Overpass/Underpass “aka” Cloverleaf Design

(Use of unique BNL dipole for PoP Demo with SBIR Budget)

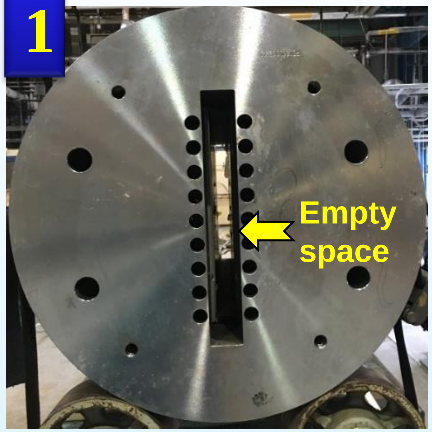
CERN/BNL Collaboration Meeting
February 11, 2021

Rapid turn-around, Low-cost R&D Approach

Five Simple Steps/Components

1. Dipole with a large open space (backup slides)
2. Coil for high field testing
3. Slide coil in the magnet
4. Coils become an integral part of the magnet
5. Magnet with new coil(s) ready for testing

1



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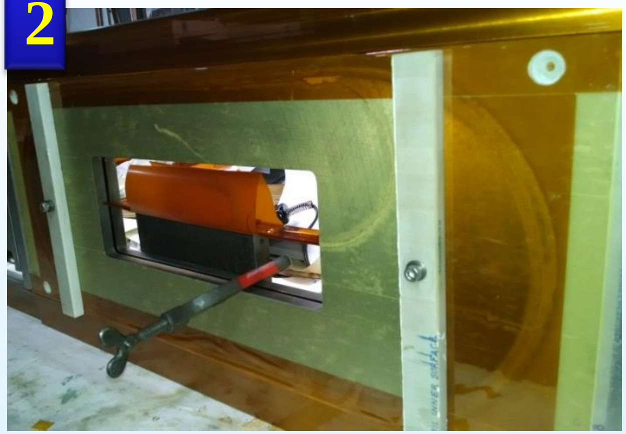

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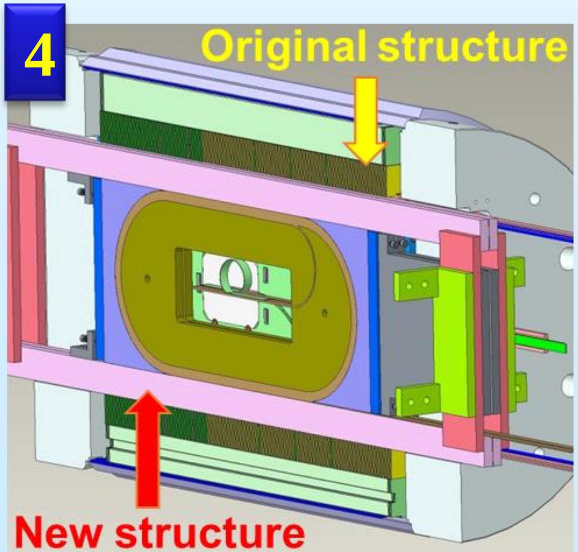

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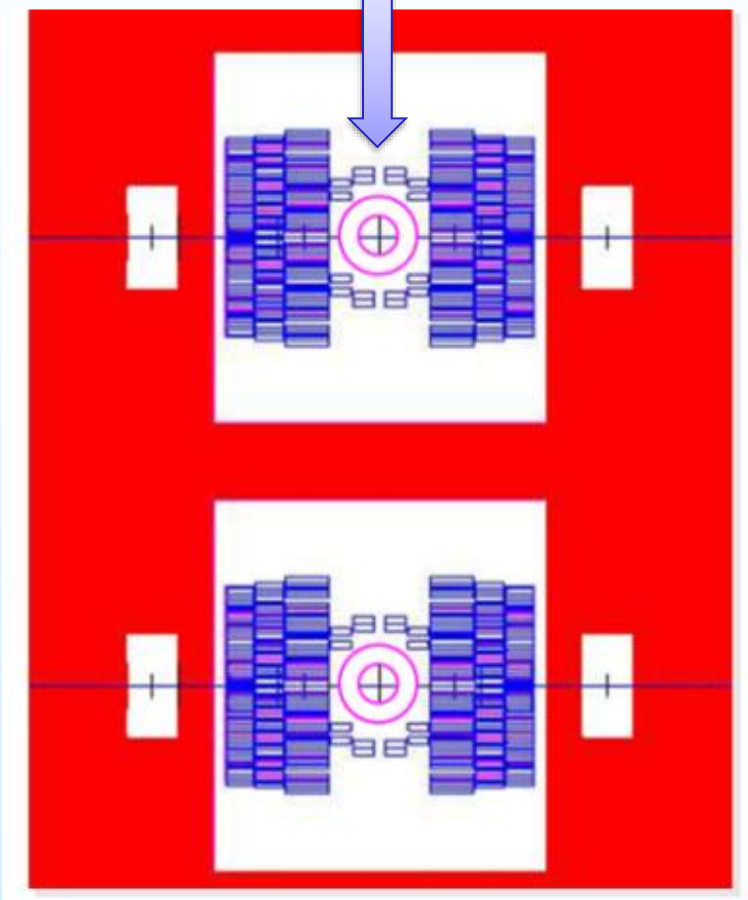
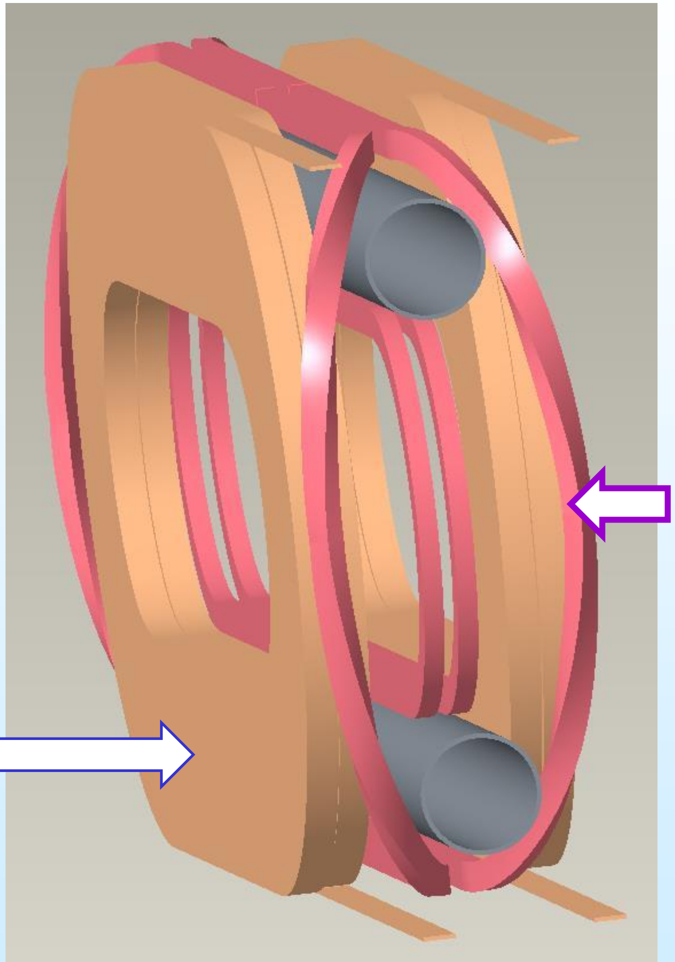
OP/UP Pole coils for Field Quality Common Coil Design (some blocks must be lifted to clear the bore tubes)

