



U.S. MAGNET
DEVELOPMENT
PROGRAM

Status of the ReBCO CORC Coil Program for MDP

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September 30, 2020

Two R&D programs. Magnet Design Program (MDP) and Small Business Technology Transfer (STTR) .

- 1.MDP: 4+4 turn coil made with CORC[®] cable (includes a S-turn to change the direction of current between two 4-turns) for quench studies (instrumentation, etc. being decided with MDP partners)**
- 2.STTR: Two sets of 6+8 turn double pancake coils (total 14+14=28 turns) for high field hybrid dipole design studies**
 - In both cases, CORC[®] coils will run in series with the Nb₃Sn coils of DCC017 (we are looking into the possibility of a shunt of a few kA between the two)**
 - BNL will help in the design and winding of both coils. We will try to make the two as similar as possible.**

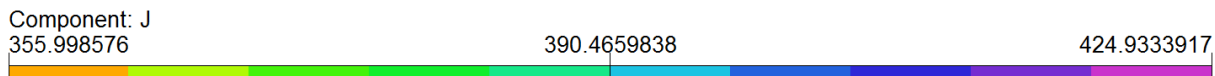
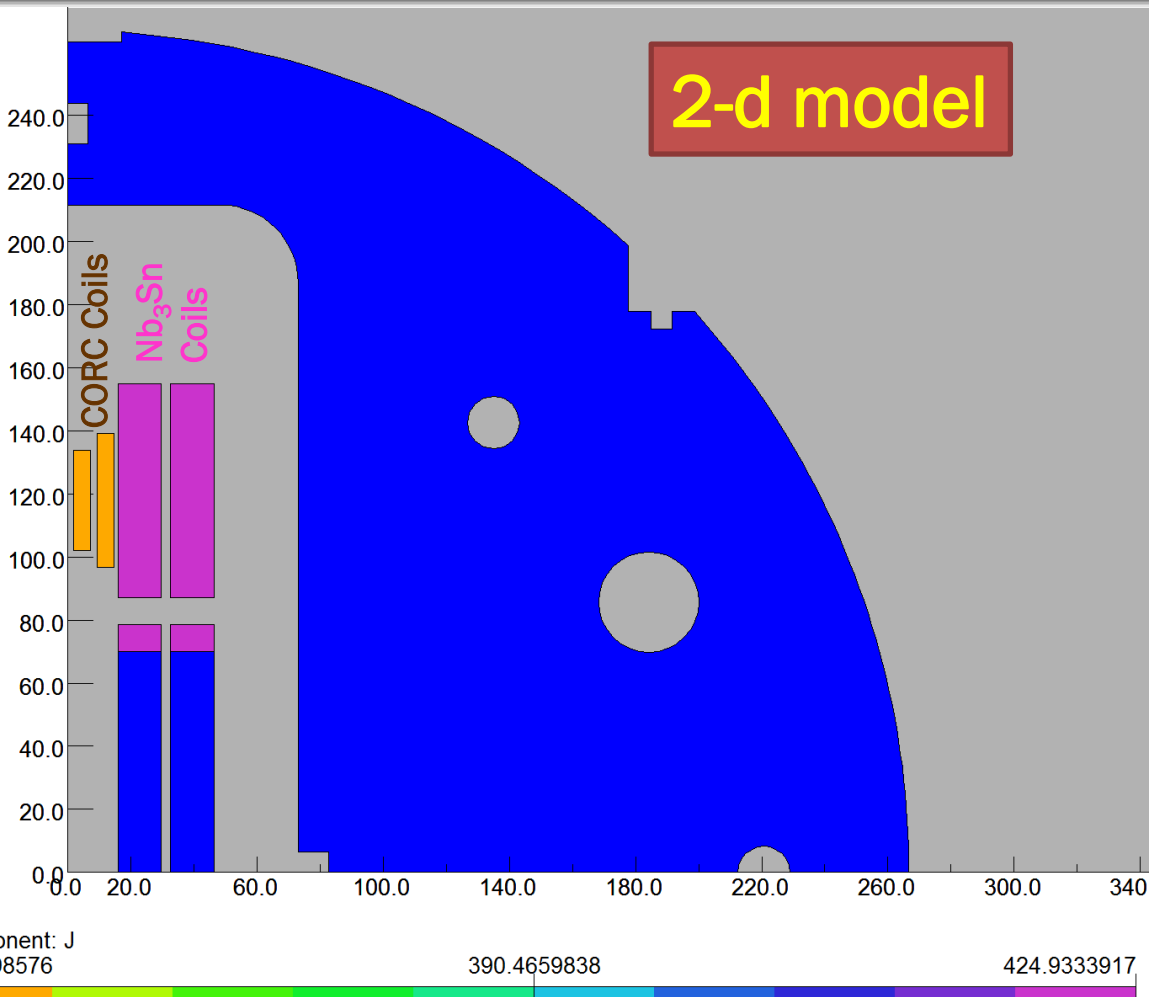
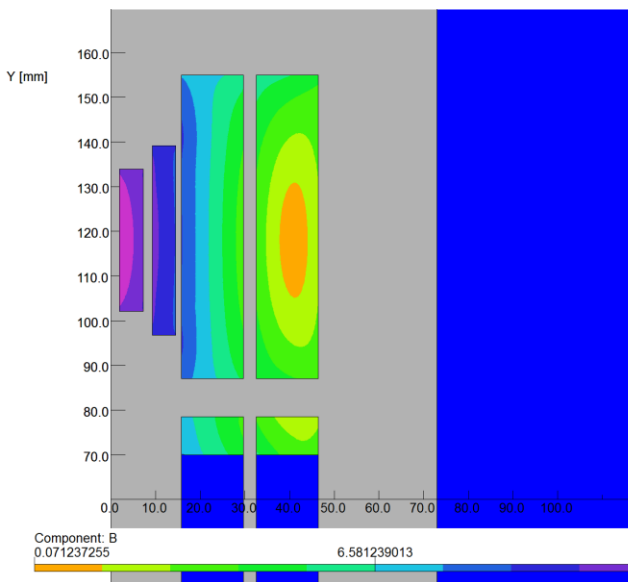


