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Albuquerque, NM, USA

ATF2 SC FD Quad Discussions and Cryo System

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Outline:

- Review the status of ATF2 design & production.
- Present thoughts for discussion re. cryo system.

The Intent and Focus for this Presentation.

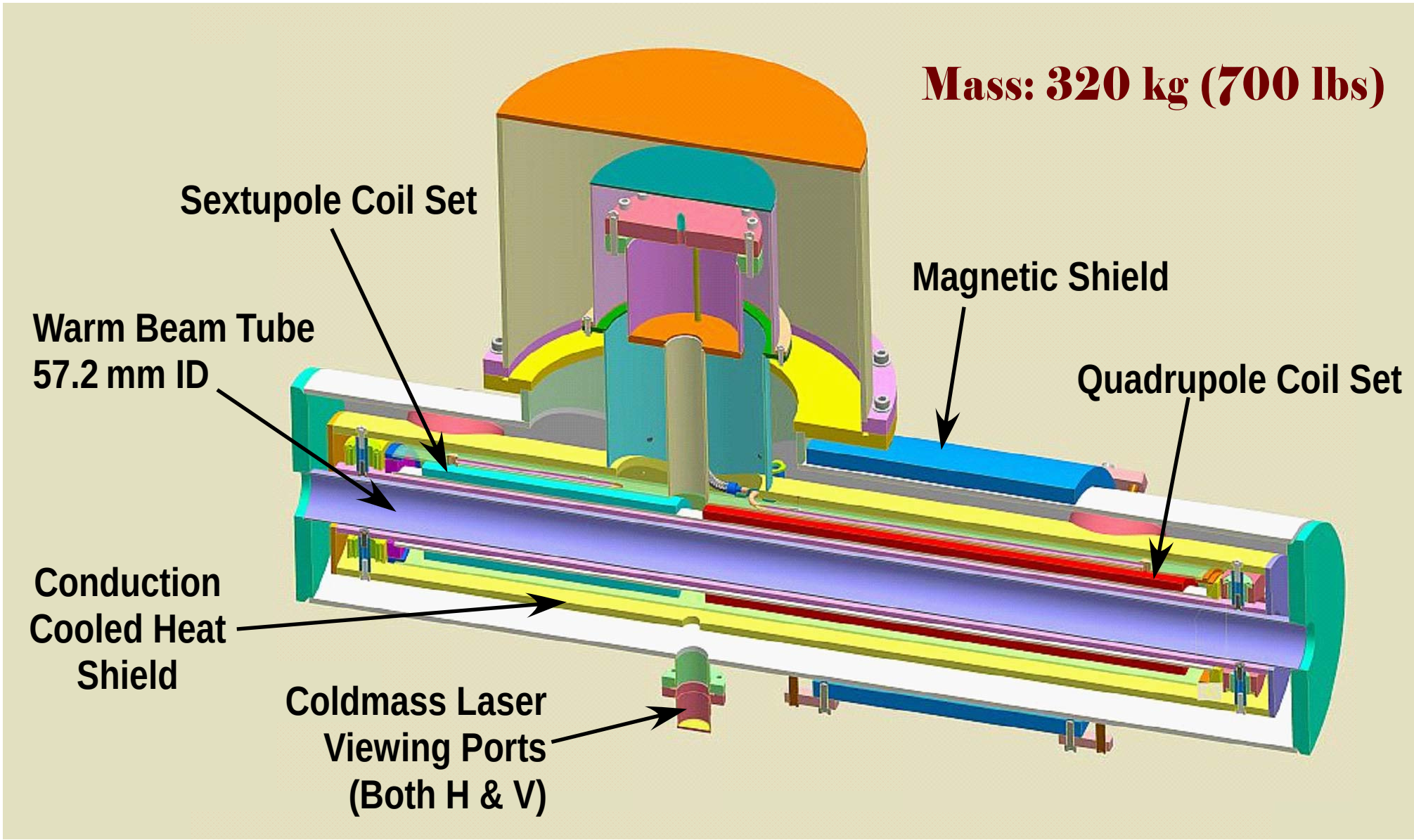
There are many topics that need to be discussed before the next, December 2009, ATF2 Technical Board Meeting, but during my time today I shall concentrate on a few physical interface and cryogenic design issues. I hope that in follow on discussions we can develop roles and responsibilities for tackling the future work that is needed.

Before I start I want to address a point that I feel is sometimes a source of confusion. The ATF2 superconducting magnet work is intended to be complimentary to our ongoing full length QD0 R&D prototype program in that with ATF2 we learn about real world accelerator operational issues at a scaled FF optics system; with the QD0 R&D prototype we learn about system performance of a full fledged system, with magnet and service cryostats, that would be needed to go inside an ILC detector. The ATF2 magnet cannot (should not) be identical to the R&D prototype but should have features (such as its system of correctors) relevant to accelerator physics.

ATF2 Upgrade Magnet Design Summary.

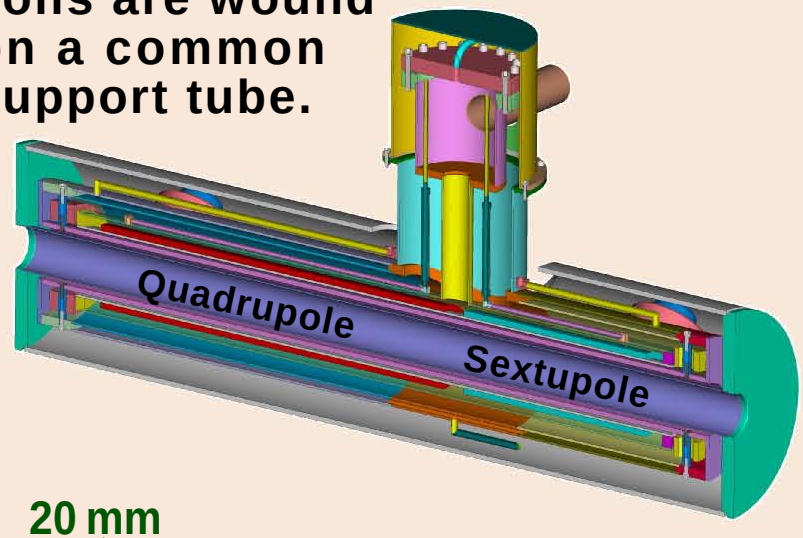
- Designed to operate @ 2K or 4.5K
- Compatible with either service cryostat operation or cryocooler operation.
- Cryocooler and lead assembly not designed.
- But a conceptual design for the interface with the service cryostat does now exist.
- Currently analyzing/optimizing support and heat shield designs.

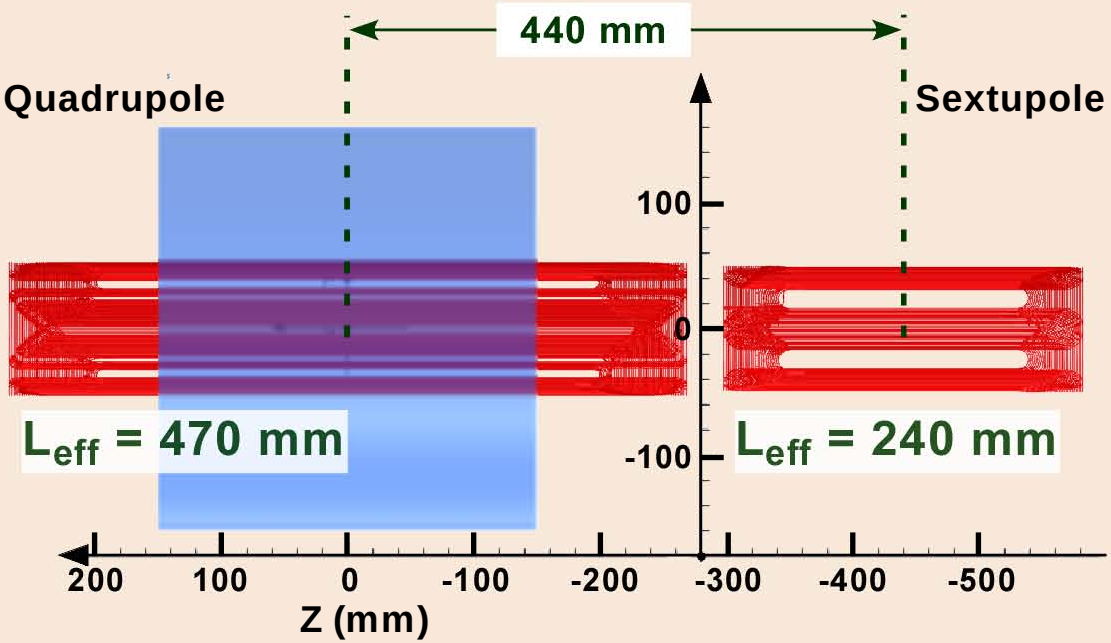
Some ATF2 Upgrade Magnet Design Features.

