



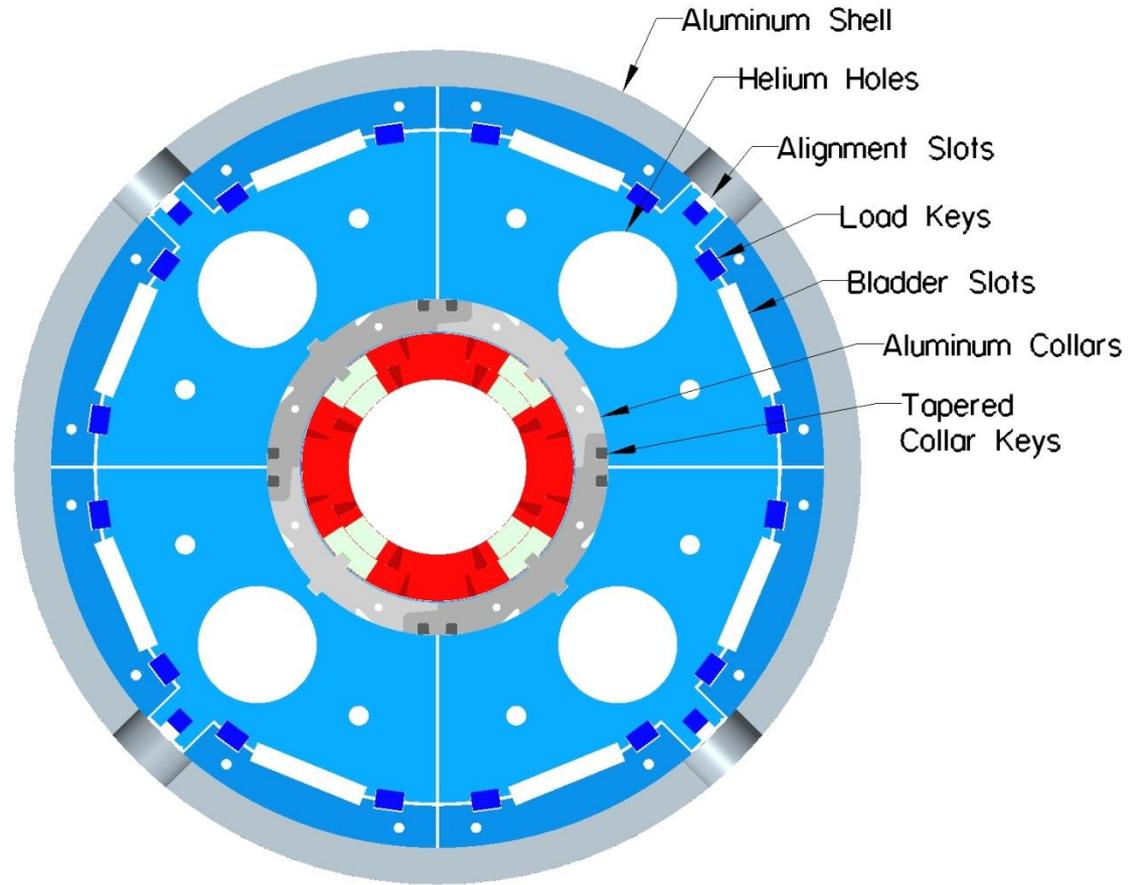
HQ Structure – Mechanical Model

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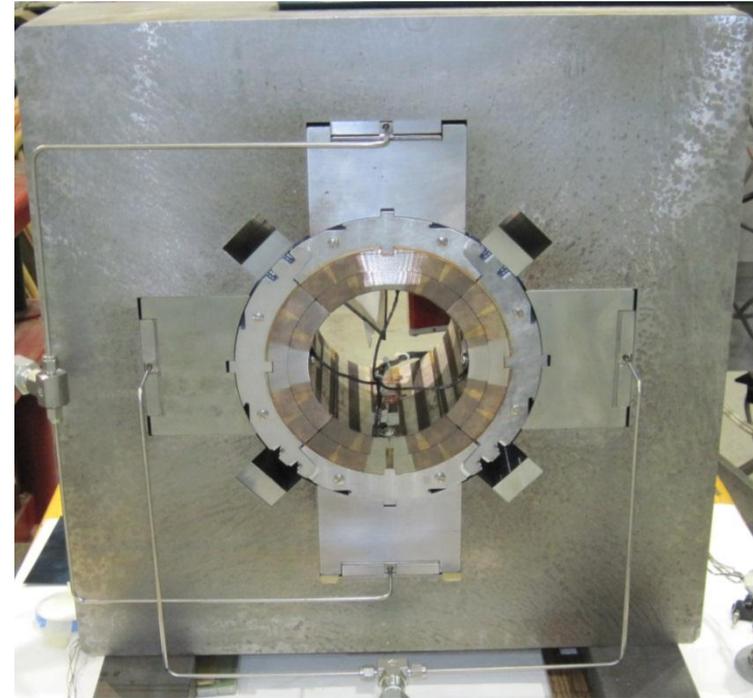
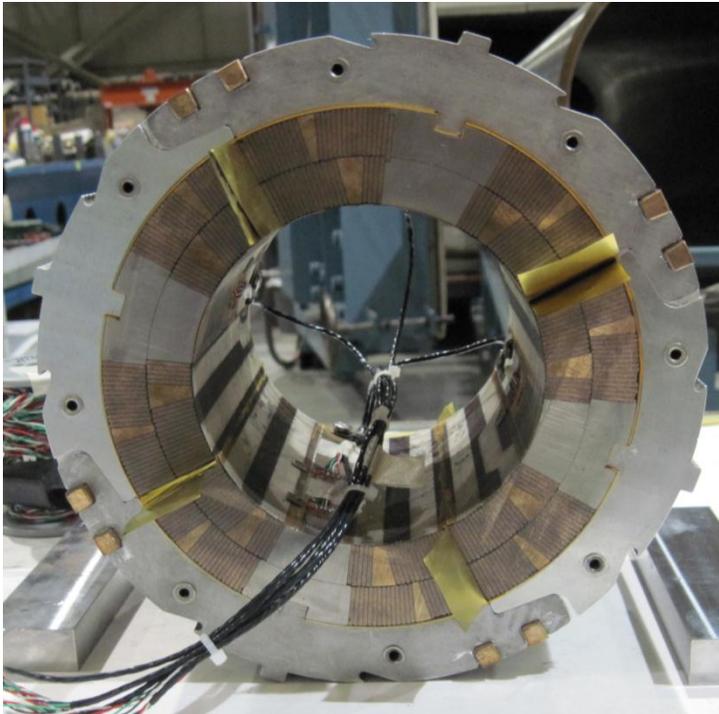
Structure Overview

- 120 mm HQ Structure.
- Keyed aluminum collars, low initial pre-stress at collaring.
- Mechanical stops to prevent over compression, lock coil position at initial collaring.
- “Bladder and Key” assembly in aluminum shell.
- Direct transfer of alignment - coil to collar to yoke to external fiducial.
- 4 part quadrupole yoke.
- Load keys independent from alignment keys.
- Provisions for 1.9k cooling (80 mm holes).
- Fixtures used to maintain alignment during collaring and yoke assembly.



