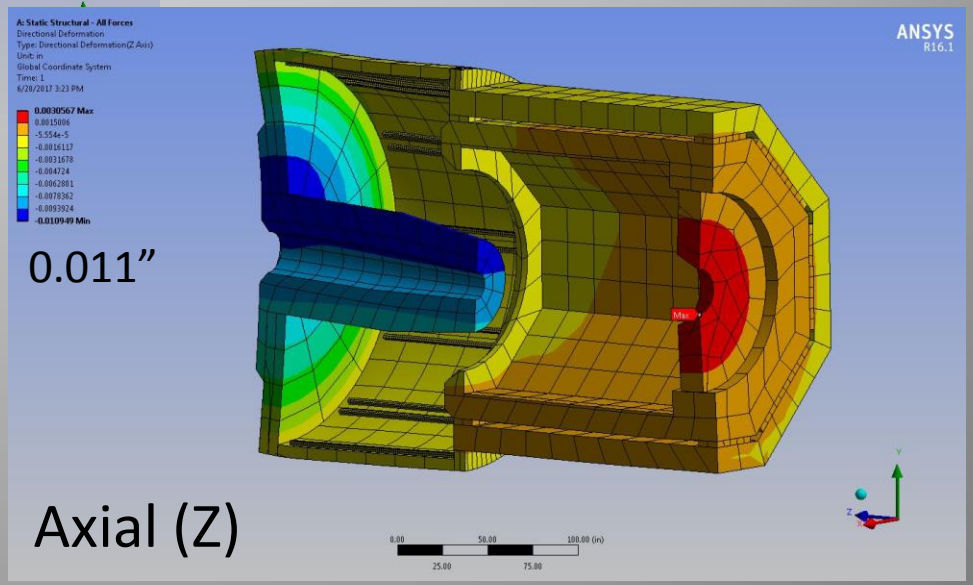
FEA analysis of SoLID iron

Magnetic, detector and gravitational forces - DEFLECTION



0.008”

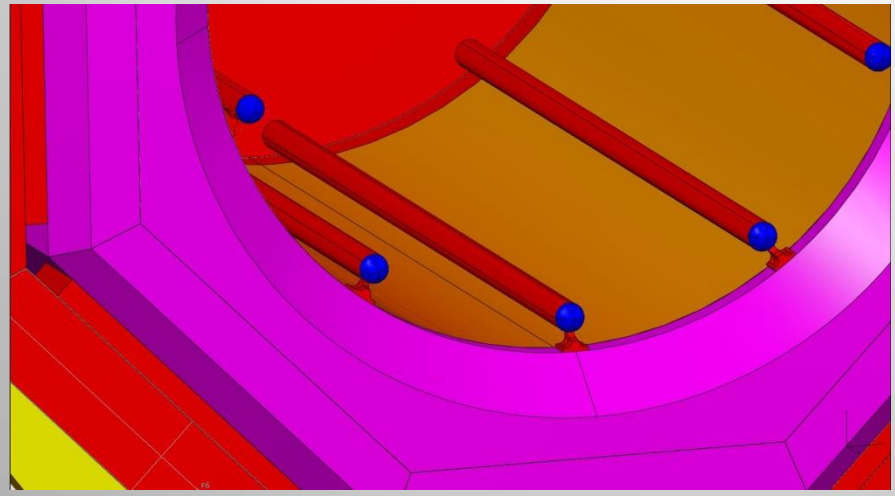
Vertical (Y)



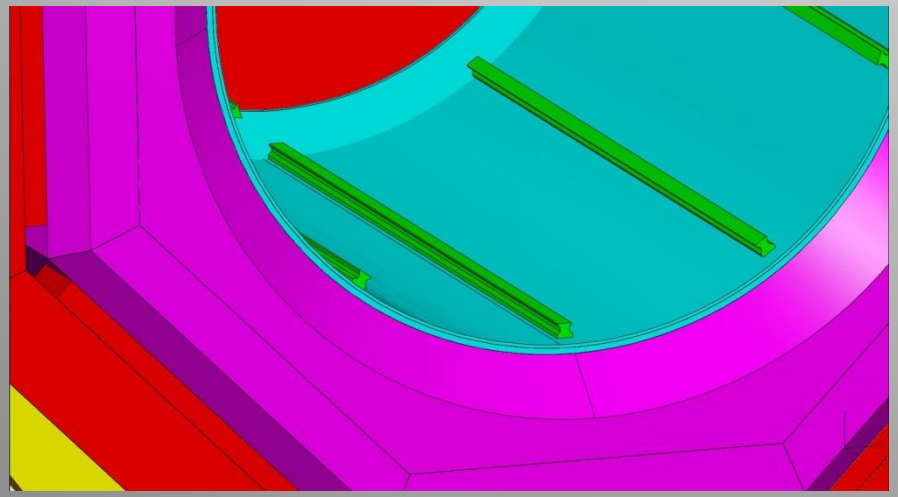
0.011”

