

Open Midplane Dipole Mechanical Design and Analysis

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LARP Collaboration Meeting, 4/6/05

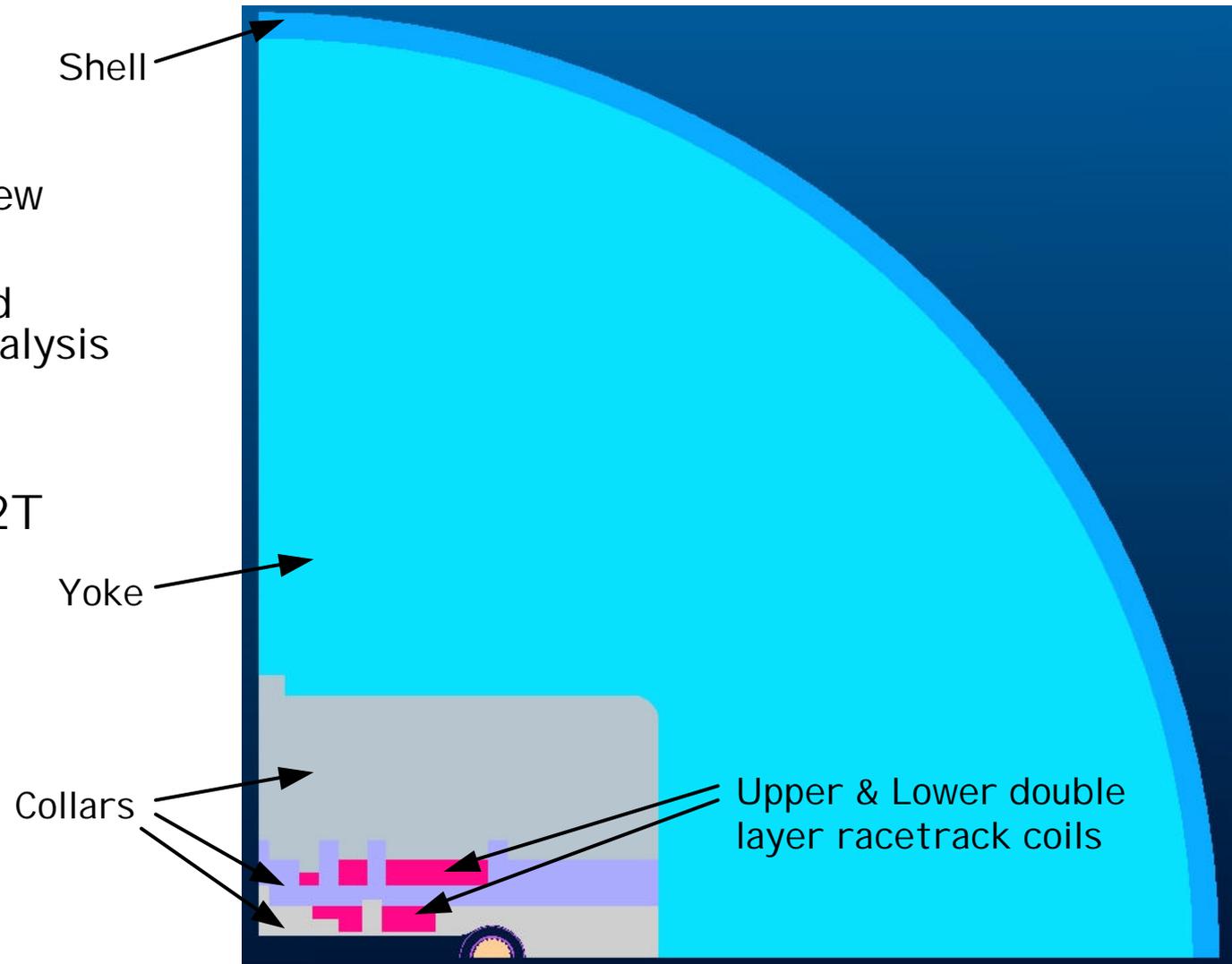
LARP Open Midplane Dipole

- D1 Dipole

- Design overview
- Preliminary 2d mechanical analysis

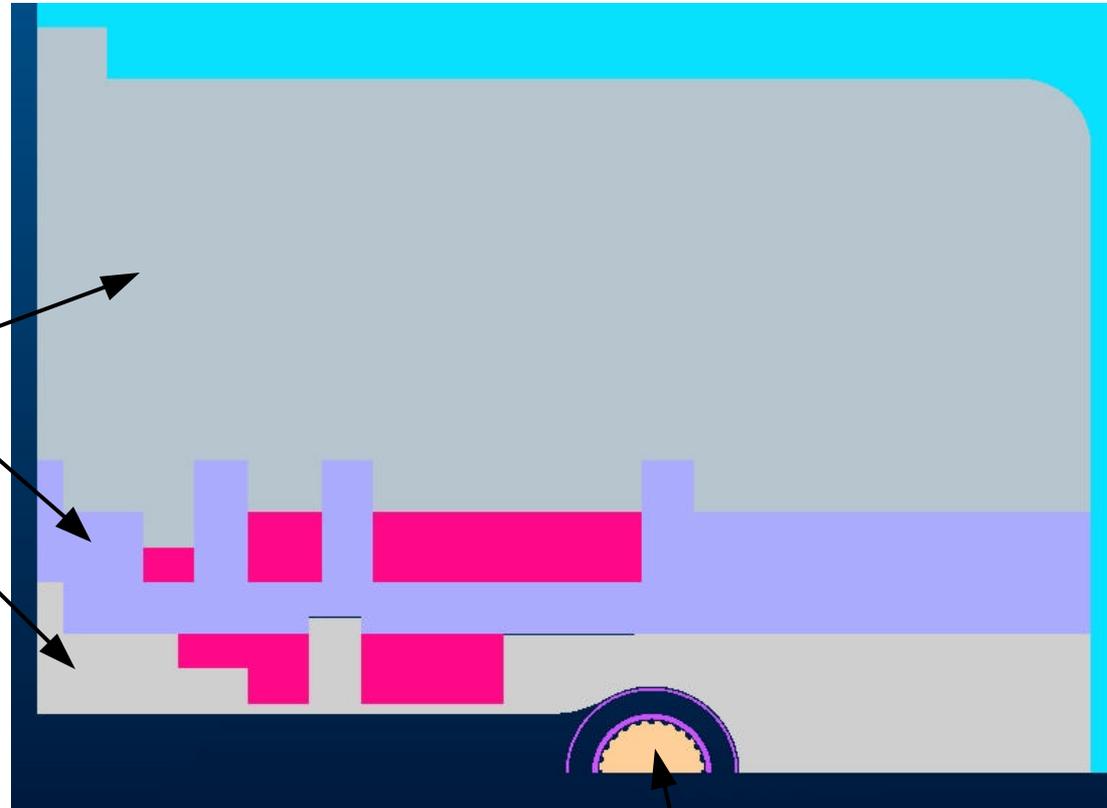
- Reconfigured 12T

- Overview
- Analysis



LARP D1 Dipole – Assembly Overview

- Collars interlock (pinned) and hang from yoke to support coil forces.
- Upper coil supported by stainless steel collar laminations
- Lower coil support is solid stainless steel machined part.
- No separate beam cavity, lower coil support acts as vacuum enclosure.
- Pre-load coils in both X & Y
 - X via shims/wedges
 - Y via hydraulic press