6" Model - Collaring

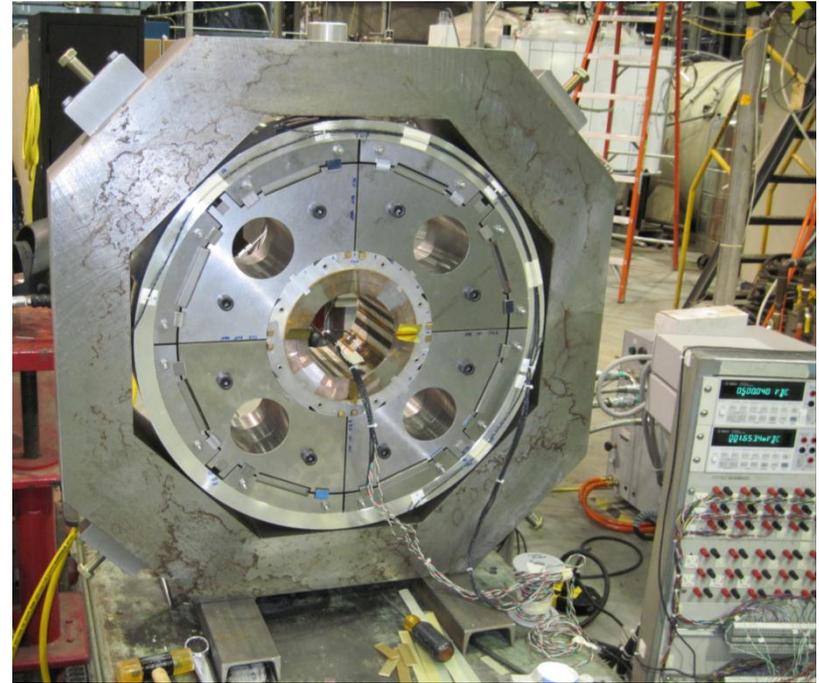
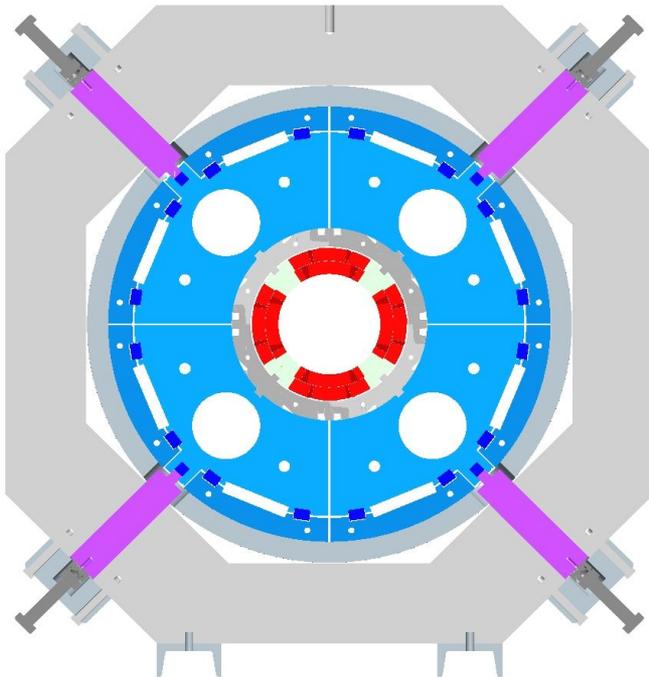
- Fixture to maintain coil alignment during collaring.
 - 4 way symmetric loading.
 - Pushers guided in precision slots.
 - Bladders to apply load for key insertion.



- Cut sections from scrap coil HQ02.
- Strain gauges on pole of each section.
 - Azimuthal & Longitudinal Gauge sets.
- Coil stress 1100 psi (7 Mpa) after collaring.
- Bladder pressure 2000 psi (14 Mpa).