Pole coils for field quality



Main Coils – Flat racetrack



Pole coils with hard-way bend

OP/UP coils will be replacing these coils

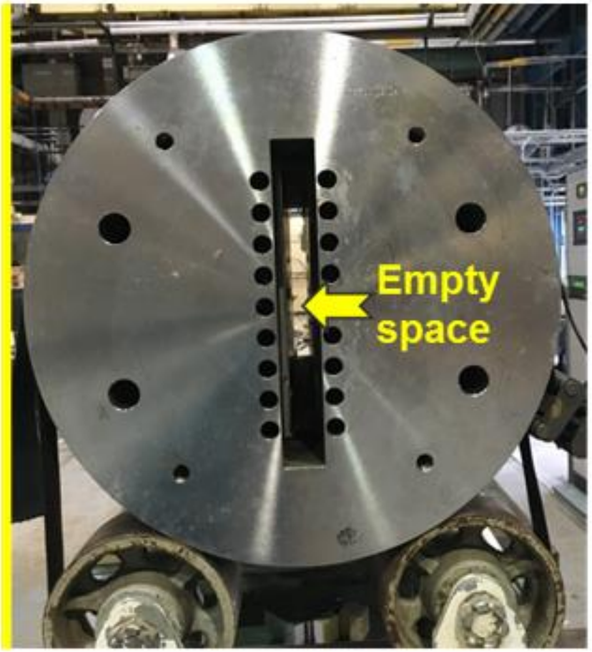
Most common coil magnets have been built with the main flat racetrack coils only. Demo of field quality require more complex pole coils – yet to be done.

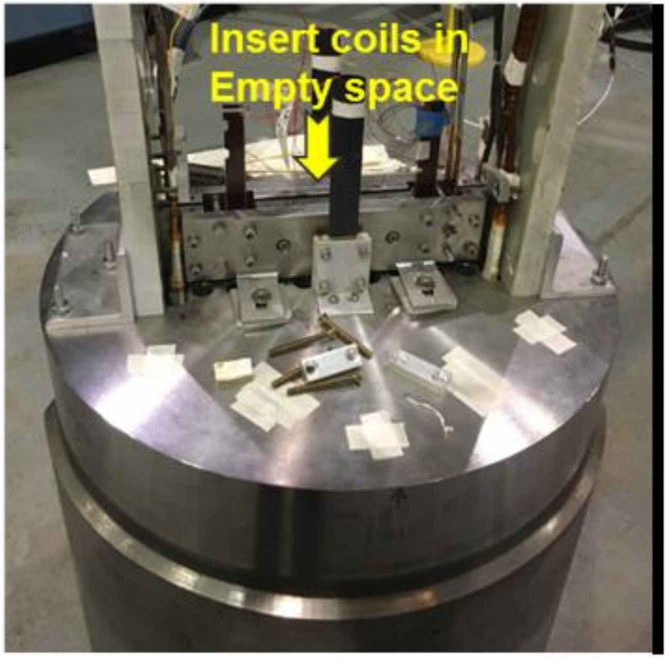
Goal of PBL/BNL Phase II, if funded
(Current Phase I to carry out the basic design work)

"Proof-of-Principle" demonstration of :

(a) overpass/underpass end design (b) Field quality common coil design

(Note: this SBIR with BNL is for Nb3Sn, last with e2P was for HTS)