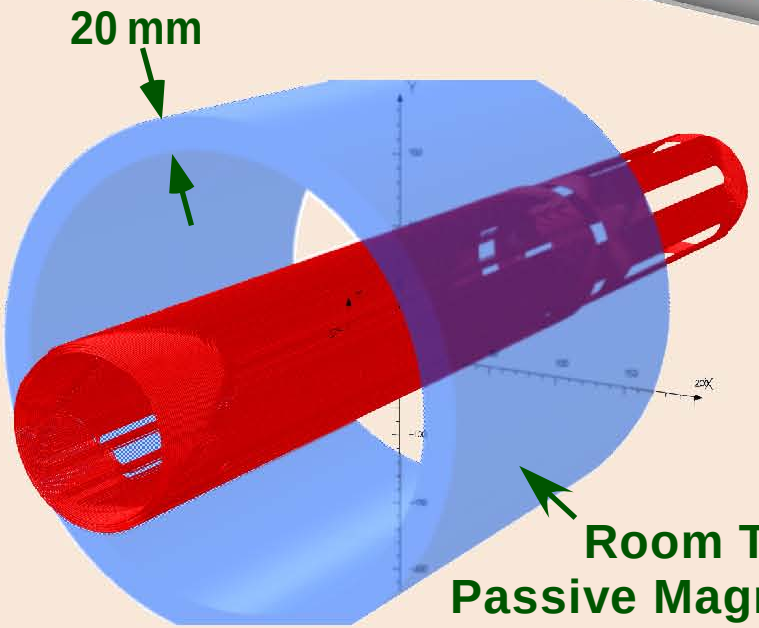


ATF2 Upgrade Superconducting Coil Design.

ATF2 Quadrupole and Sextupole coils are wound on a common support tube.

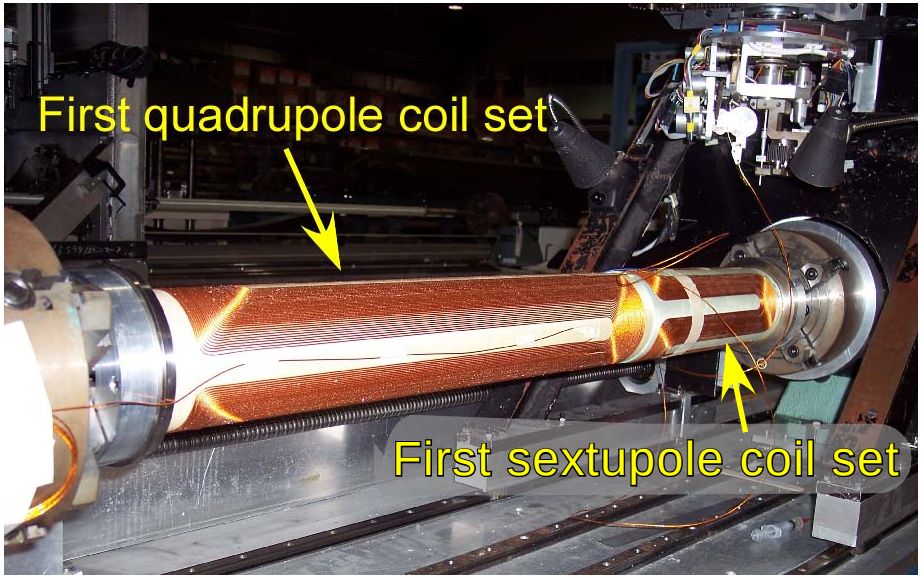


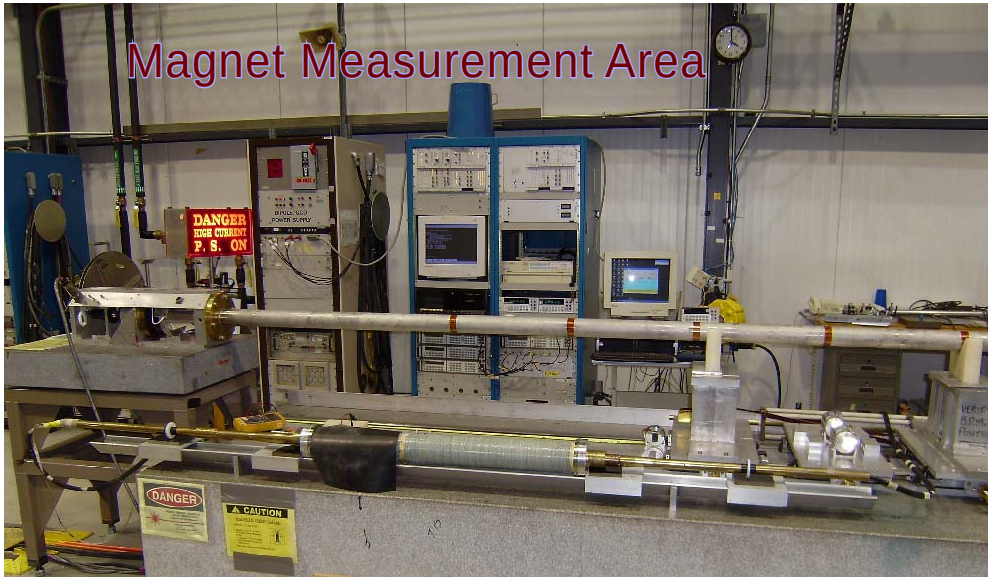


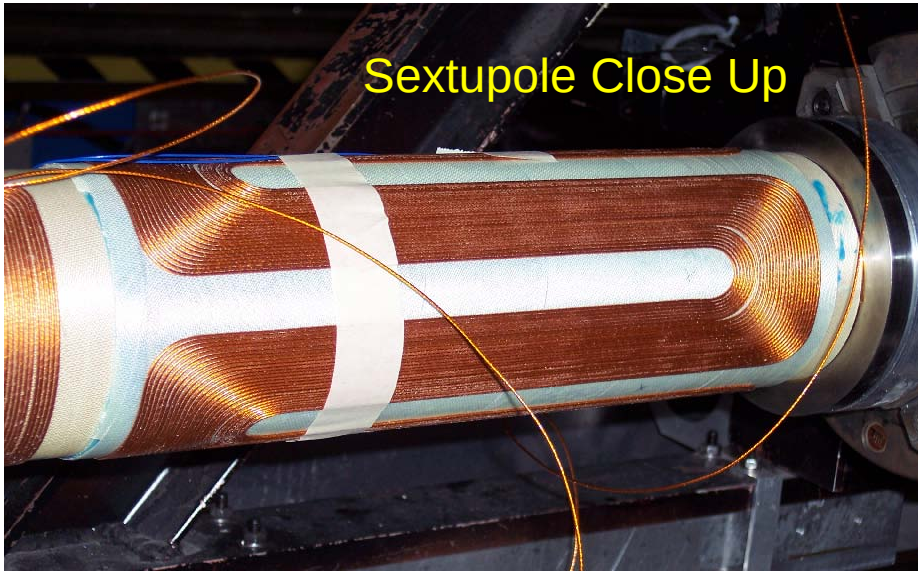


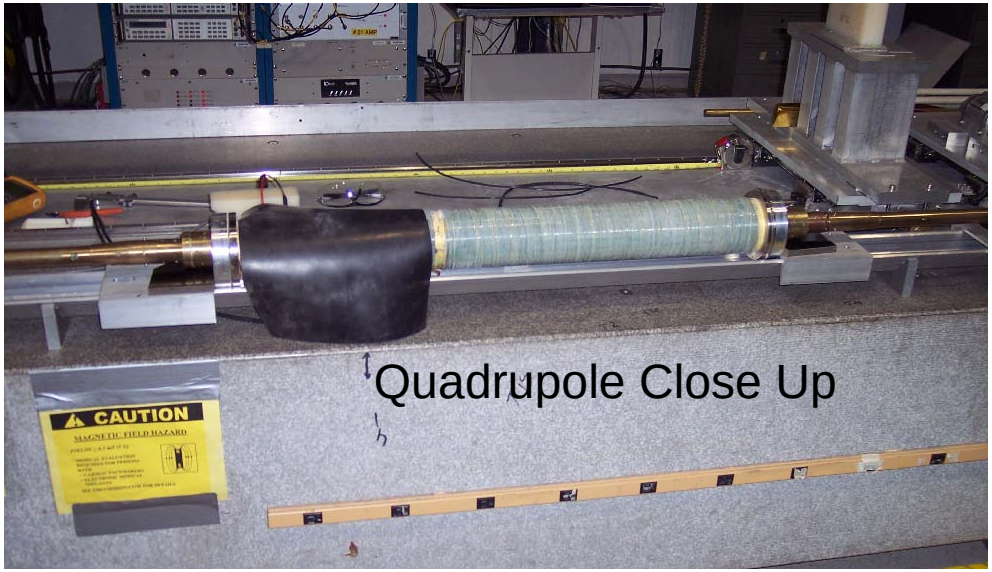
A thin, warm magnetic shell centered on the quadrupole coil, but located outside the cryostat is used to reduces the external fringe field. Note planned ATF2 magnetic lengths & field center separations are as shown above.

Start of ATF2 Coil Production & Measurement.