6" Model – Yoke / Shell Assembly

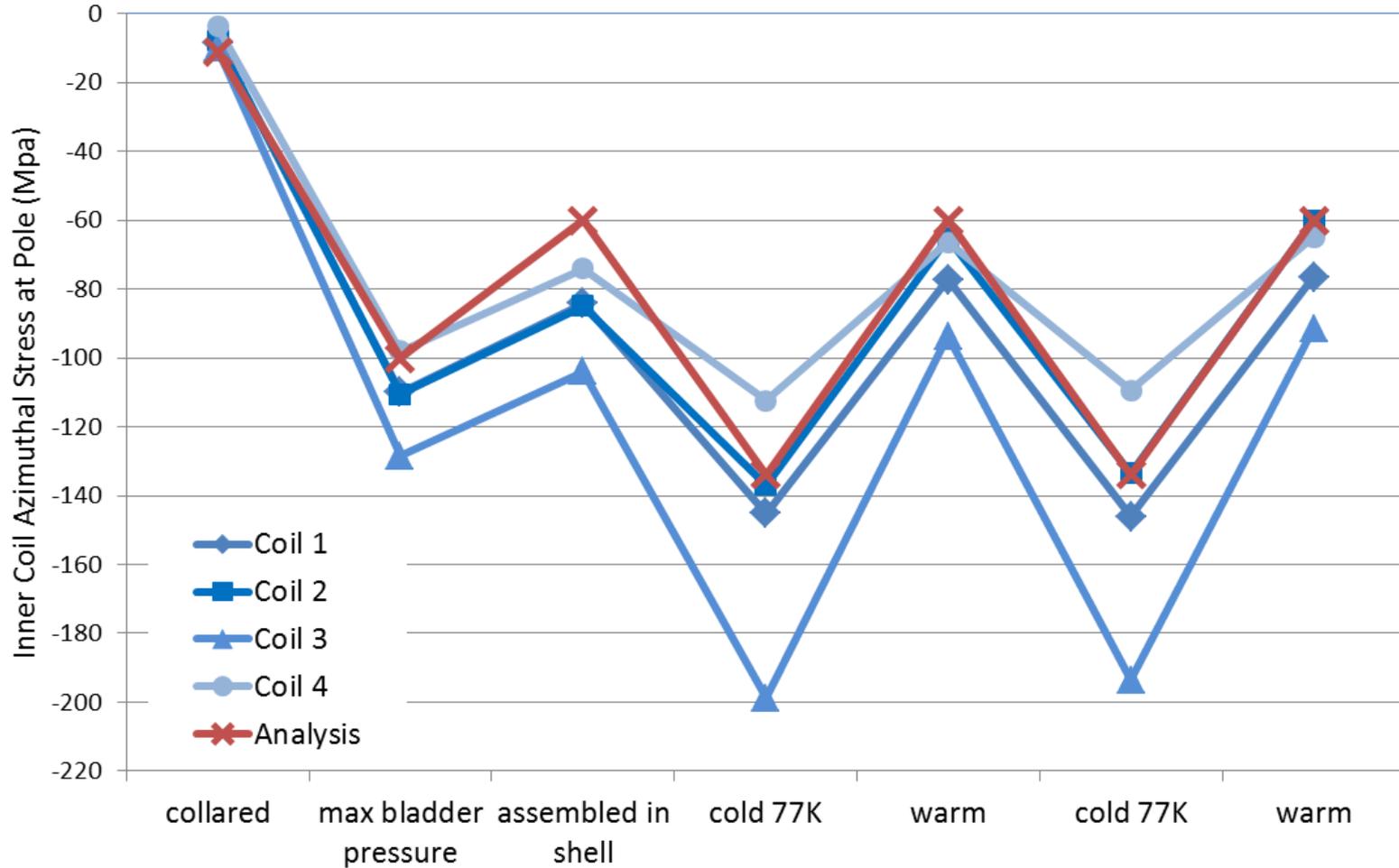
- Fixture to maintain coil alignment during yoke assembly / loading.
 - Large frame with precision pins to locate yoke.
 - Pins pass thru hole in shell, engage keyways in yoke, align yoke firmly against collars during loading.
- Bladders to load yoke /shell for load key insertion.
- Symmetric loading – all bladders loaded at once.