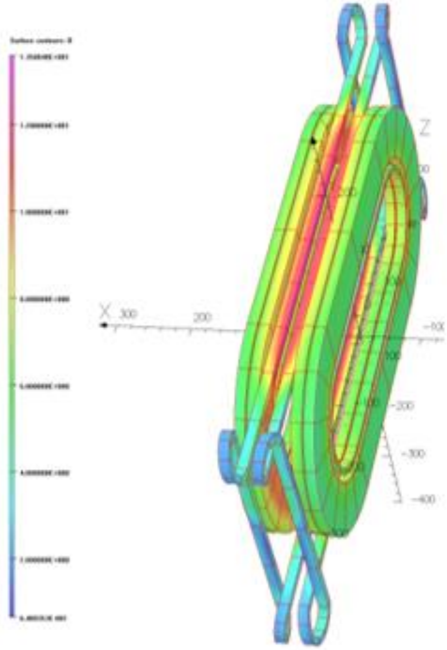
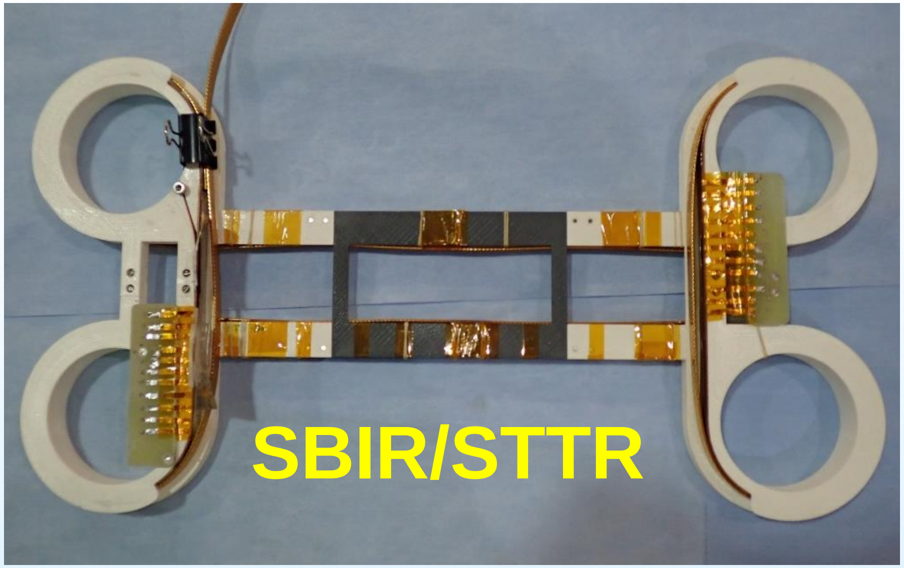
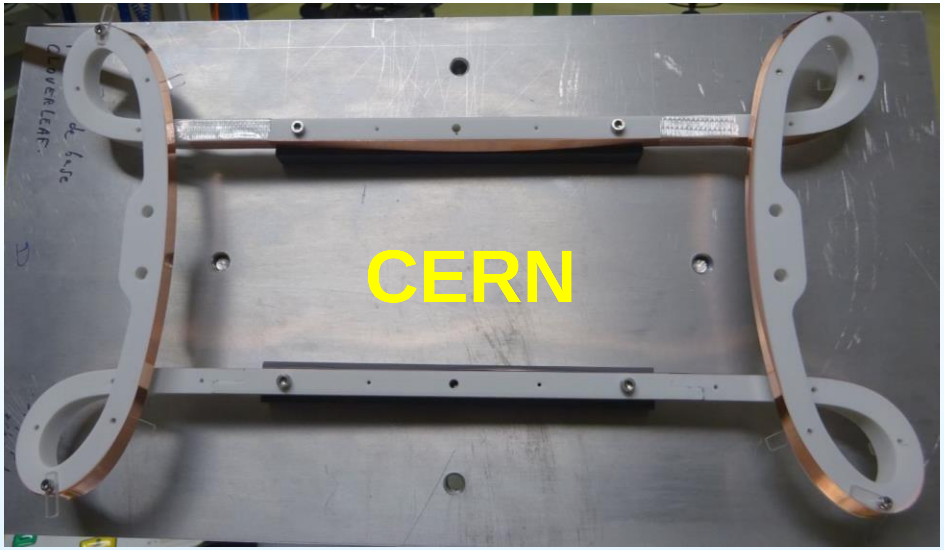
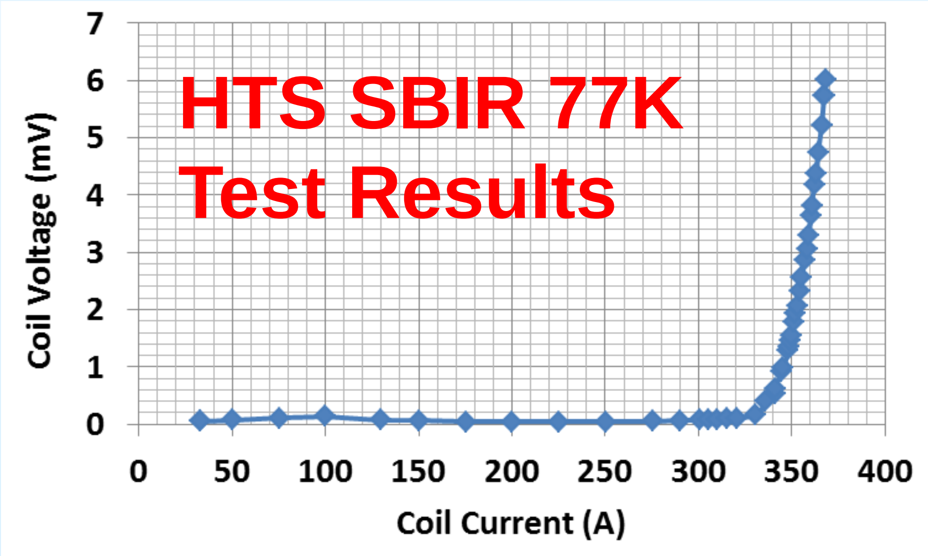