Axial (Z)

Exploring new concept for supporting the items inside the bore of the magnet

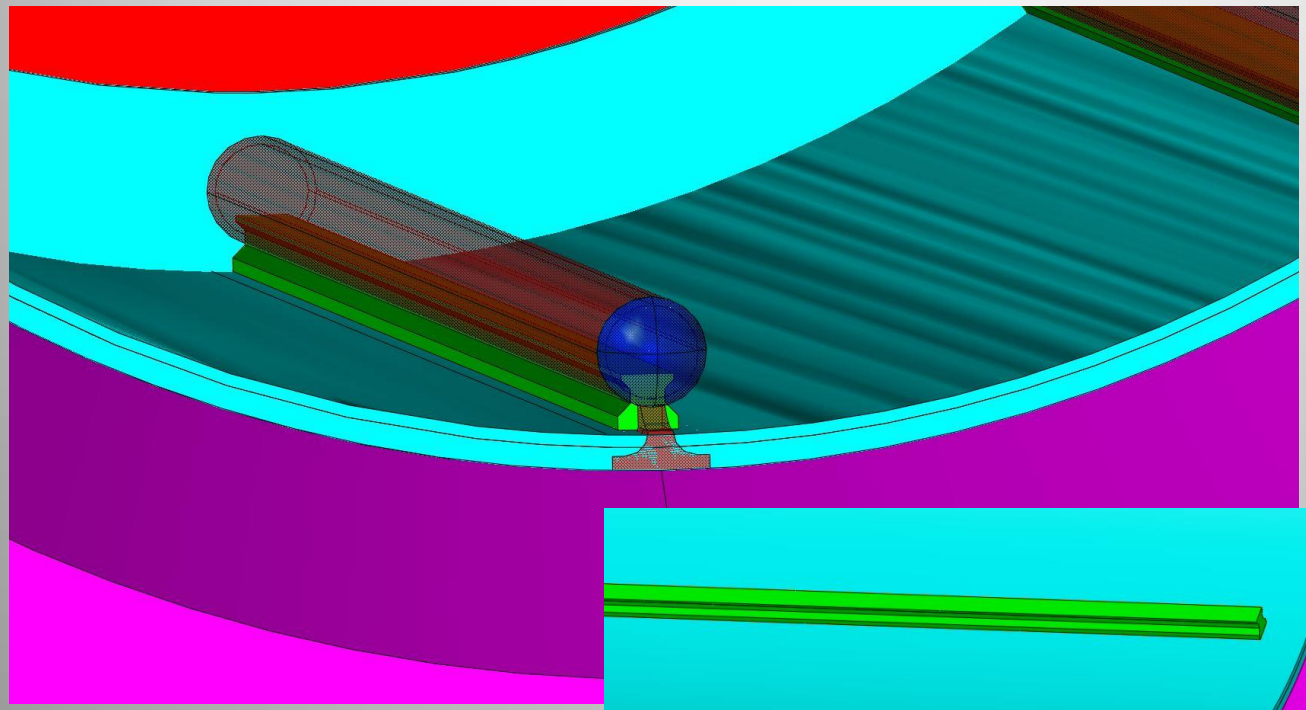


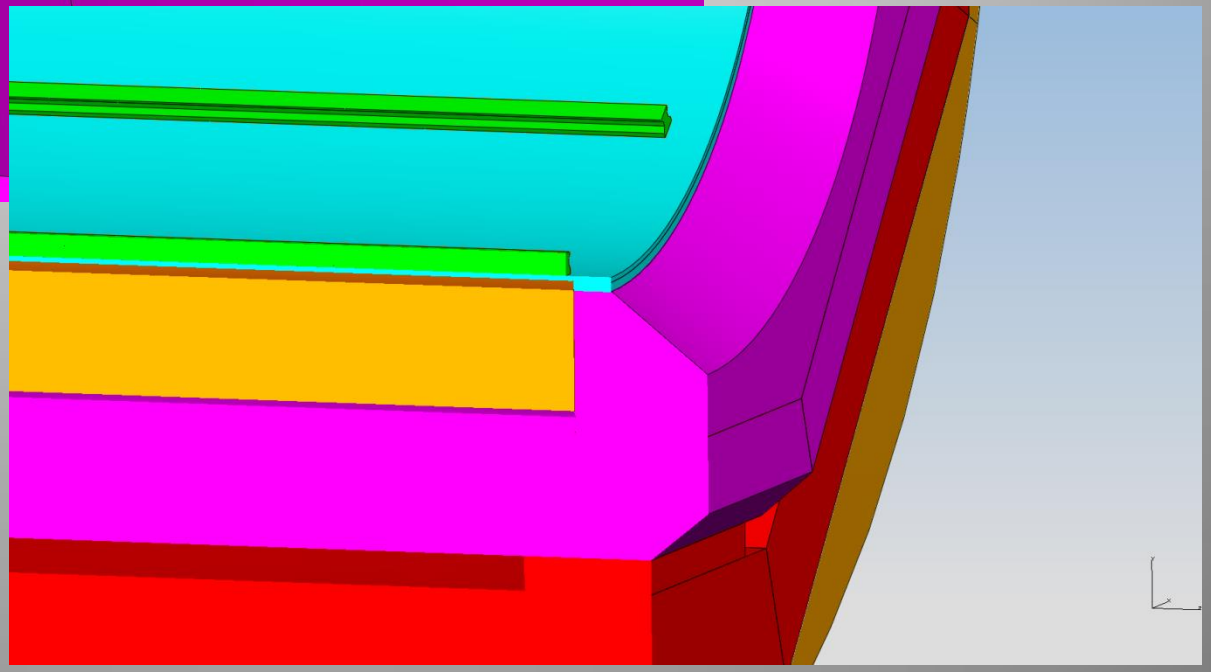
The old design used large SS pipes to bridge across the cryostat. Deflections were a concern. Custom, yet to be designed, rollers required.