- 34 mm vertical aperture
- 700 mm yoke radius

- Warm 30 mm tungsten absorber at 175 mm

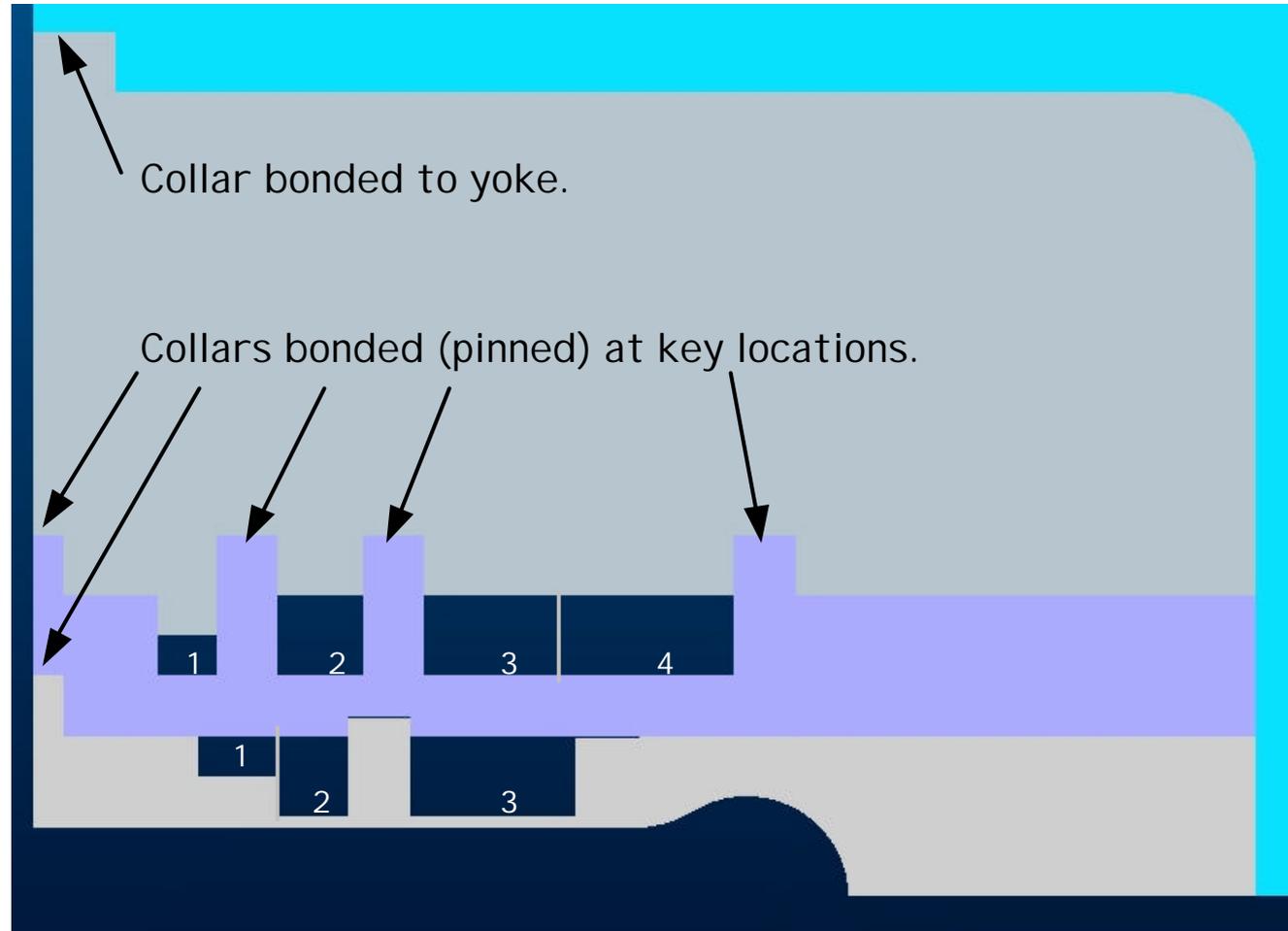
LARP D1 Open Midplane Dipole - Analysis

- Preliminary simplified 2d analysis
 - Forces at 13.5T design operating field
 - Collars, yoke and shell only, no coils
 - Forces applied to walls of coil cavities