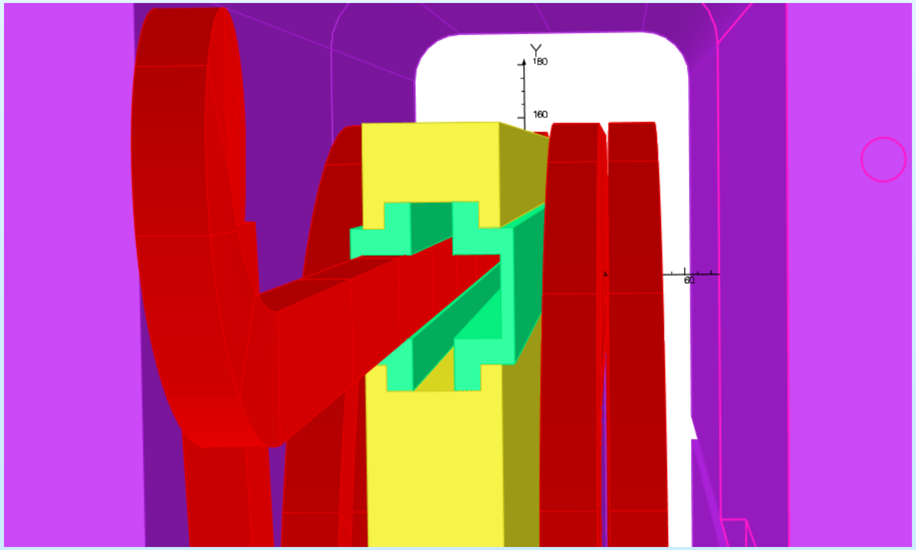
Figure 12: BNL common coil dipole with a large open space (left), with insert coil for another PBL/BNL STTR (middle), and the magnetic model of the proof-of-principle test (right). Similar to the design of the pole blocks of a high field common coil dipole, the overpass/underpass ends of the proof-of-principle design will be in a relatively lower field region, pointing to another advantage of the design.