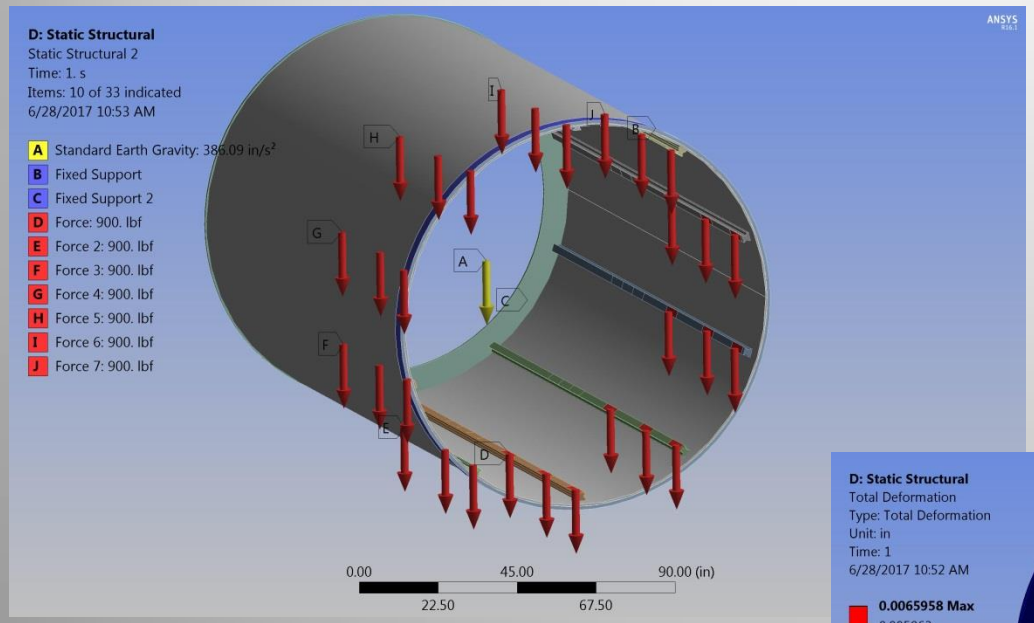
The new concept employs a rolled SS cylinder inserted in the bore. Attached to the same locations as previous design. Allows the use of “Off The Shelf” rails and rollers. More compact and smaller deflections.