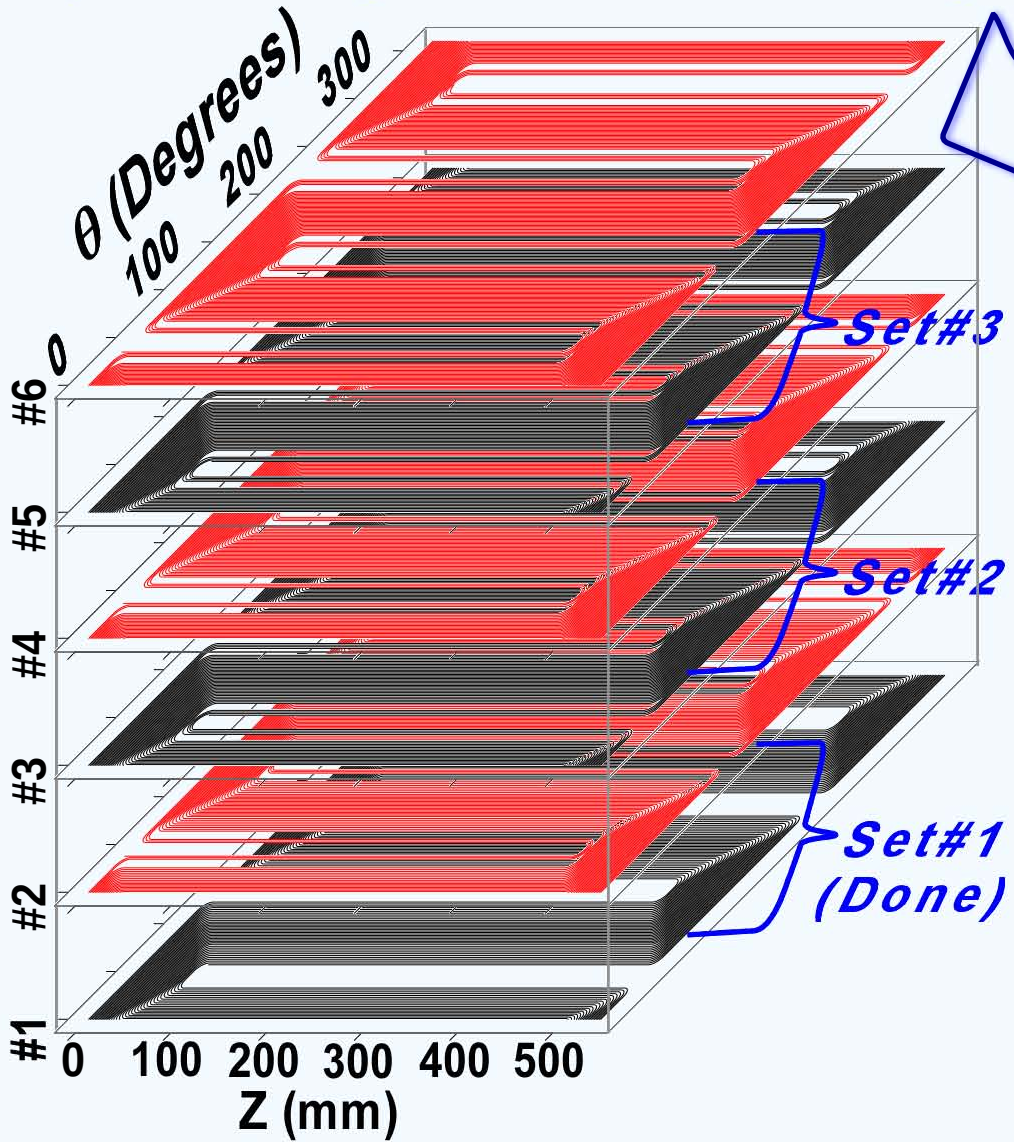






ATF2 Quadrupole Coil Layer Schematic.

Updated Design for ATF2 QD0 Winding



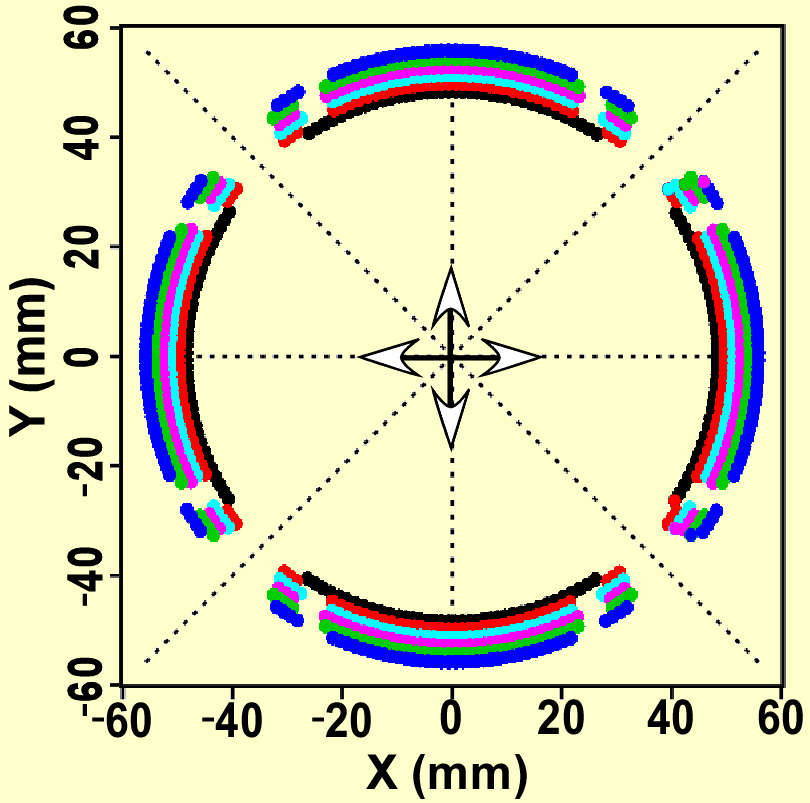
Will keep winding to add two more layers (one coil set) to original coil pattern.

Even though it adds more work (cost) to the ATF2 coil production now in progress, we committed to adding two more cable layers to the quadrupole and sextupole coils in order to bring maximum operating currents to below 300 A.

Wind ~~two~~ three quadrupole coil sets (six layers) with a 536 mm pattern length and ~~one~~ two 284 mm sextupole coil sets.

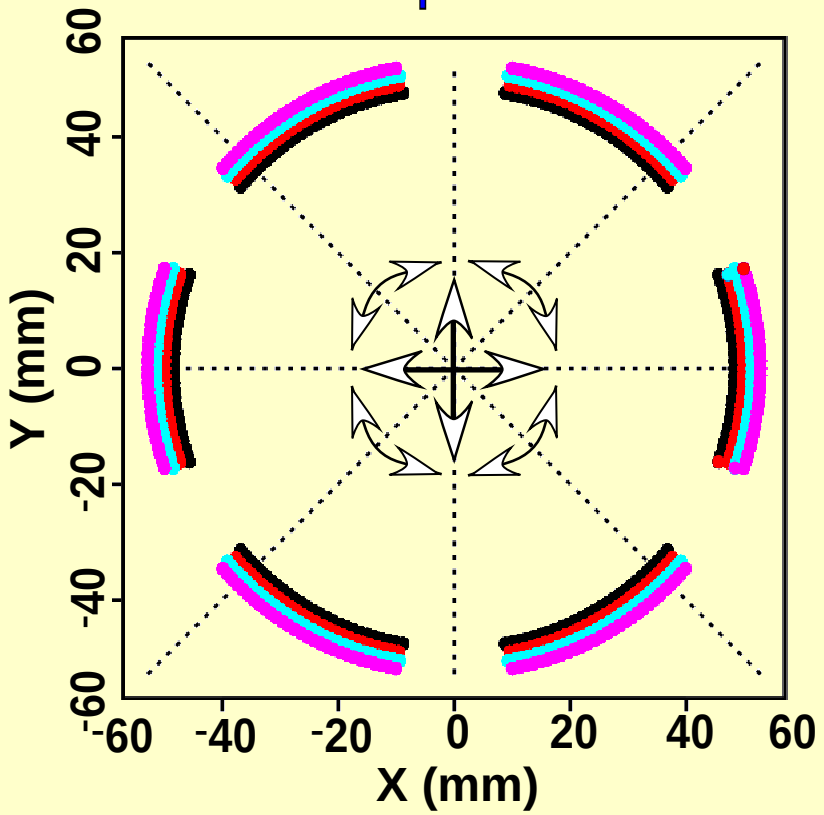
ATF2 Upgrade Magnet Coil Scheme*.

ATF2 Quadrupole Coil Pack



Quadrupole coil pack has normal and skew dipole corrector windings to be able to shift magnetic center.