- Detailed analysis to continue
 - 2d with pre-loaded coils, thermal, magnetic
 - Complete 3d analysis

D1 Mechanical Analysis – Forces, Constraints

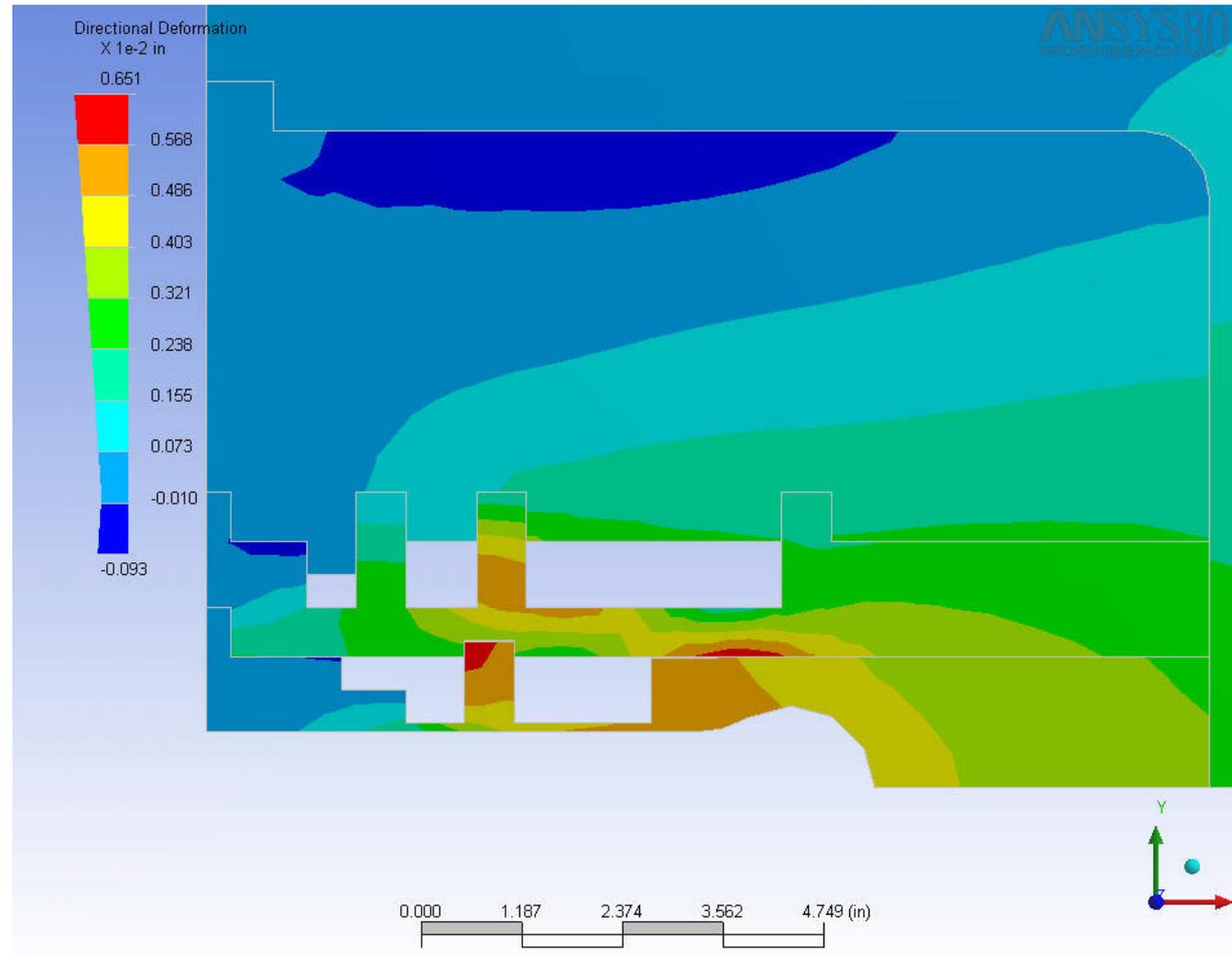
Coil Forces N/mm		
Block	X	Y
Lower Coil		
1	725	-41
2	1800	-36
3	2479	163
Upper Coil		
1	665	-104
2	2162	-855
3	2600	-2257
4	-1021	-2228