CORC Coils in the STTR Program

CORC coils:

6 and 8 turns, running
in series with Nb₃Sn coils

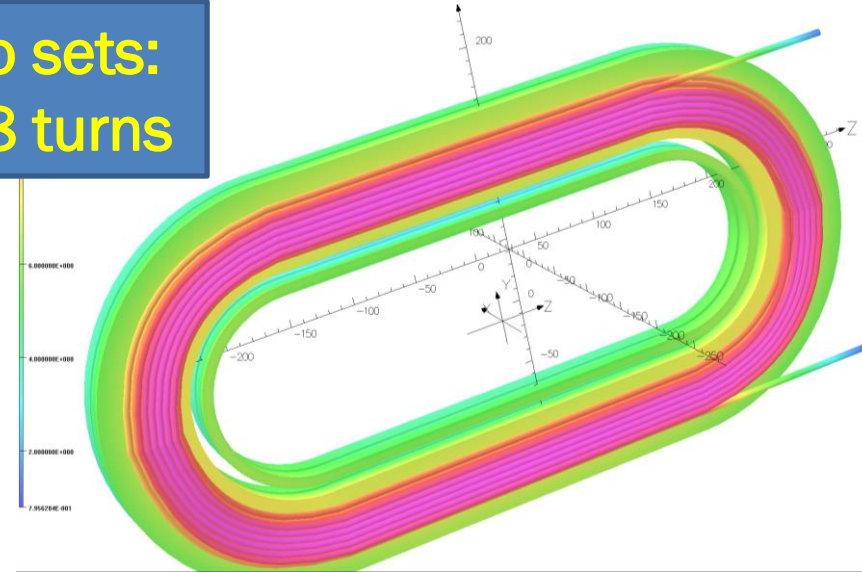
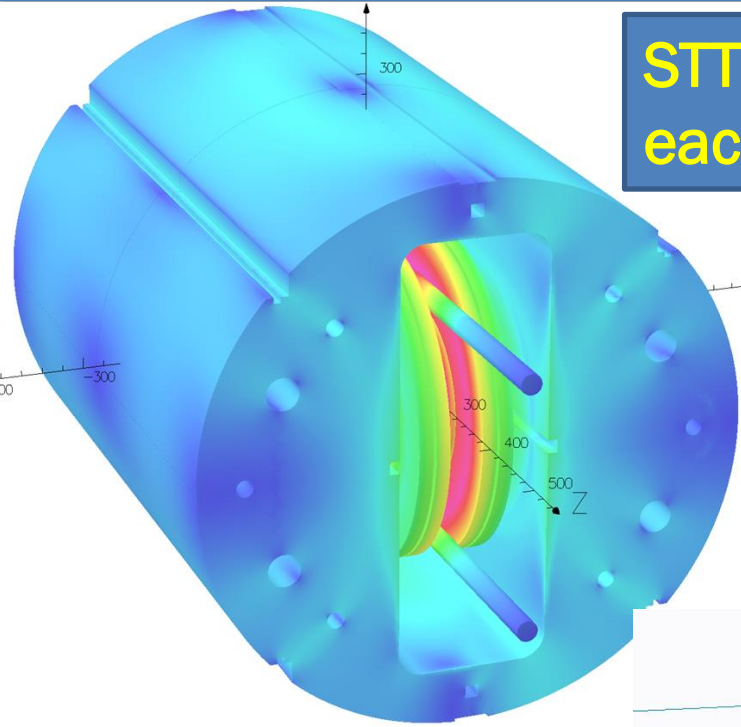
Hybrid field: 13.1 T @10 kA
: 14.4 T @11 kA
(peak field in Nb₃Sn coils
reduced by CORC coils)