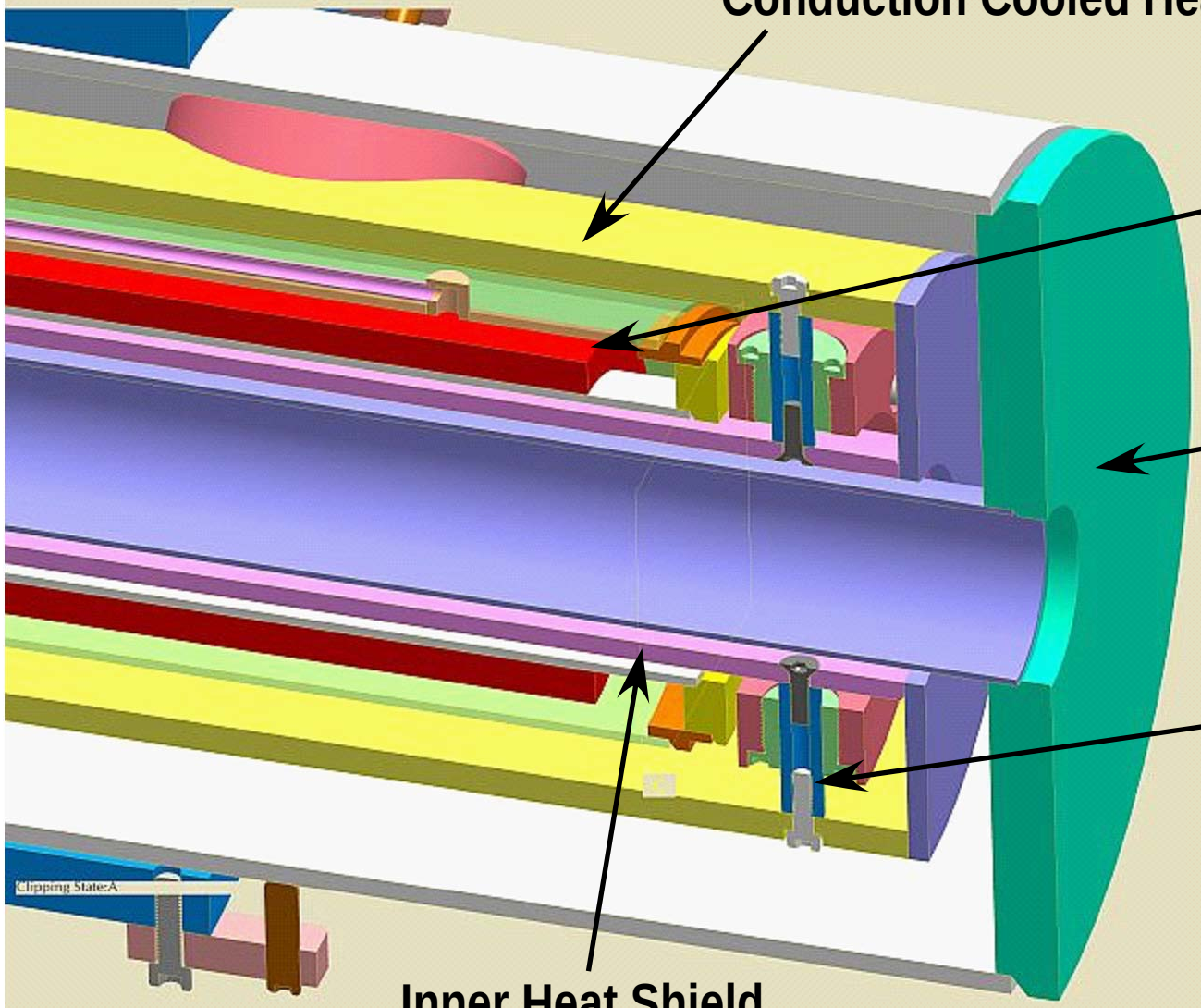
ATF2 Sextupole Coil Pack



Sextupole coil pack has normal and skew quadrupole corrector windings as well as skew sextupole to be able to shift and rotate the magnetic center.

*Has magnetic degrees of freedom similar to ILC QD0.

ATF2 Upgrade Magnet Cryostat Features.



Conduction Cooled Heat Shield (Outer)

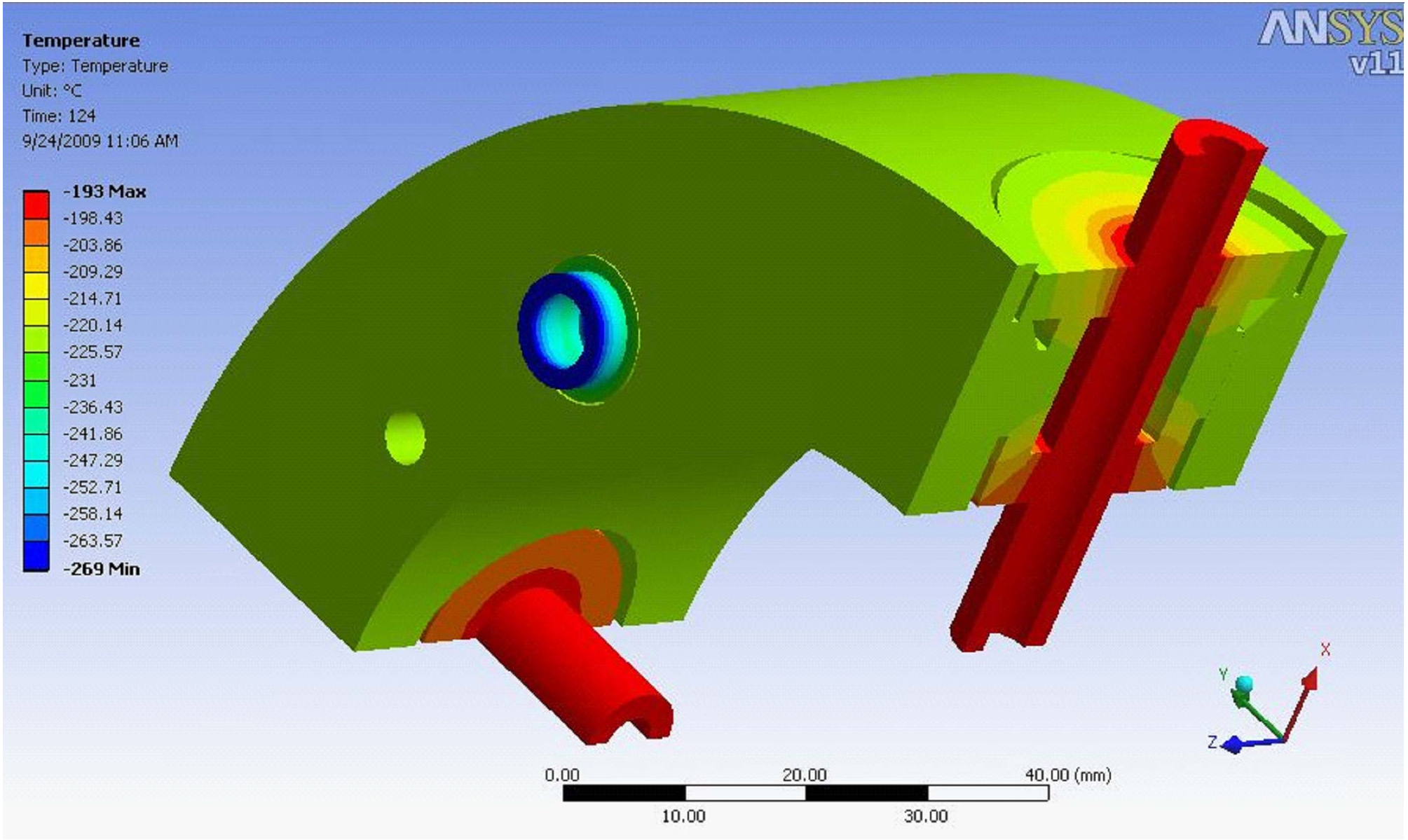
Helium Cooled Coldmass

Proposal needed for the flange/interface to BPMs and the vacuum system.