- Net vertical force on lower coil is upward.
- Forces applied directly to collars.
- Pre-stressed shell around the yoke.
- Yoke/shell OD free.



D1 Mechanical Analysis – Deflection X

- No pre-load, relative deflection less than .003" on vertical surfaces
- Preload to be applied in horizontal direction via shim/wedges installed in each coil block.



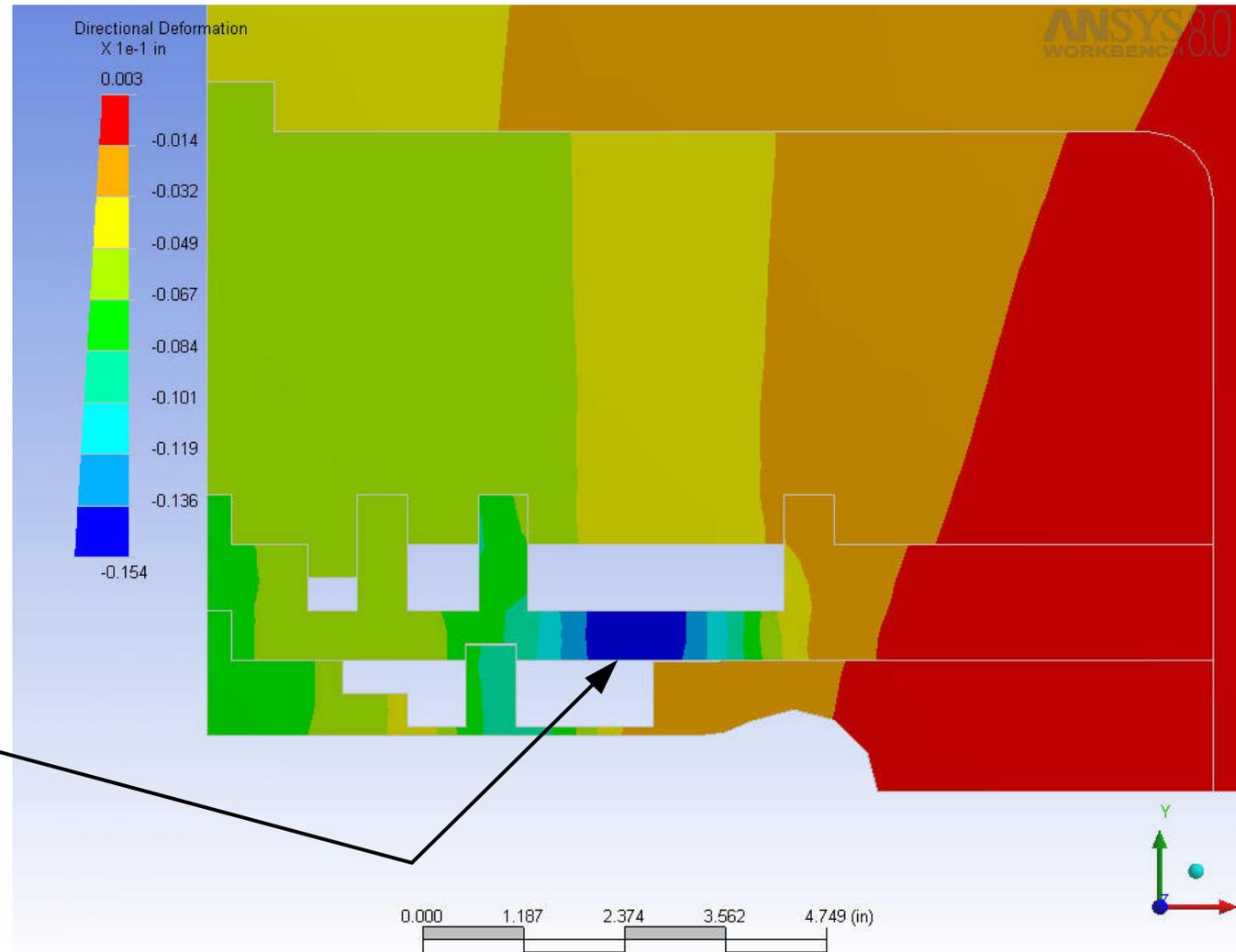
D1 Mechanical Analysis – Deflection Y

ANSYS 80
WORKBENCH

- No pre-load, .012" deflection of large upper coil block.

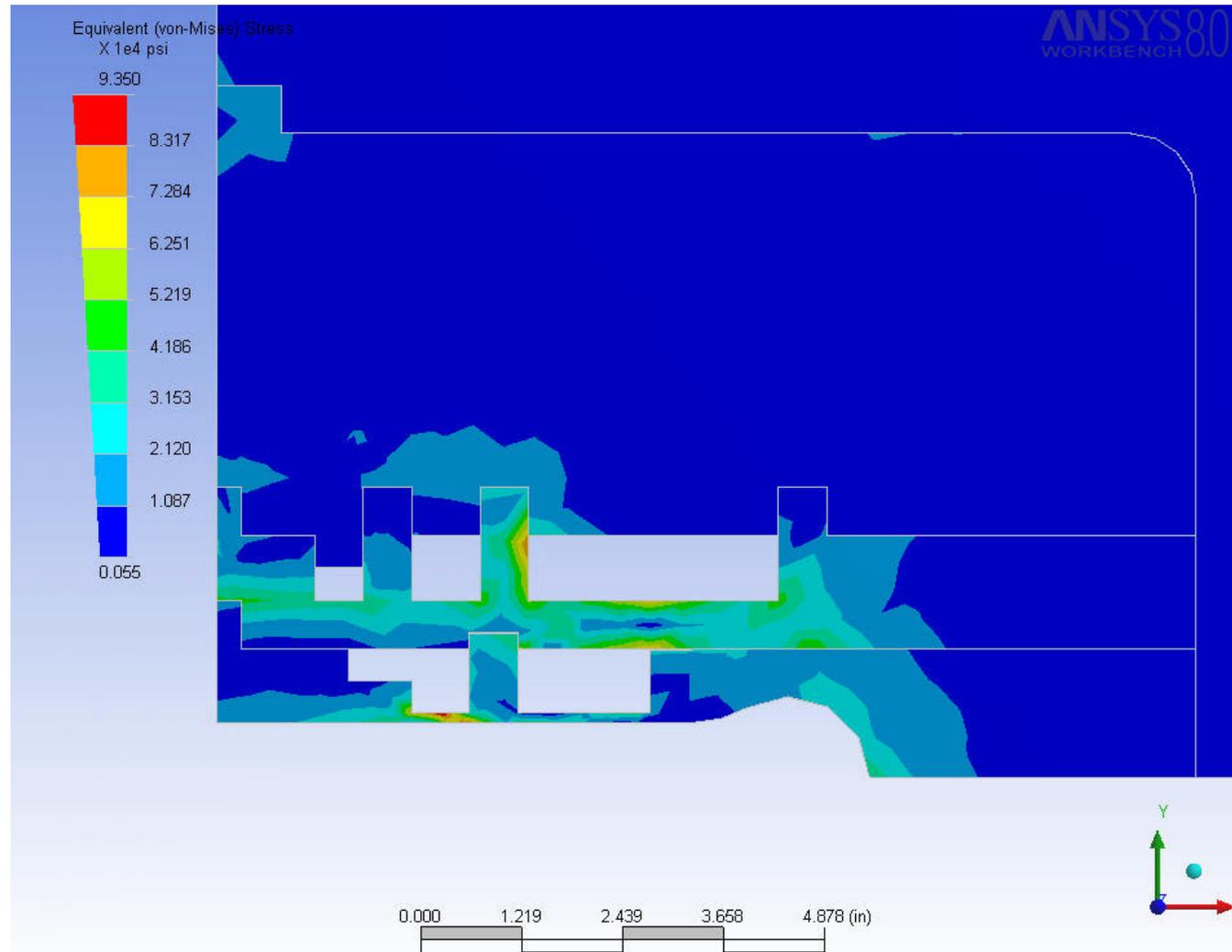
- Preload to be applied in vertical direction via pressing operation.