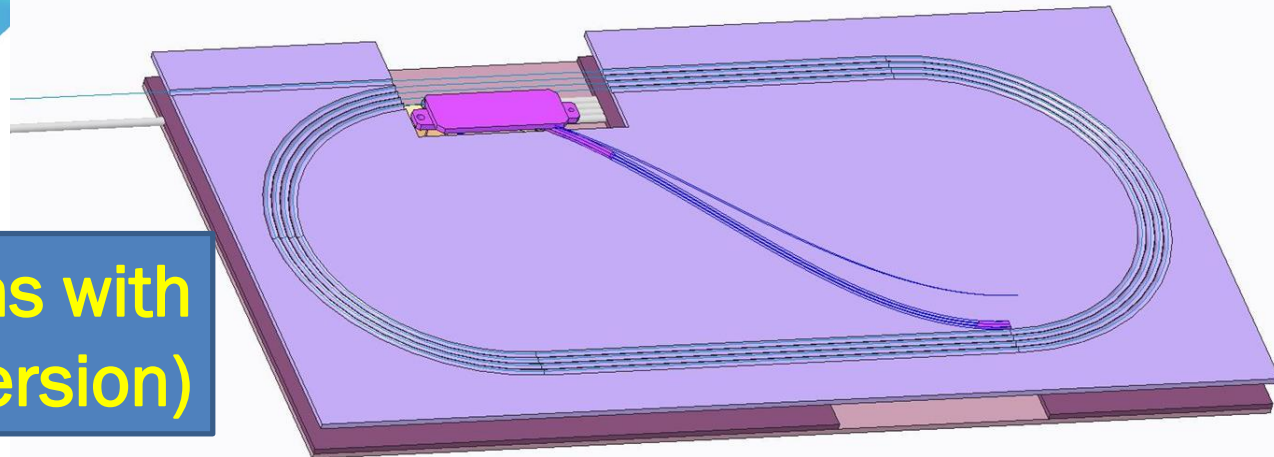


CORC Coils inside the Common Coil

STTR Coils two sets:
each with 6&8 turns



MDP Coil 4+4 turns with
S-turn (earlier version)