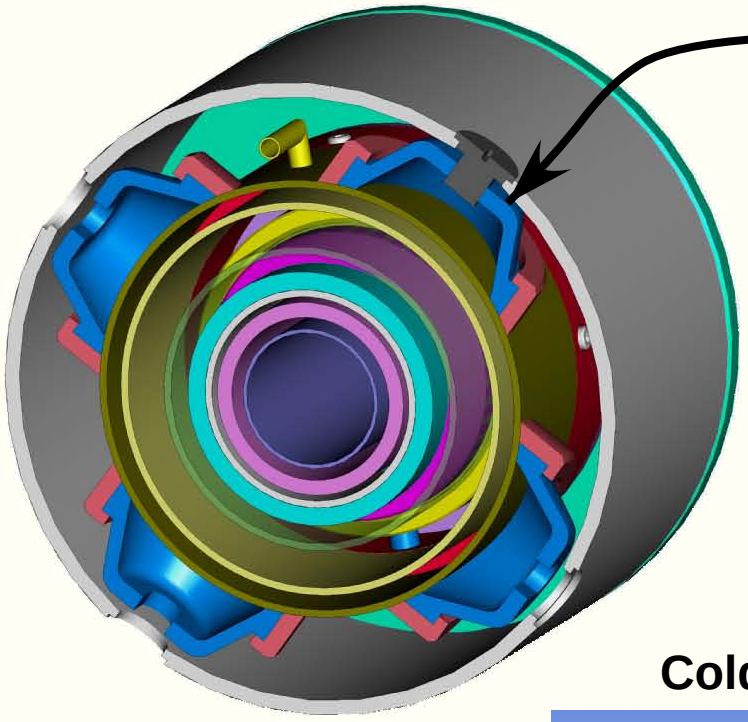
Coldmass to Heat Shield Supports

Inner Heat Shield

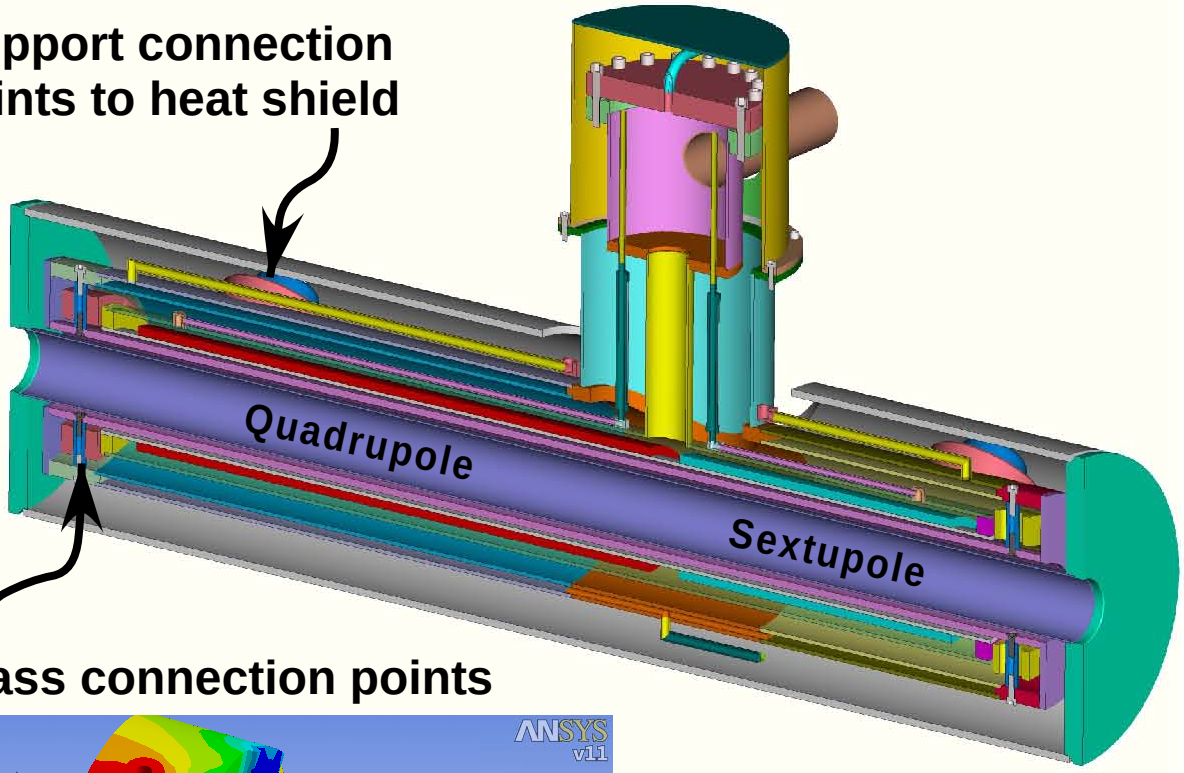
Heat Leak Calculation: From Shield to Coldmass.



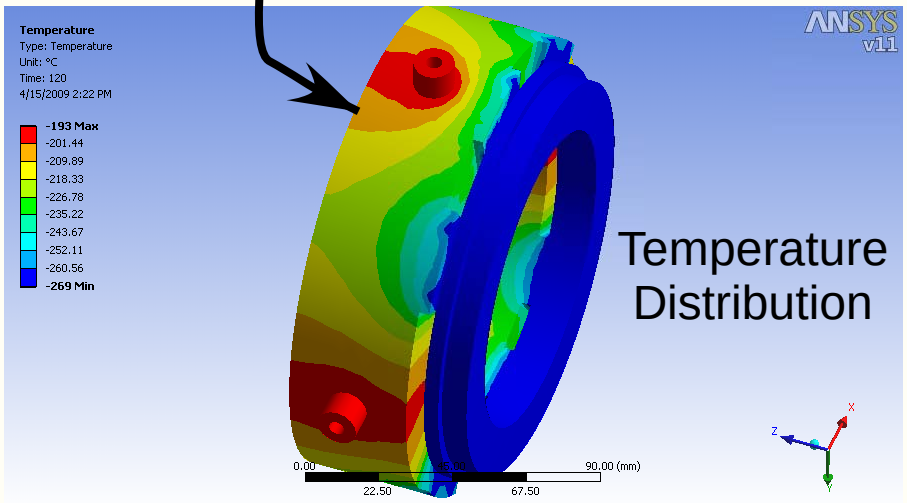
Heat Leak Calculation: From Supports to Shield.



Support connection points to heat shield



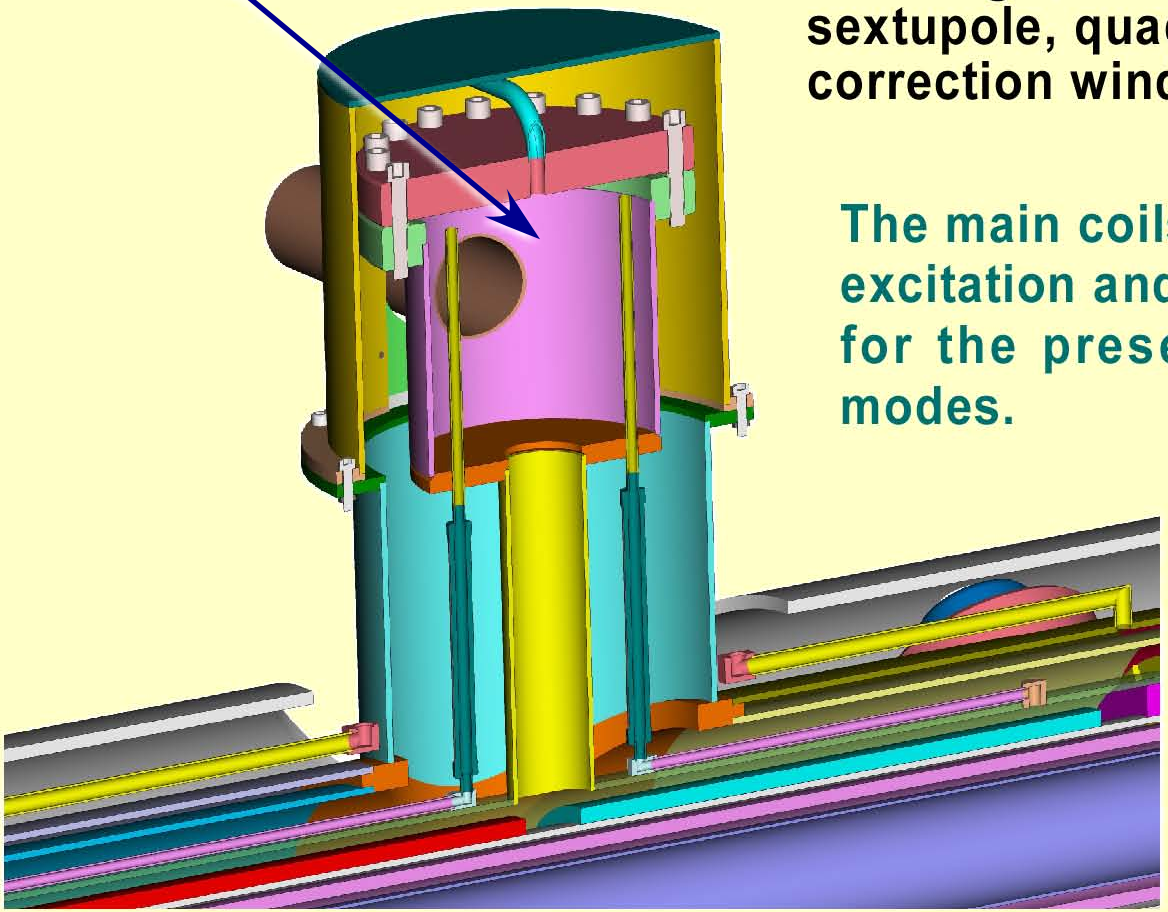
Cold mass connection points



Temperature Distribution

Heat leak to cold mass via the inner support structure is quite low.

ATF2 Upgrade Superconducting Coil Design.