- Collar to be curved to start in order to achieve a flat coil after assembly and limit deflections when operating.



D1 Mechanical Analysis – Stress

- Stress in the main support web are below 80 kpsi
- Peak stress 93 kpsi (one small spot)

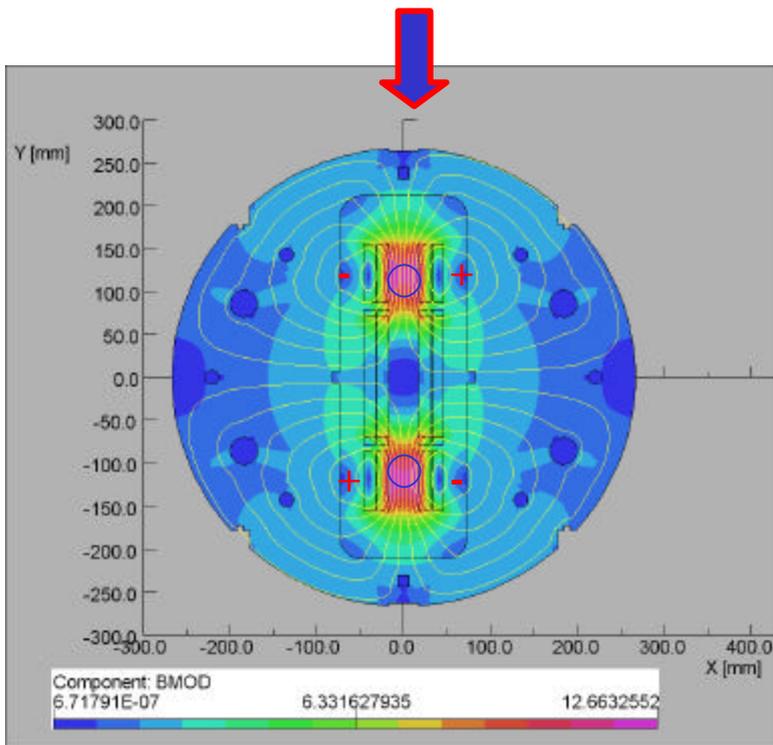


LARP D1 Dipole – Conclusions / Issues

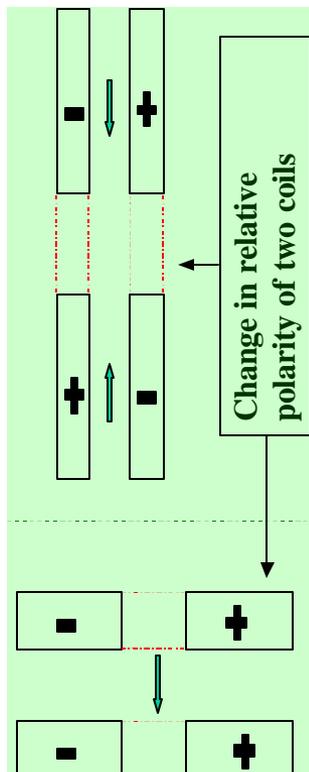
- Conclusions
 - Mechanical structure is within acceptable stress limits at operating field.
- Issues
 - Effectiveness of pre-curved collar & pre-loaded coil in limiting the coil deflections (to less than 0.1 mm).
 - Test using reconfigured 12T common coil magnet.
- Next Step
 - Comprehensive 2d analysis
 - Pre-loaded coils, thermal, magnetic.
 - Develop 3D design.