Comparison of the two rail concepts

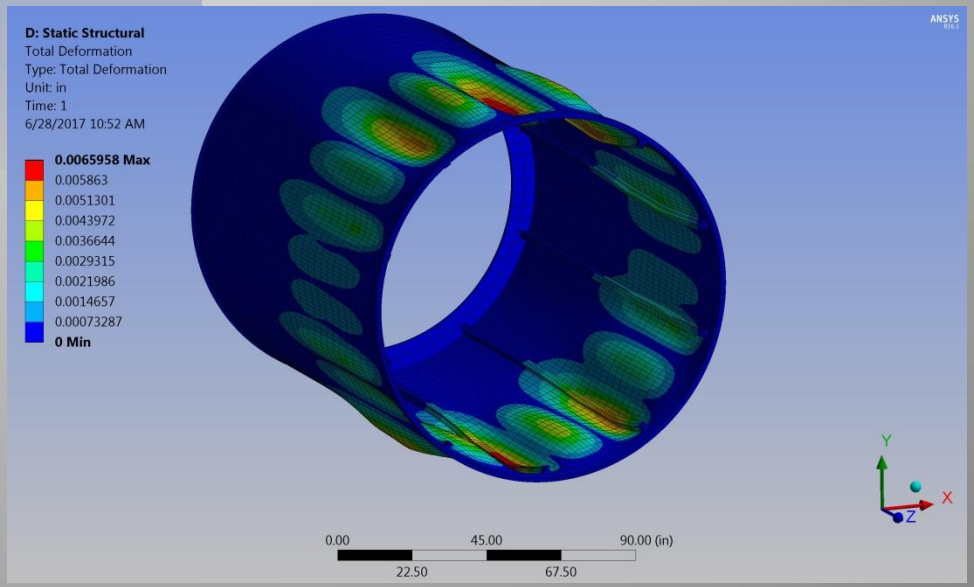




FEA analysis of new support concept

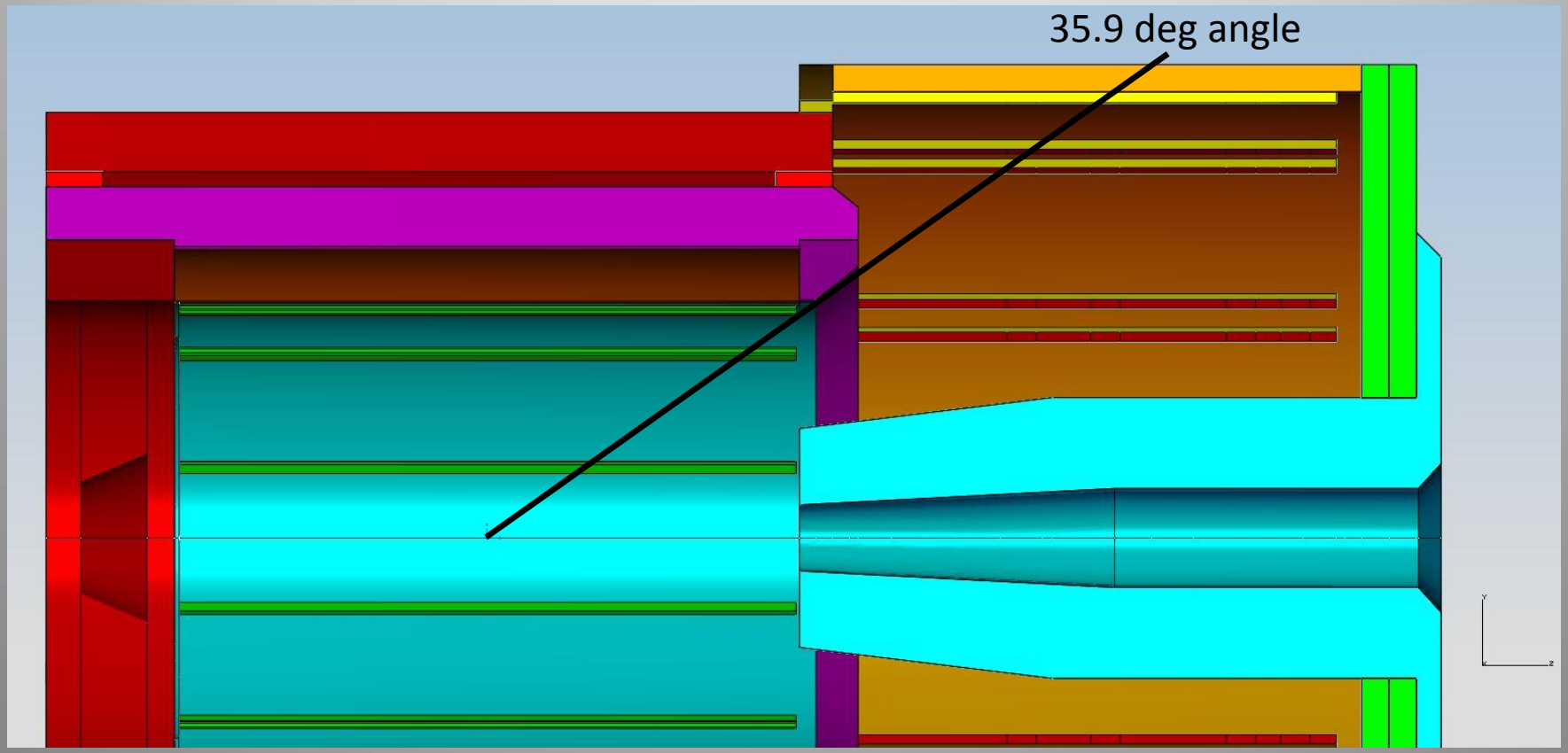


Max stress = 3100 psi