More Background

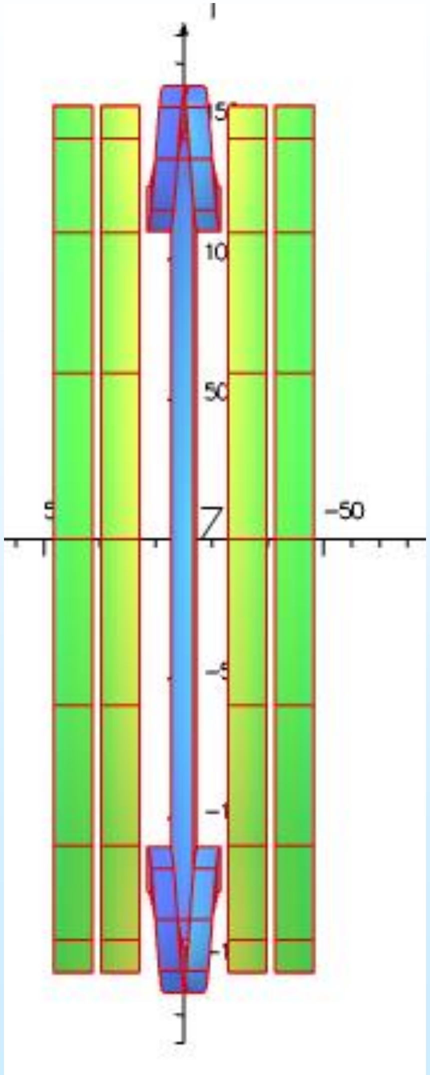


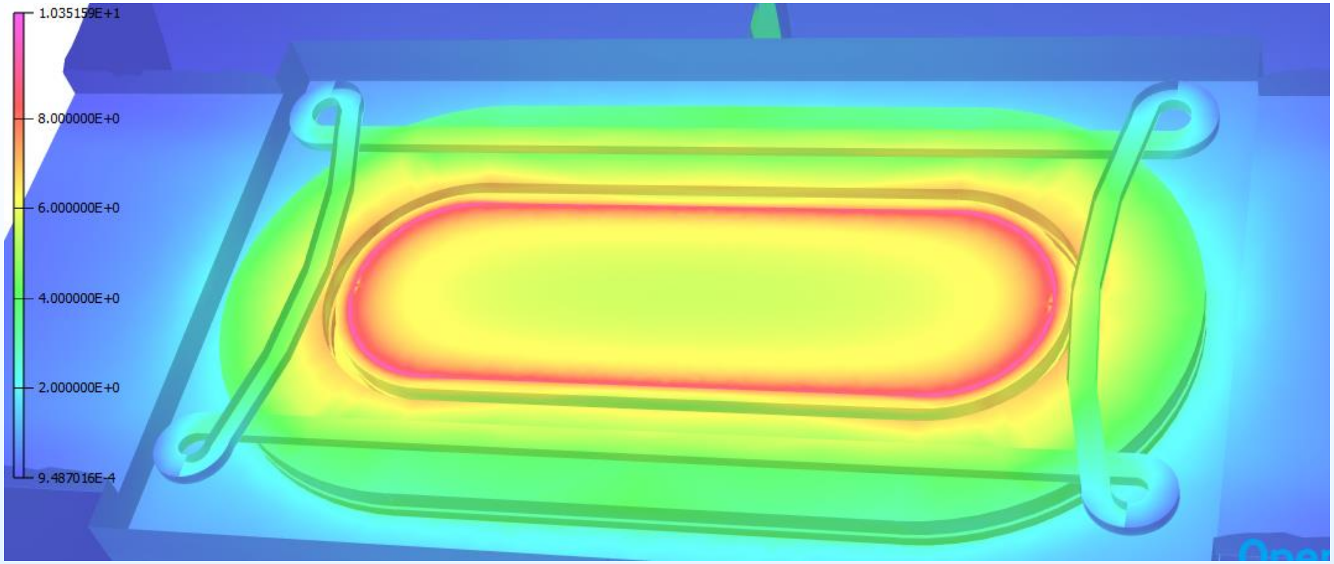


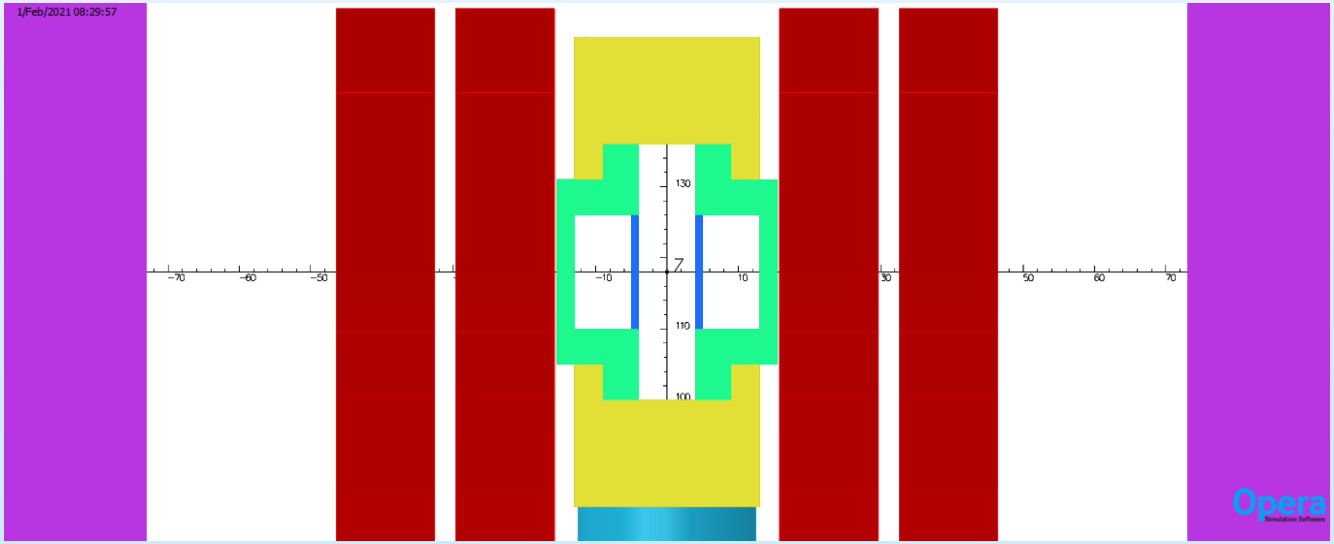




OPERA Models

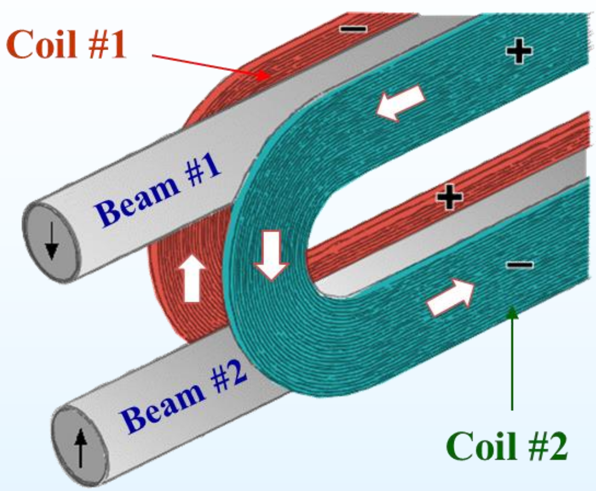


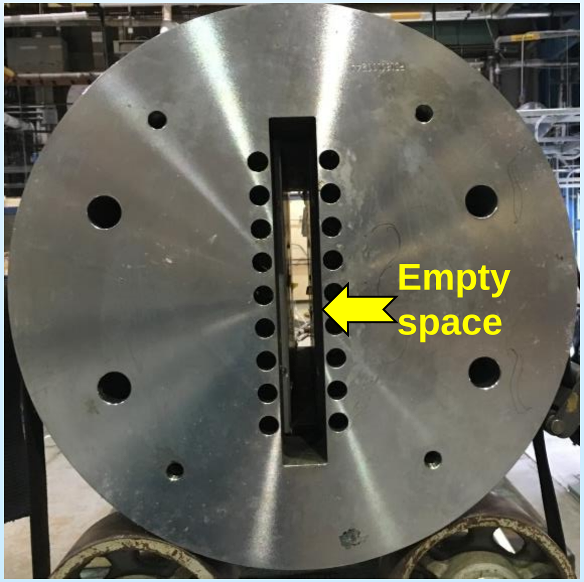




Backup Slides

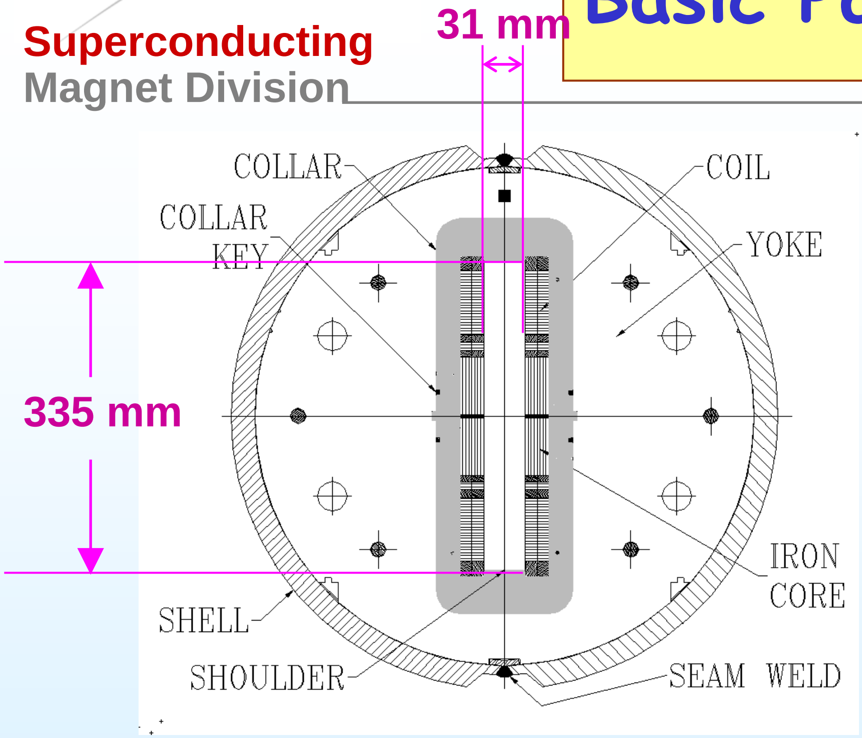
A Unique Background-field Dipole

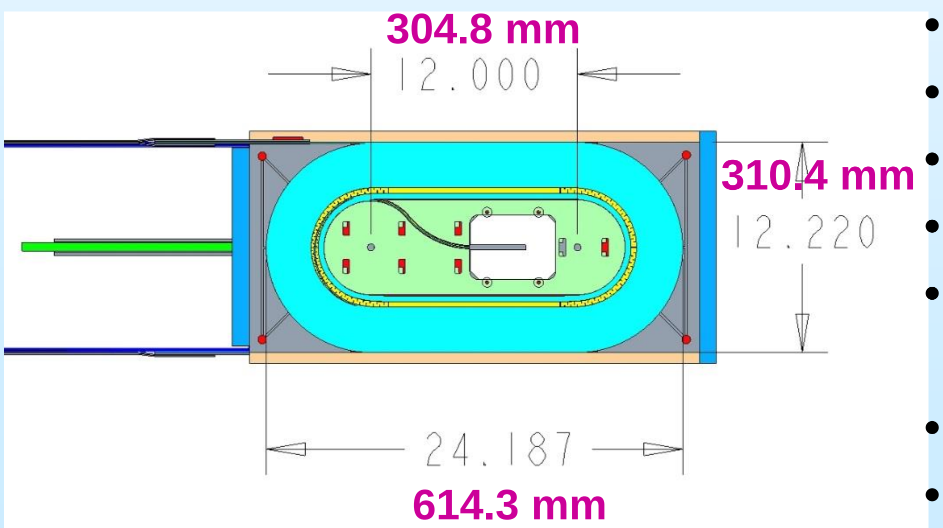




- Nb_3Sn, 2-in-1, common coil dipole
- Structure specifically designed to provide a large open space (30mm wide, 335mm high)
- New racetrack coils can be inserted here for testing them in a background field of ~10 T
- These new insert coils come in direct contact with the existing Nb_3Sn coils and become an integral part of a potential ~16 T dipole
- A new coil test becomes a new magnet test
- Allows a rapid-turn around, low-cost test
- A unique facility for testing HTS cables also