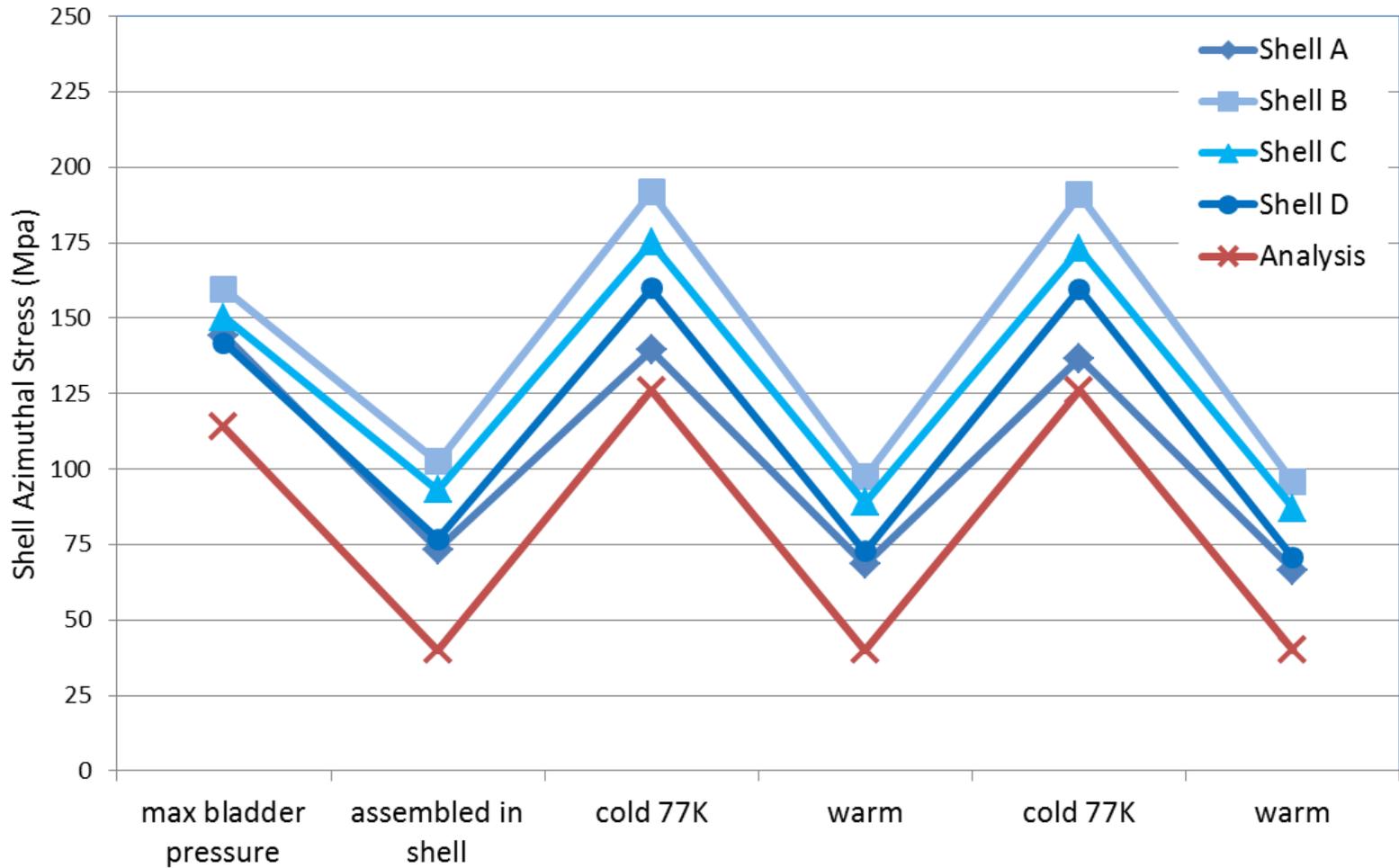
- Strain gauges on aluminum shell.
 - Azimuthal & Longitudinal Gauge sets.
 - 4 locations, max stress area according to analysis.
- Bladder pressure 5500 psi (38 Mpa).
- Identical load keys installed at all 16 locations.
- Yoke / Shell assembly cooled to 77K in a bath of liquid Nitrogen.



6" Model – Coil Stress



6" Model – Shell Stress





6" Model - Conclusion

- Model successfully demonstrates a design that includes:
 - Low pre-stress aluminum collars to lock in coil alignment.
 - Minimum number of parts to directly transfer alignment from coil through to helium vessel.
 - Aluminum shell to provide increase in coil stress at cool-down.
 - Bladder and key assembly for easy adjustment of load or exchange of coils.
 - Provisions for 1.9k helium heat exchanger cooling.

- Possible future work:
 - Design and fabrication of 1m long magnet.
 - Design and fabrication of short 150 mm aperture model.