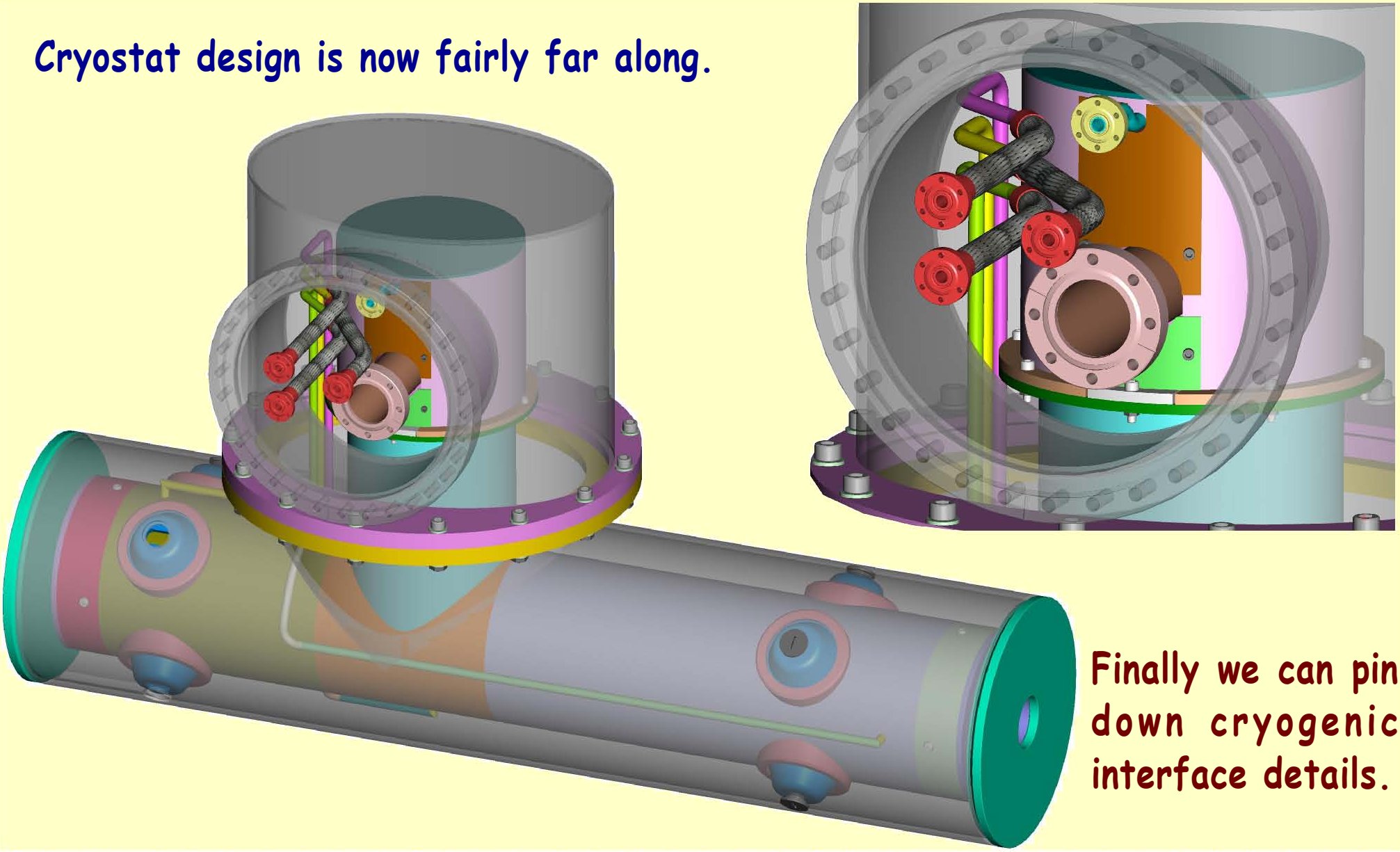
The quadupole coil winding is planned to have both dipole and skew-dipole correction windings; the sextupole coil gets skew-sextupole, quadrupole and skew-quadrupole correction windings.

The main coils could be energized to 300 A excitation and the correction coils to 100 A for the presently anticipated operation modes.

So we need four 300A and ten 100A current leads plus a number of instrumentation leads.

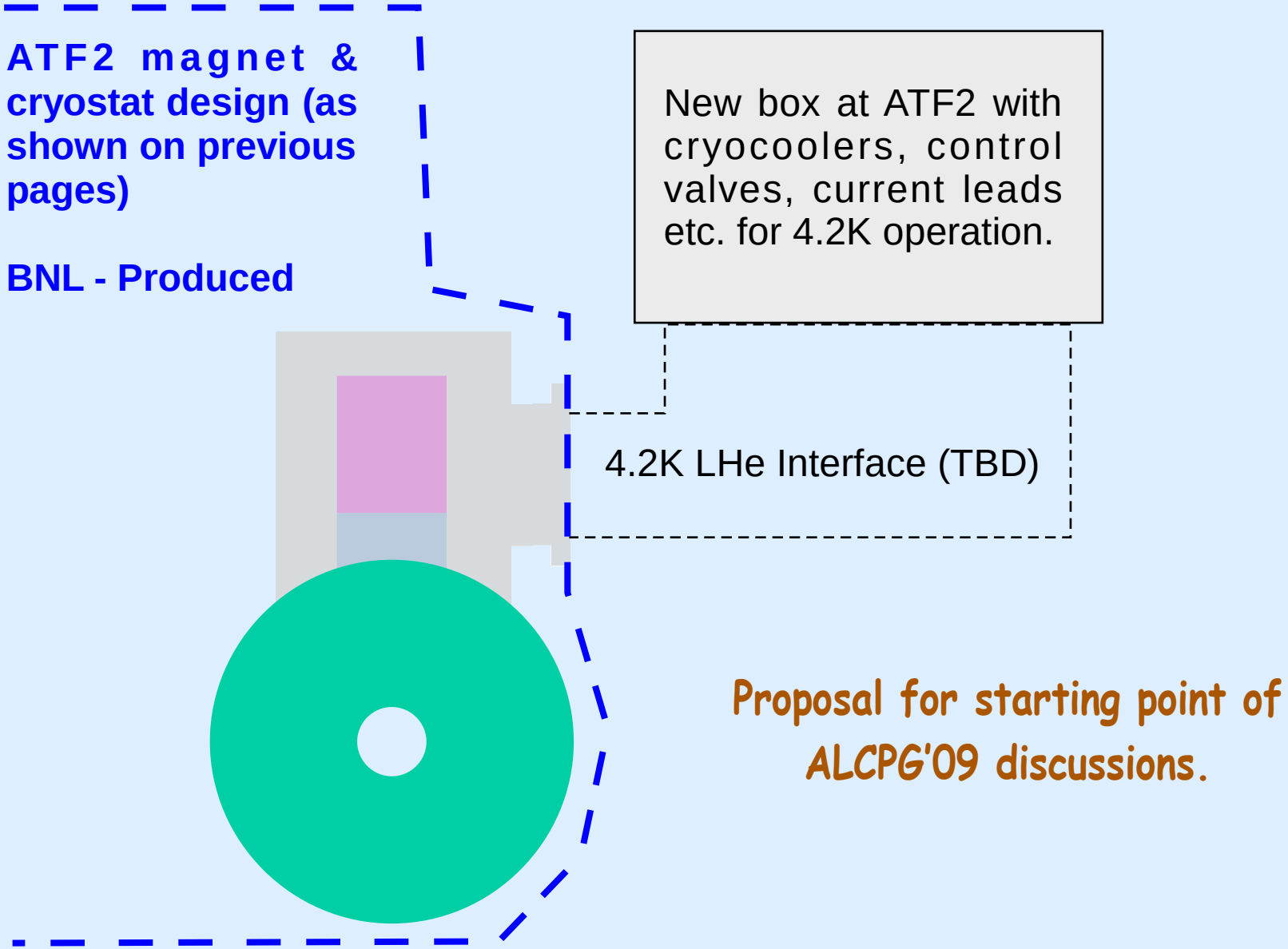
ATF2 Upgrade Cryostat Design Parameters.

Cryostat design is now fairly far along.



Finally we can pin down cryogenic interface details.

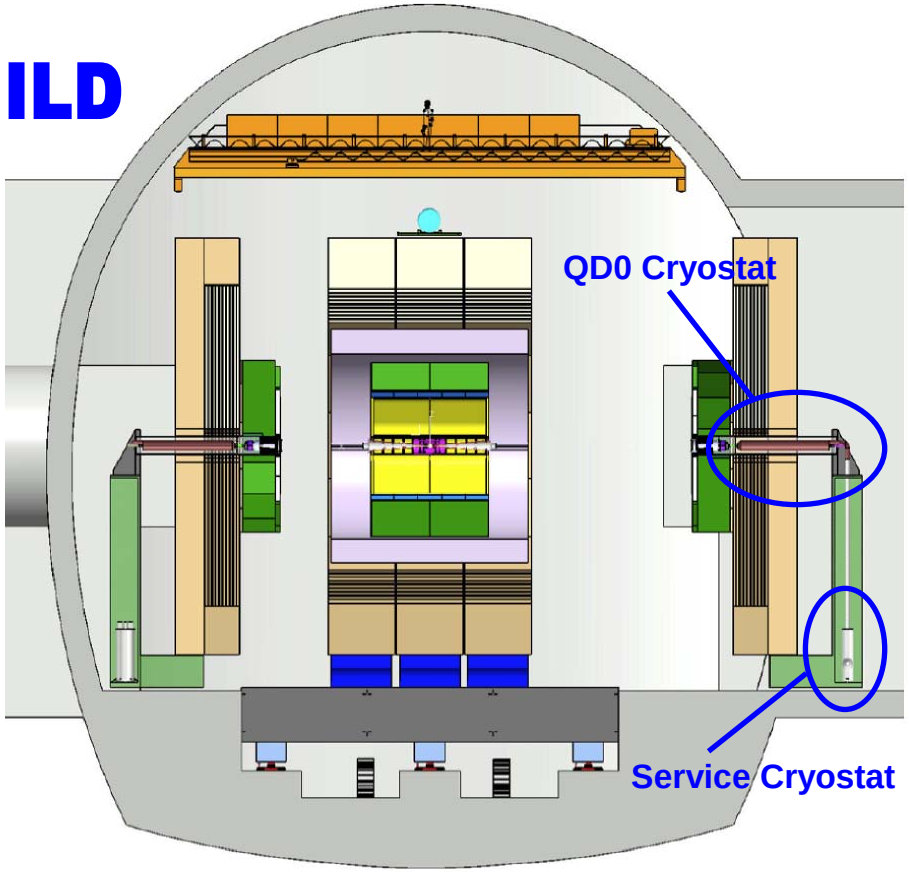
ATF2 Upgrade Cryostat Interface.