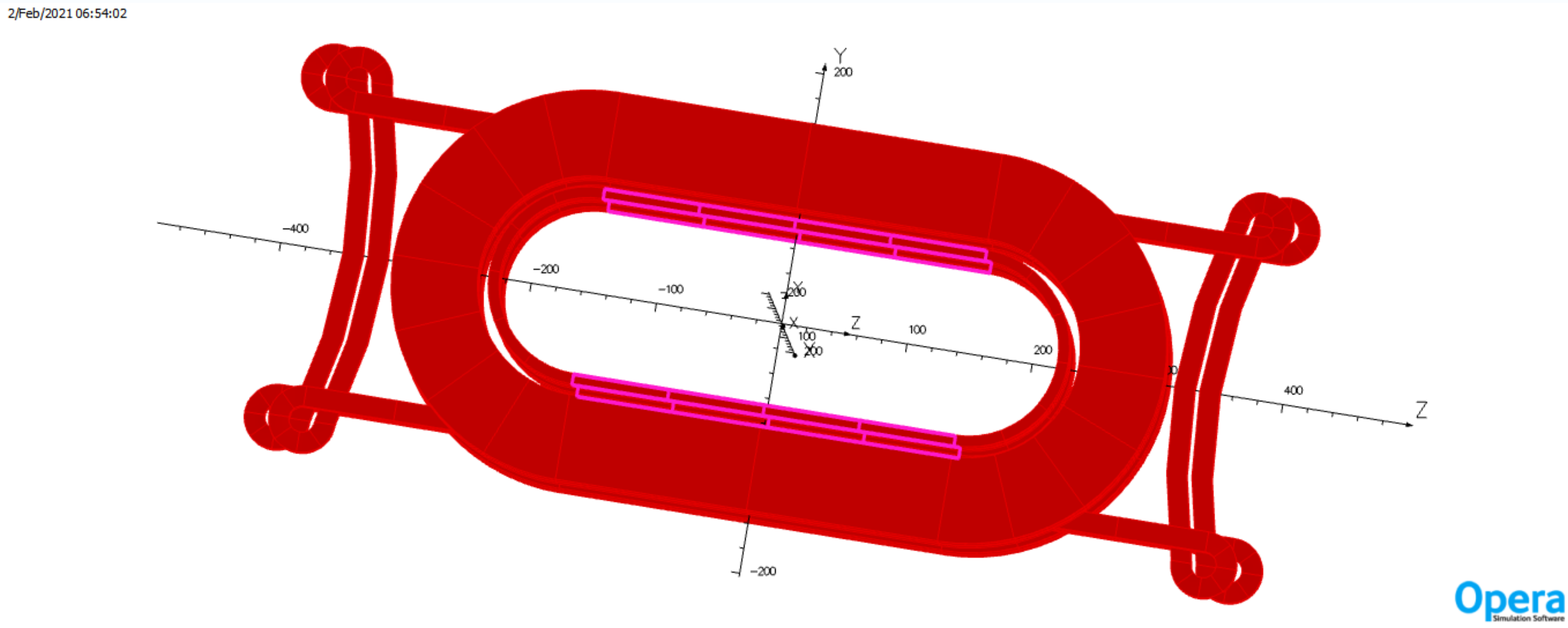
Basic Parameters of Dipole DCC017



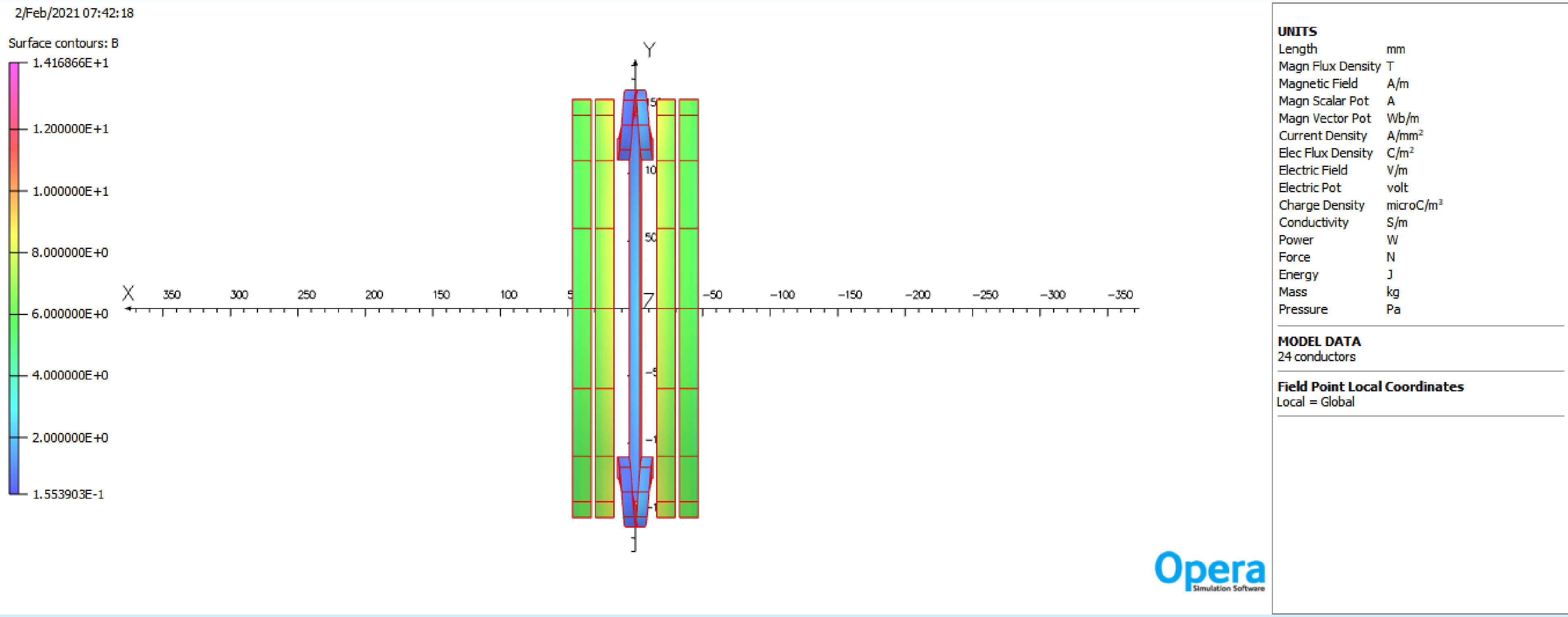


- Two layer, 2-in-1 common coil design
- 10.2 T bore field, 10.7 T peak field at 10.8 kA short sample current
- **30 mm horizontal aperture**
- **335 mm vertical aperture**
  - **A unique feature for testing insert coils or cables**
- **977 mm magnet length (overall)**
- 0.8 mm, 30 strand Rutherford cable
- 70 mm minimum bend radius
- 85 mm coil height
- 305 mm coil straight section
- 614 mm coil length
- 653 mm yoke length One spacer in body and one in ends
- Iron bobbin
- Stored Energy@Quench ~0.2 MJ