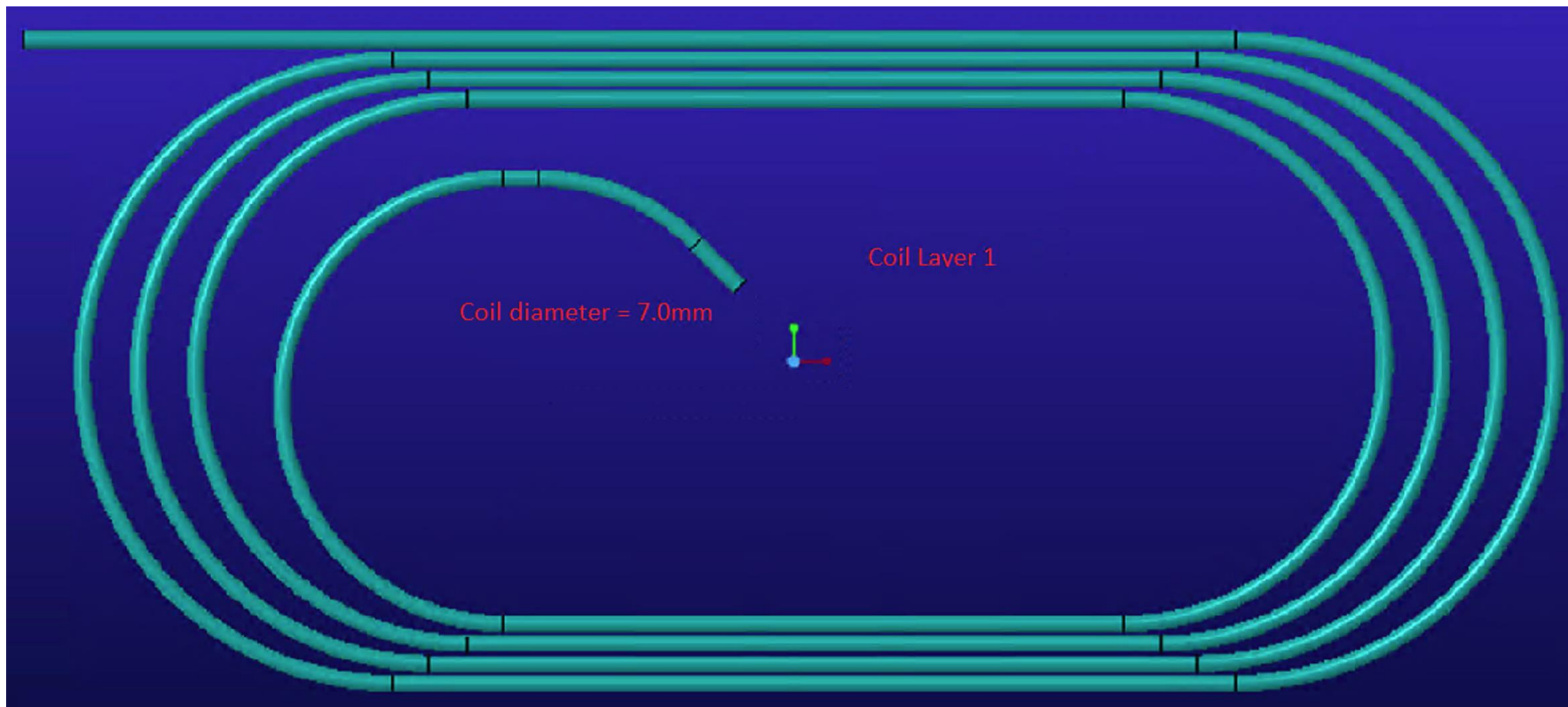


- **The primary purpose of MDP CORC coil program is to perform quench studies of CORC coil at a significant field**
- **A secondary purpose is to transfer benefits of this study to a higher field hybrid magnet program being carried out under STTR**
- **We have had several meetings to discuss more details of the test plans, purpose, instrumentations, coil winding, structure, etc.**
- **ACT also participated in some of those meetings. In addition, BNL had independent meetings with ACT.**
- **We have agreed on the basic coil winding structure and the frame. It was decided that MDP and STTR parameters should be as close as possible for a better comparison of the two tests.**
- **A structure has been designed and a small section has been ordered by ACT for initial winding tests**



The following slides are taken primarily from a presentation of a summer student (Michael Bianco) with Jesse and Mike