Common Coil Dipole Reconfigured as Open Midplane Dipole

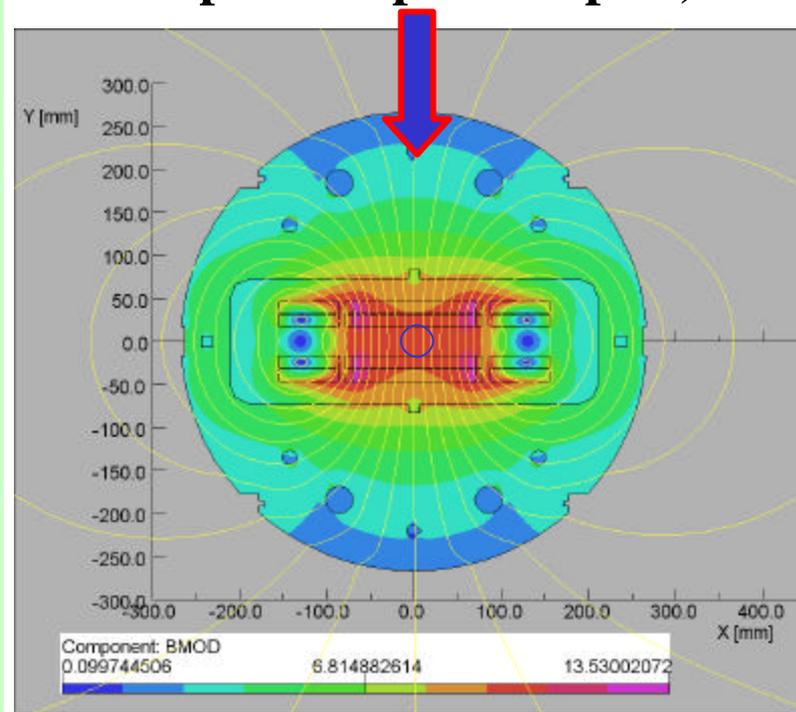
BNL 12 T Common Coil Dipole (now under construction)



Twin Aperture Dipole



BNL 12 T Common Coil Dipole (to be reconfigured as Open Midplane Dipole)