OP/UP Coil in DCC017

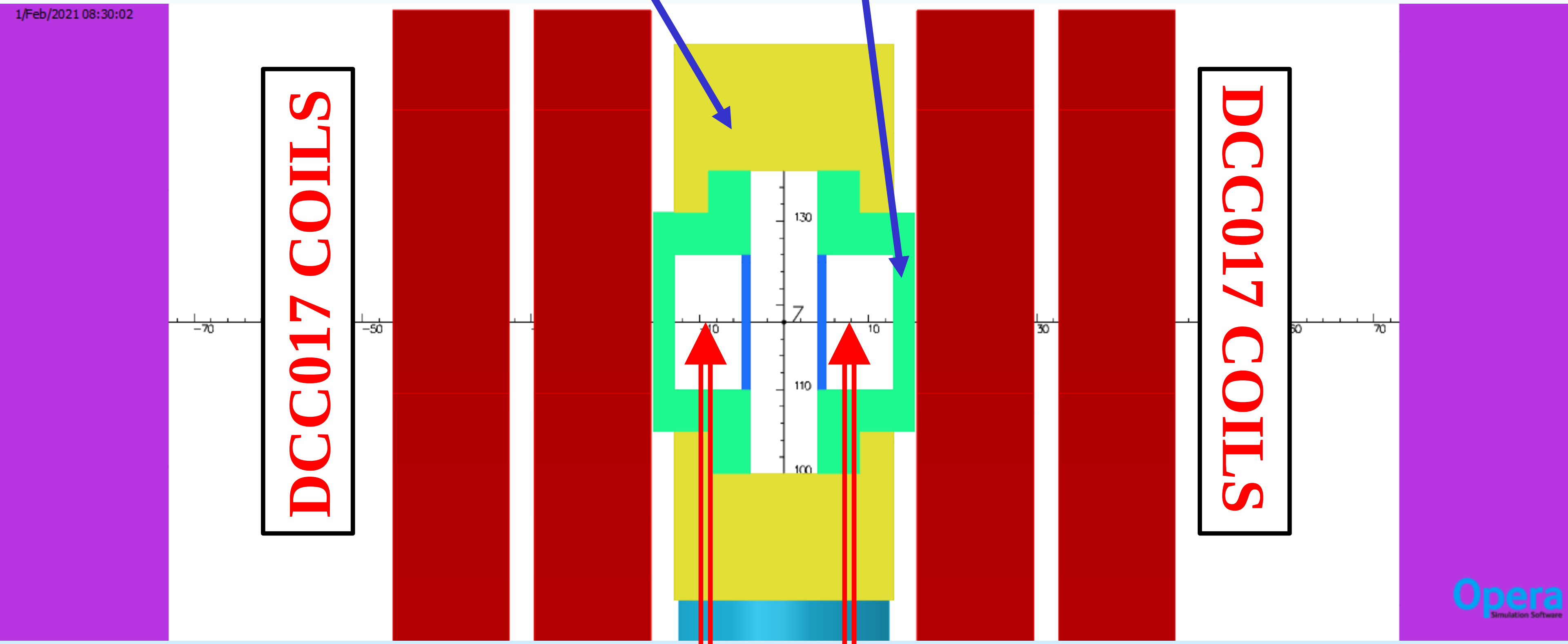


OP/UP Coil in DCC017



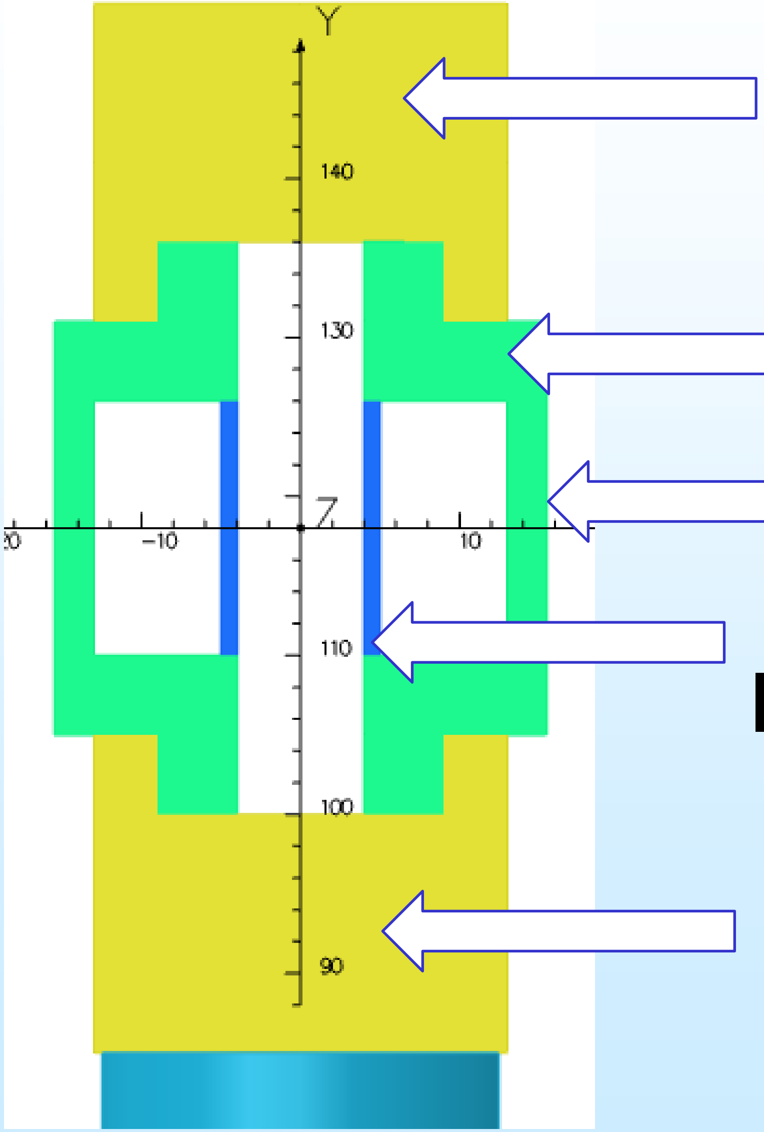
Internal Structure for OP/UP Coils (1)

When energized, OPUP Coils lean against the magnet (DCC017) coils and create local stress/strain. This could limit the performance of DCC017.
Clamp reduces the stress build-up and pads distributes the local strain.



PLACE FOR OP/UP COILS

Basic Building Blocks



Clamp for Lorentz forces

Reaction fixture

Pads for distributing Lorentz forces

Impregnation fixture

Clamp for Lorentz forces

Another Configuration of OP/UP Test in DCC017