Max deflection = 0.007”
Results from 35 kip Baffle load case
LAEC case showed similar results



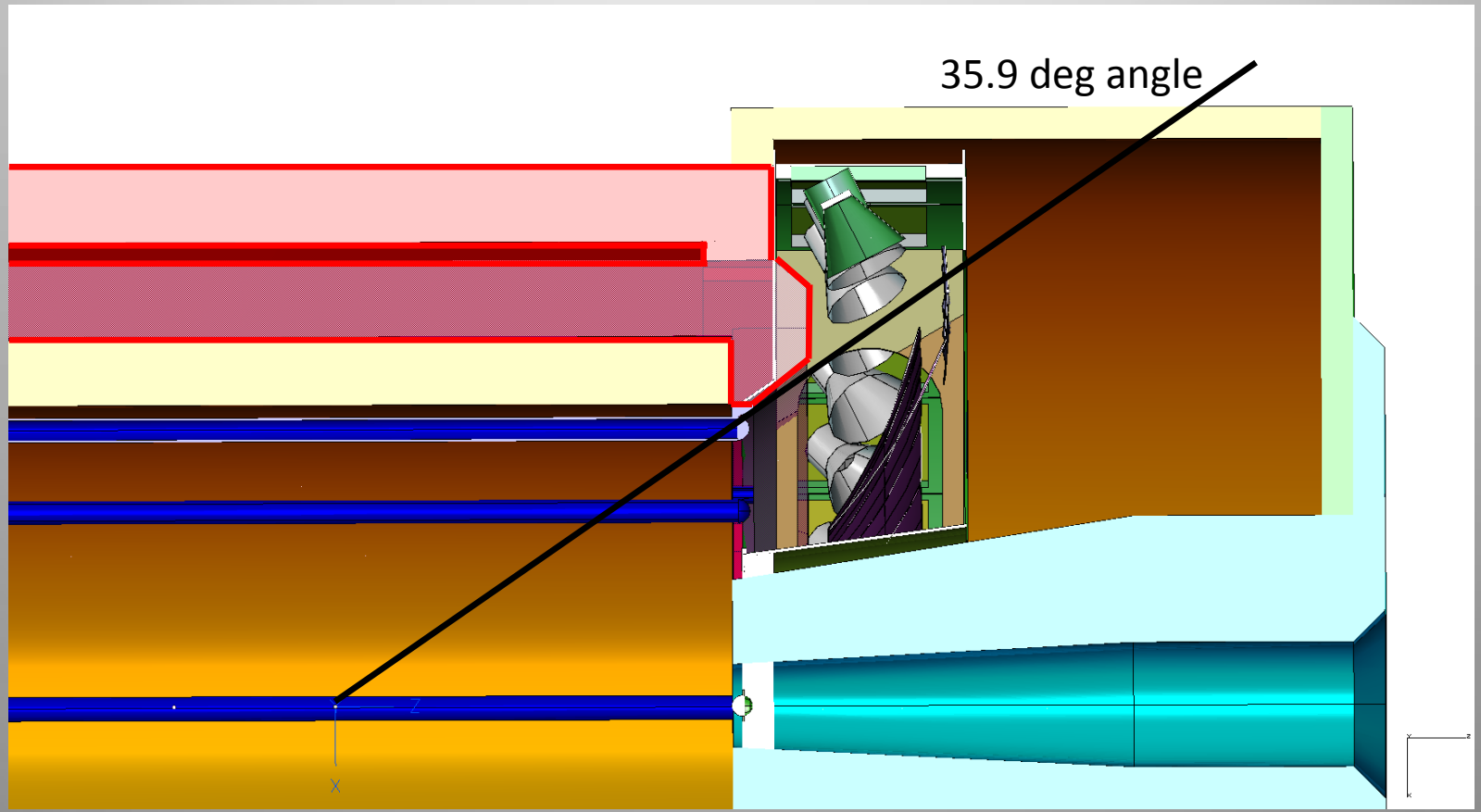
Lower profile keeps more of the support out of the acceptance