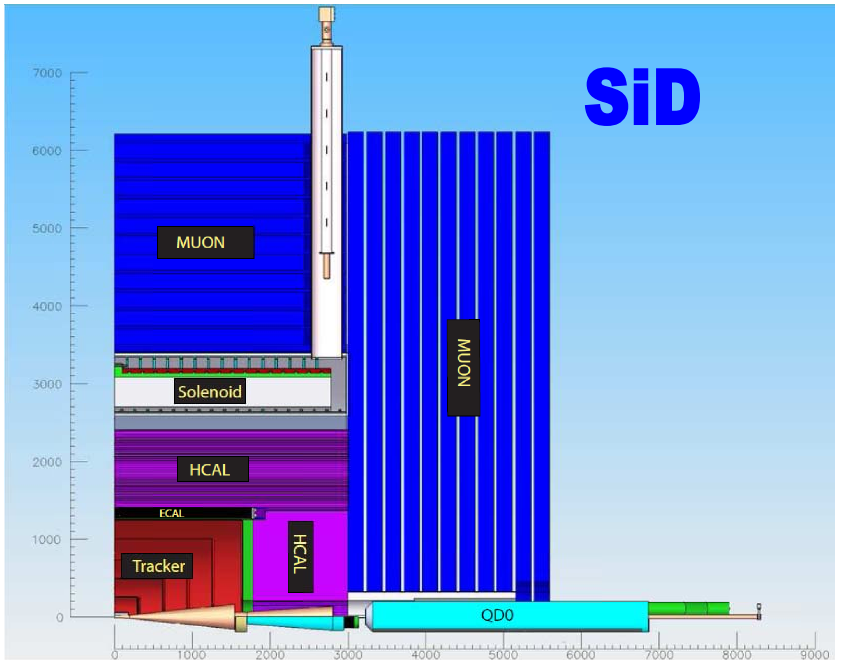


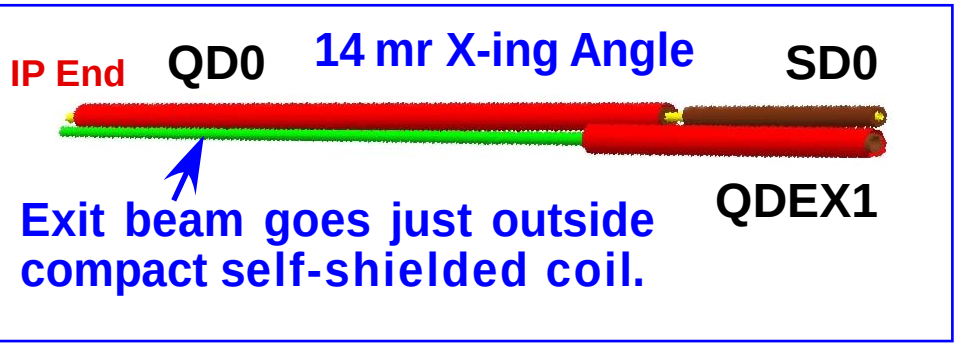
Time for Questions and Discussion.

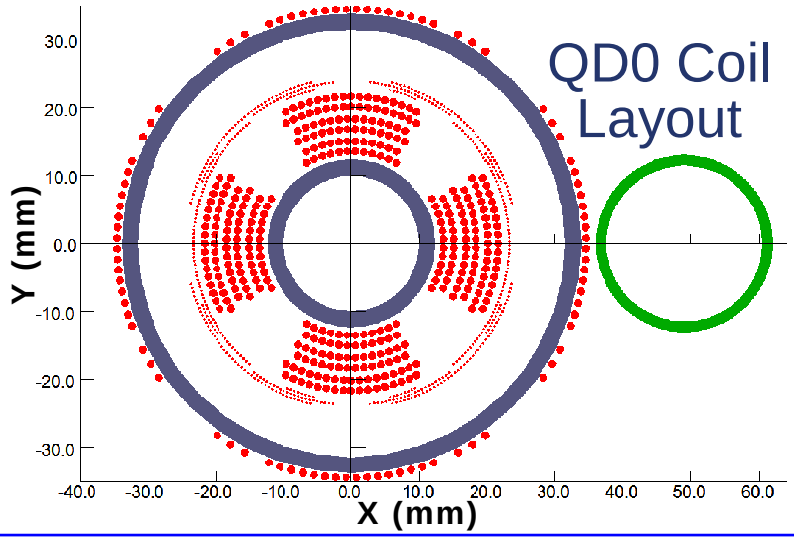
Backup Slides

FF Superconducting Magnets In ILC Detectors.

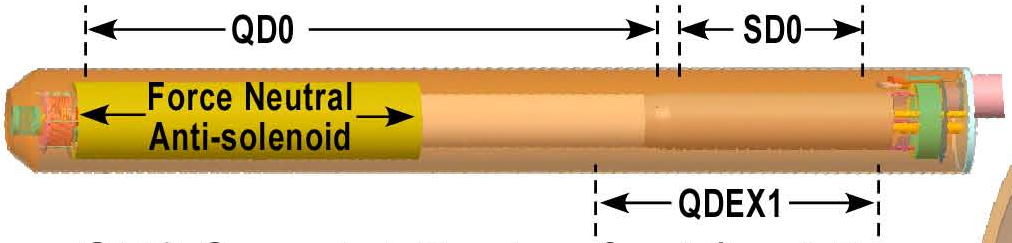




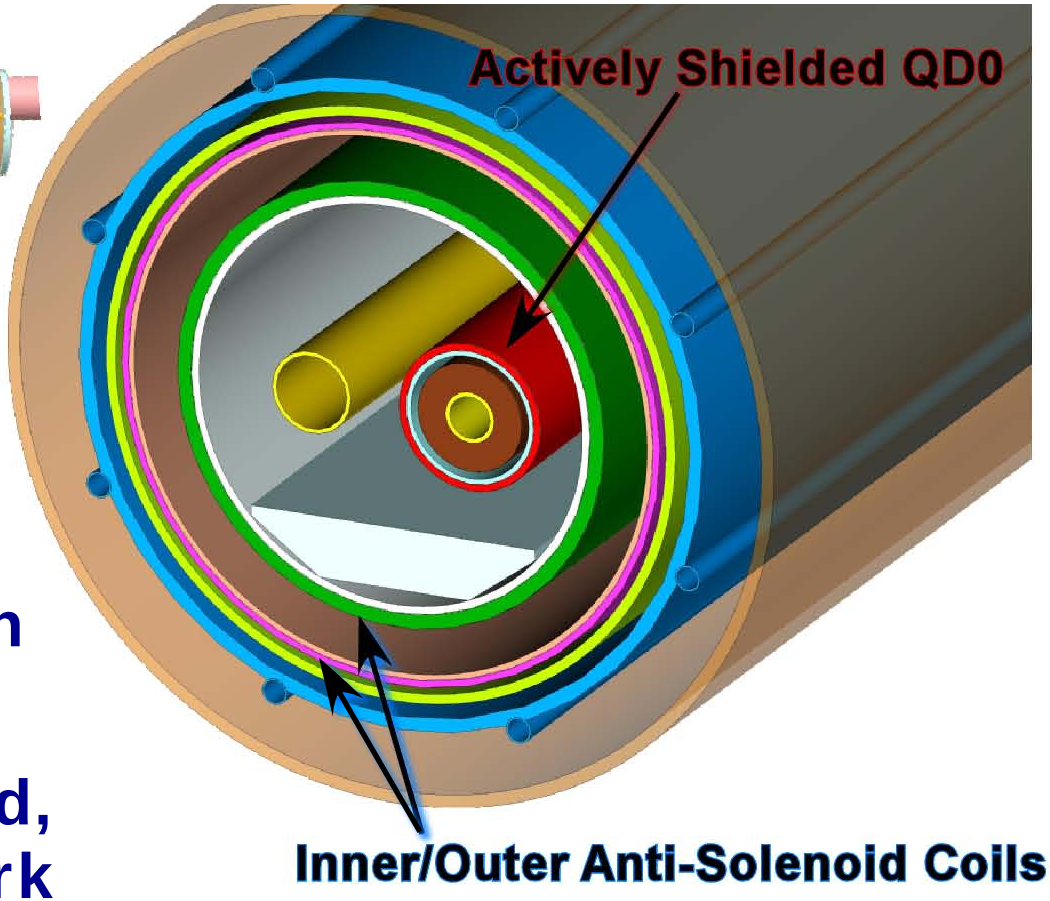




Some ILC FF Magnet Design Challenges.



QD0 Cryostat Design for L* = 4.5 m.