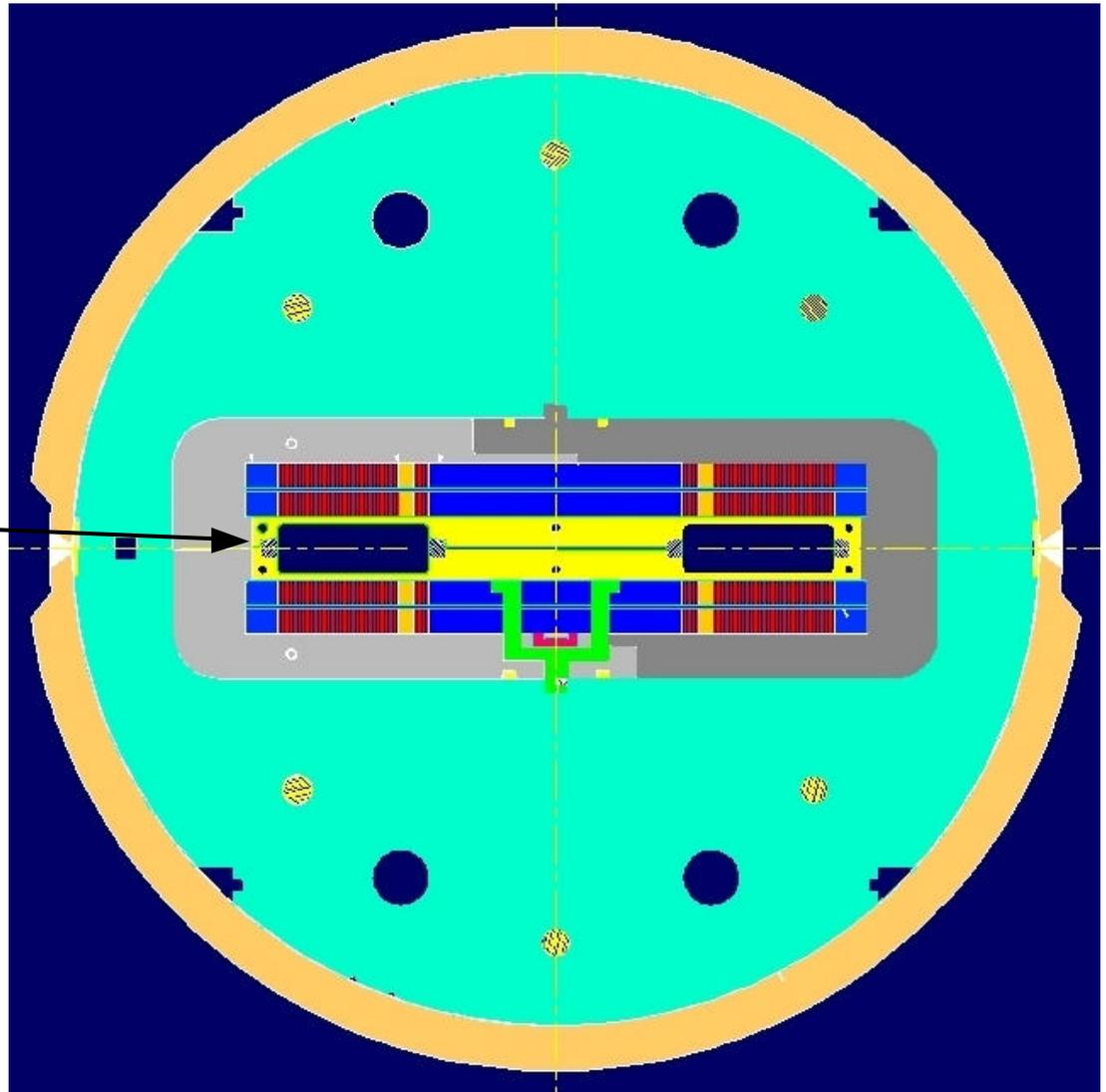


Single Aperture Dipole

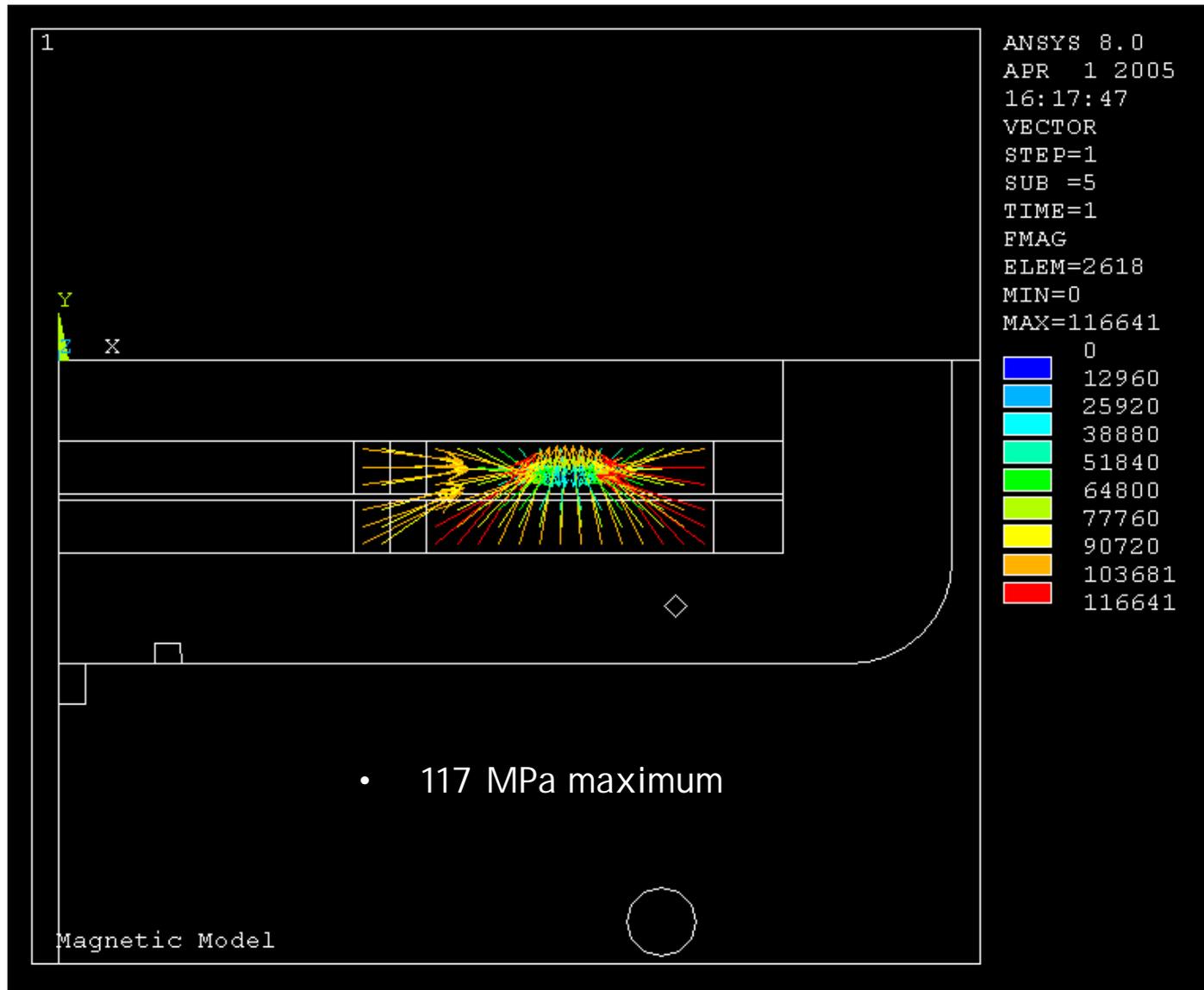
12T Reconfigured - Overview

- No disassembly of magnet required.
- Change external lead connections.
 - Forces toward midplane as in D1.
- Design coil support to mimic D1 deflections.

- Insert coil support into the aperture and preload coils.



12T Reconfigured - Lorentz Forces



12T Reconfigured - Deflection Y

- Support designed to give .012" deflection with no preload to mimic D1 dipole design.
- Currently analyzing pre-curved, preloaded coil support.