- Very little interference with the rail and cylinder along this angle.
- Better than the previous design.



Old Concept

More of the rail protrudes into the acceptance area!

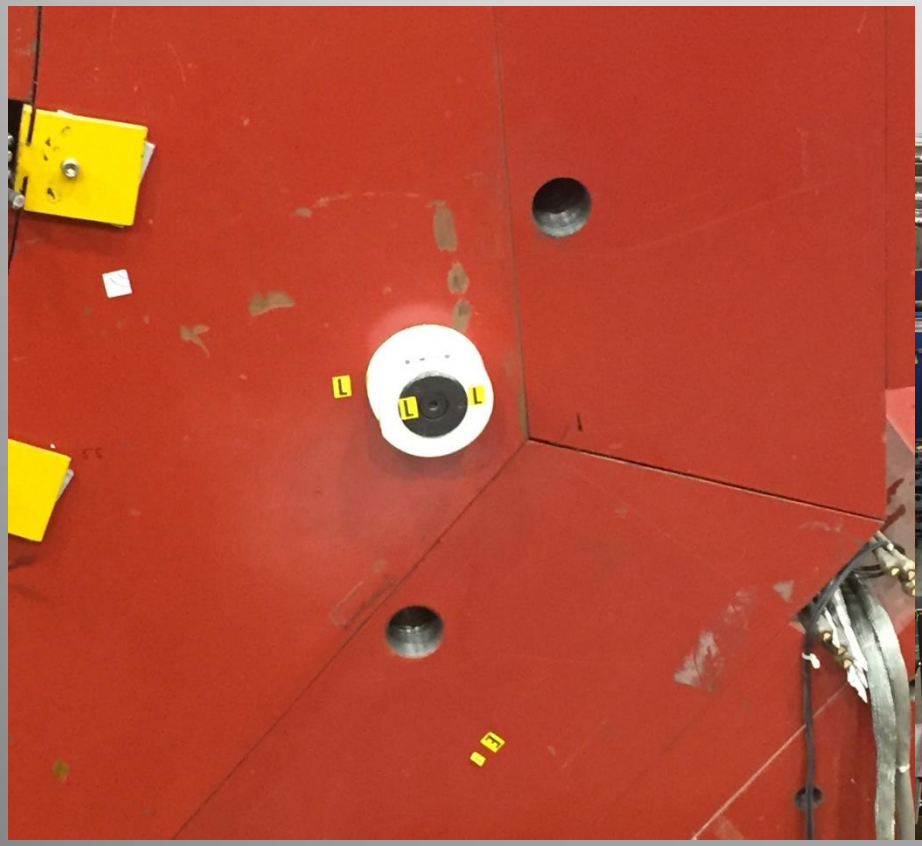


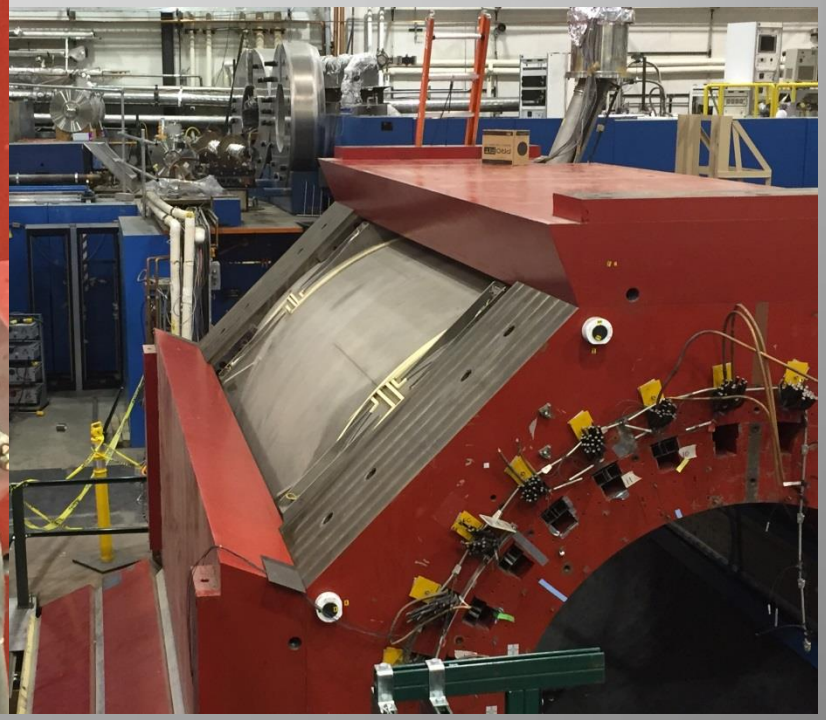
Future Work

- Further pursue new internal rail concept
- Migrate mock-up model to new CAD system (NX) and start adding details
- Prepare for next iteration of magnet iron with Jay
- Analyze openings for cable access