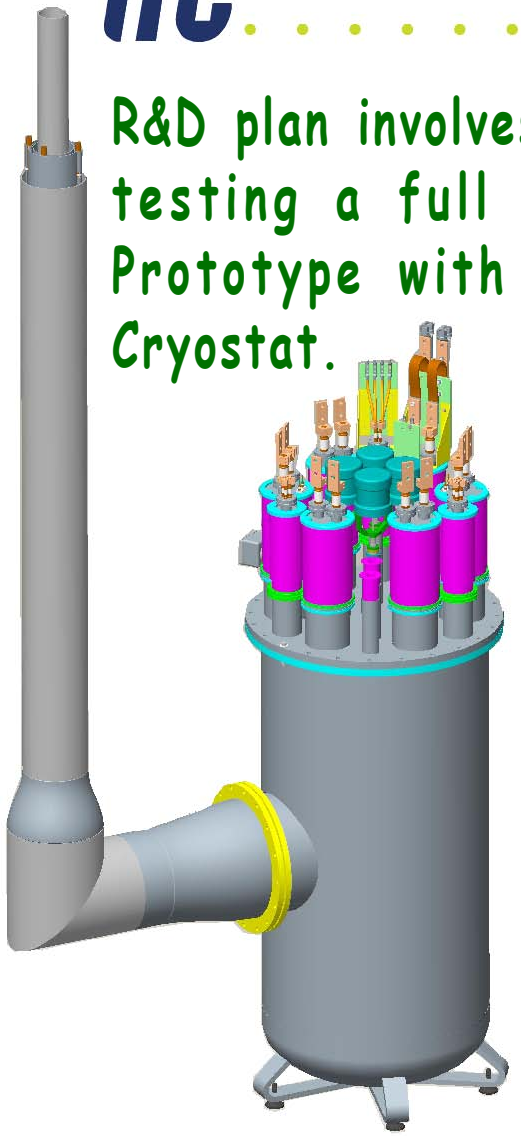


- Space is very tight inside the detector solenoid.
- Magnets must perform in ≈3T background field.
- For the active, beam based, feedback system to work need roughly 50 nm stability.

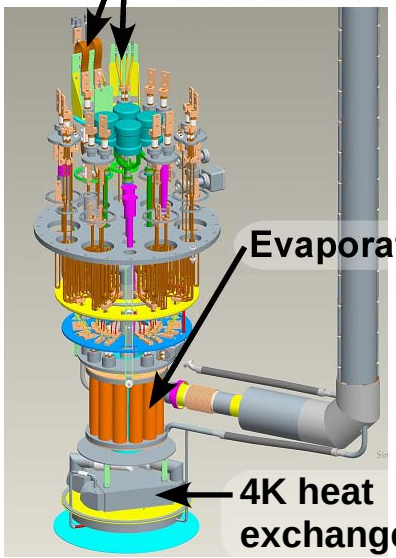
Present design avoids "flowing" helium; concept will be tested with QD0 R&D Prototype.

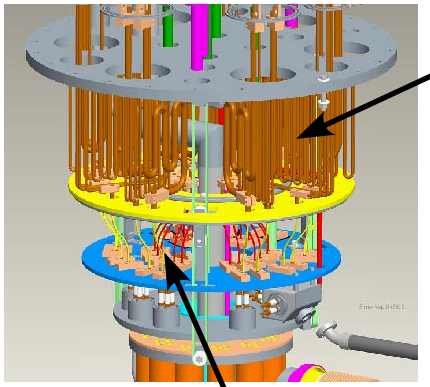
Some ILC FF Component Design Details.

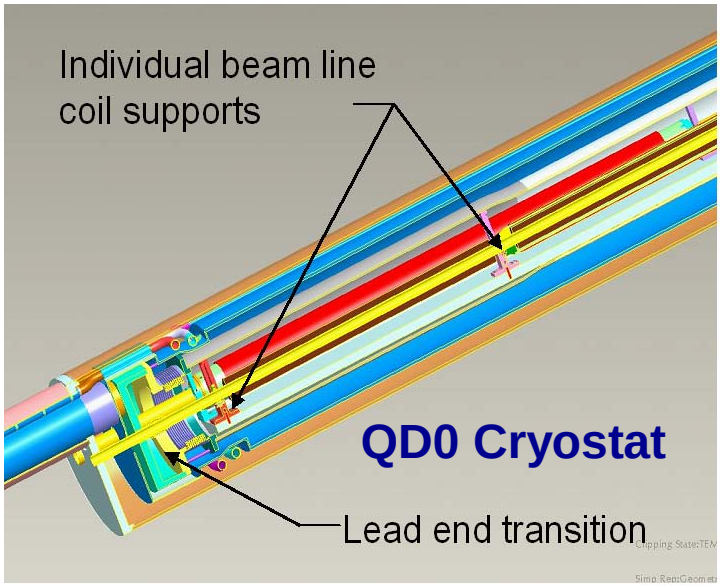
R&D plan involves making and testing a full length QD0 Prototype with its Service Cryostat.

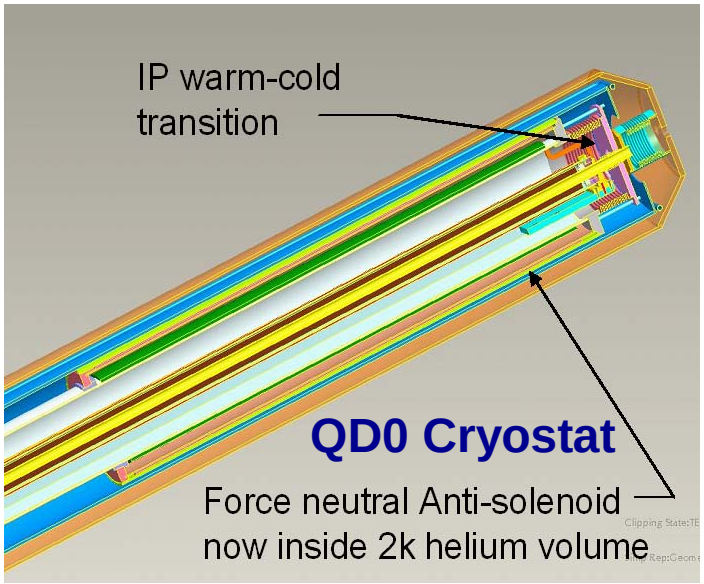


Service Cryostat

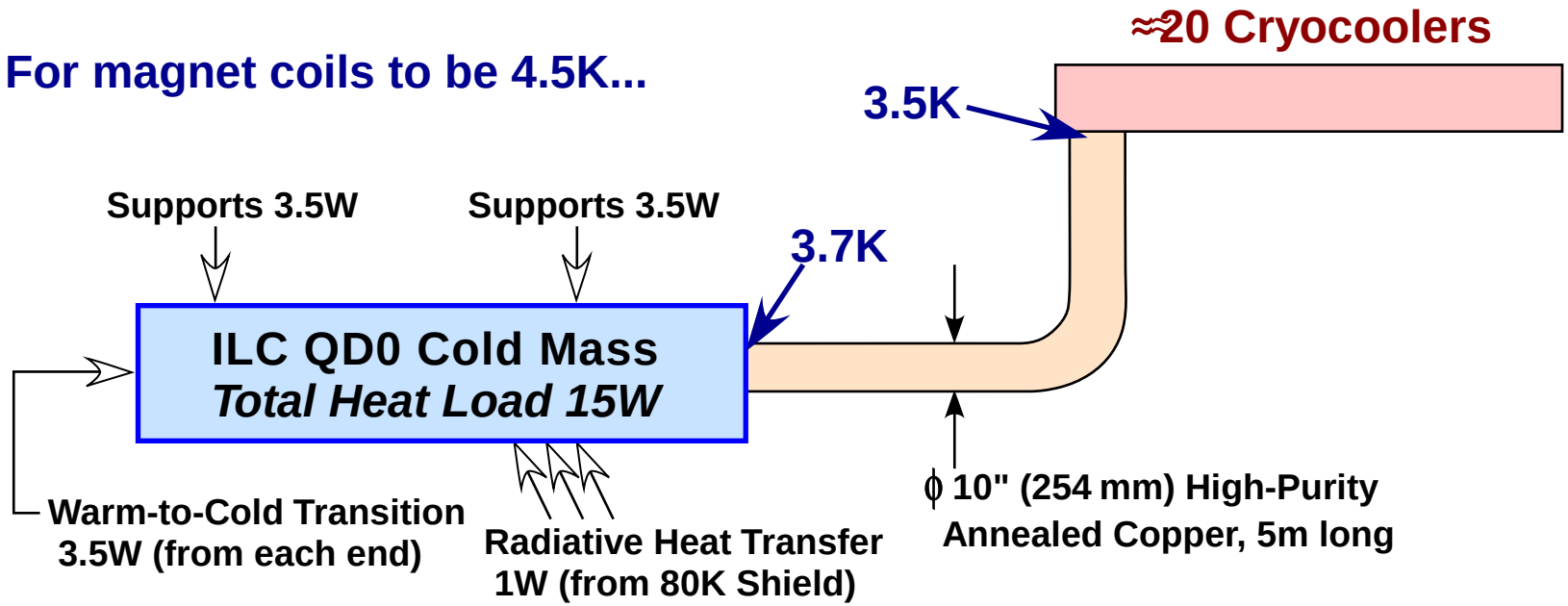








A Conduction Cooled ILC QD0; Not Practical.



Assumptions for this exercise:

1) Entire cold mass can be held to within 0.75K ΔT (cold mass assembly is extremely complicated).
2) Beam heating is not taken into account.
3) There is no safety margin.
4) Individual cryocooler can handle 0.75W @ 3.5K.