- Update model with latest detector CAD files and continue to resolve space issues and cabling routes.

Radial Coil Support Adjusters

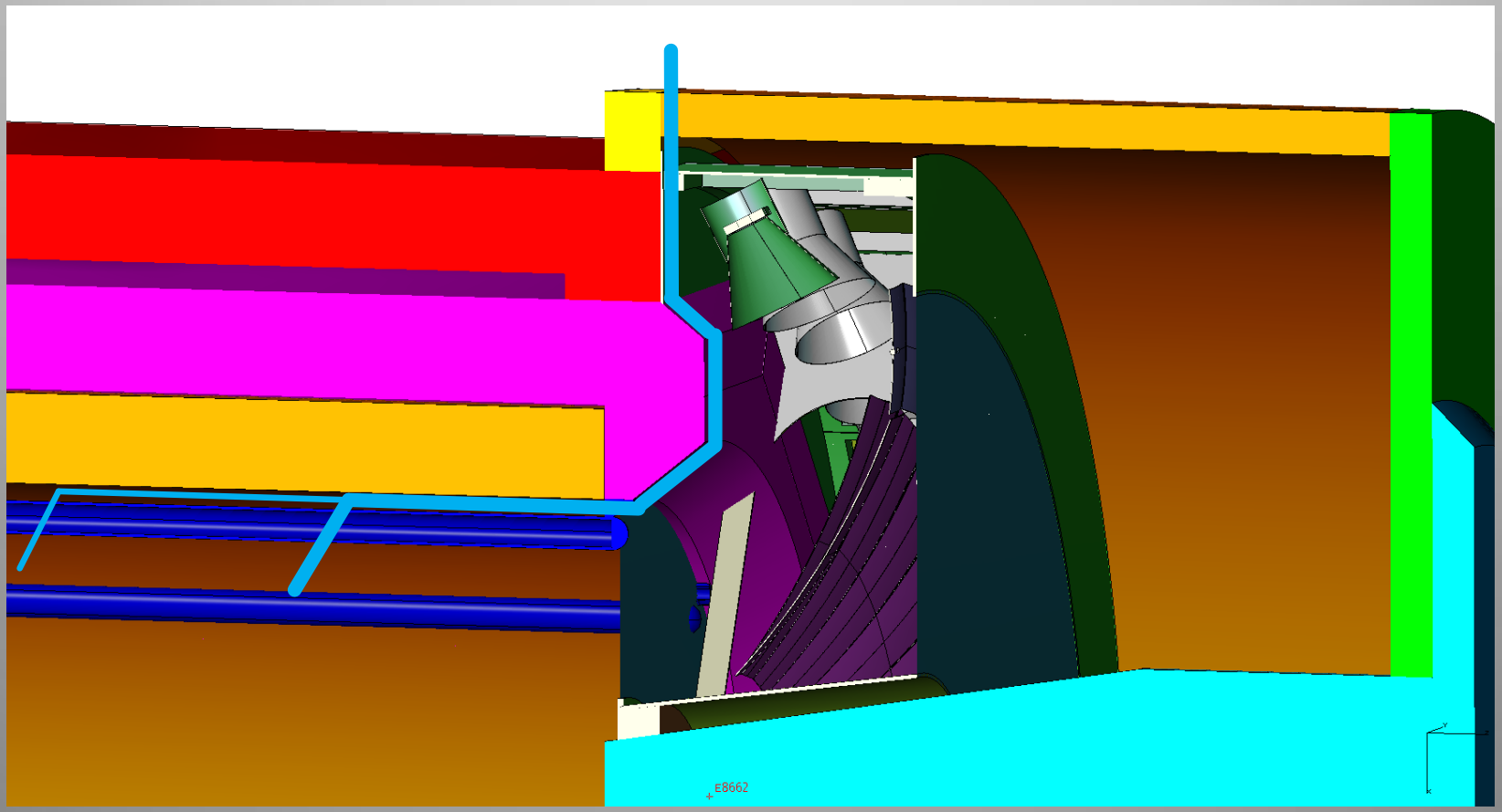
There are eight, white puck sized cylinders adjusters, that sit on the downstream face of the coil collar that adjust the radial forces on the coil supports. There are mechanical counters built into the pucks that provide feedback of coil position. The pucks will also need clearance that will intrude into the LGC space . Our model does not have that level of detail yet.





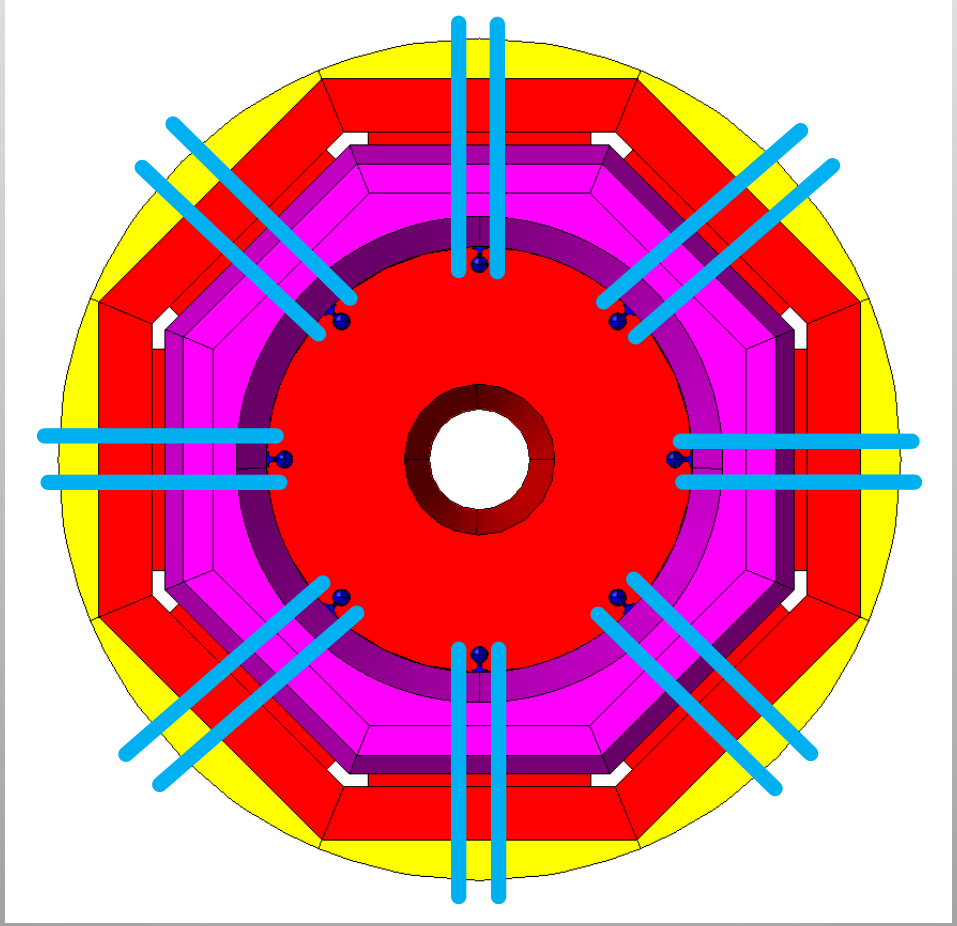
Cable Routing?

Below demonstrates the possibility of running cables from inside the bore downstream and out radially along the perimeter of the coil collar, layers of return iron and out through opening in the front of the endcap. This could create channels for bundles to weaves their way out. This also impacts the LGC space.



Cable Routing Continued

Looking upstream towards the target at the rear of the magnet steel. The endcap and detectors are hiding for clarity.



Eight sectors for cable exit were chosen because of ease to replicate in powerpoint. It seems logical the number of routes and the paths taken would be dictated by the total volume of bundles and the location of DAQ interfaces.

Access Holes for Cabling