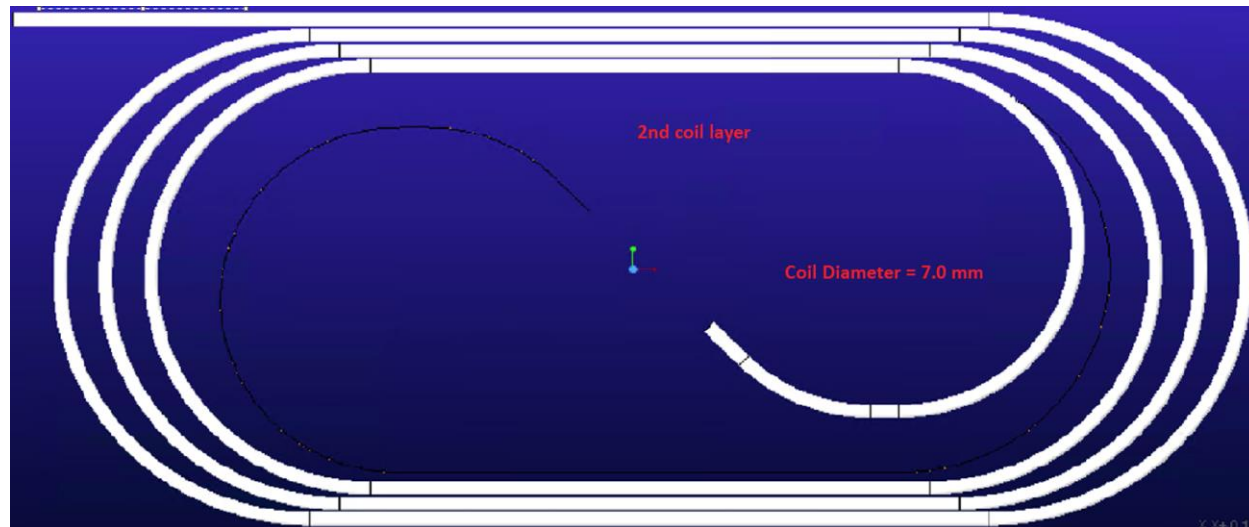
1st Coil Layer



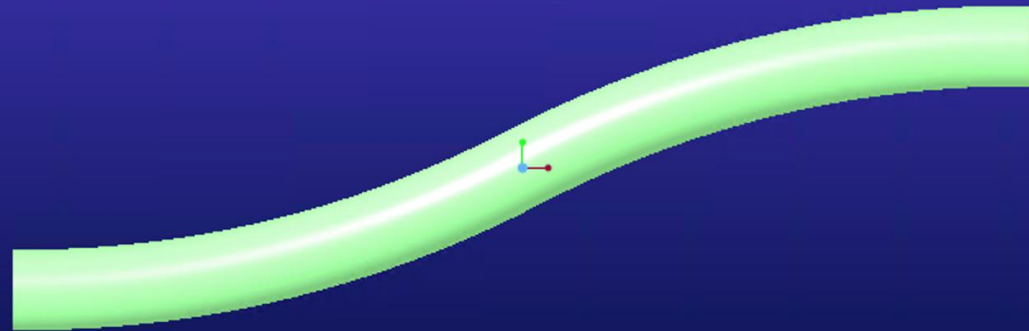
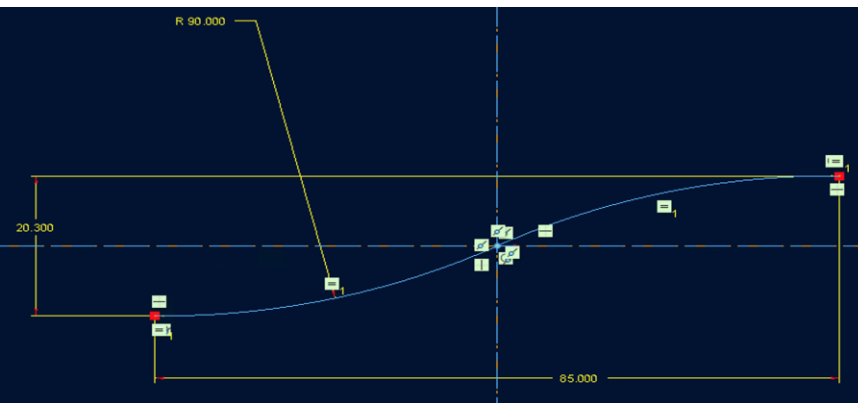
Latest design has left and right side symmetric

2nd Coil Layer

- 2nd coil layer
- The two layers are symmetric about the vertical & horizontal axes
- With one exception:
 - 1st coil layer has 4 turns on both sides
 - 2nd coil layer has 4 turns on 1 side & 3 turns on the other side to account for the “s” transition



The “s” transition layer is responsible for the transfer of electric current from coil to coil



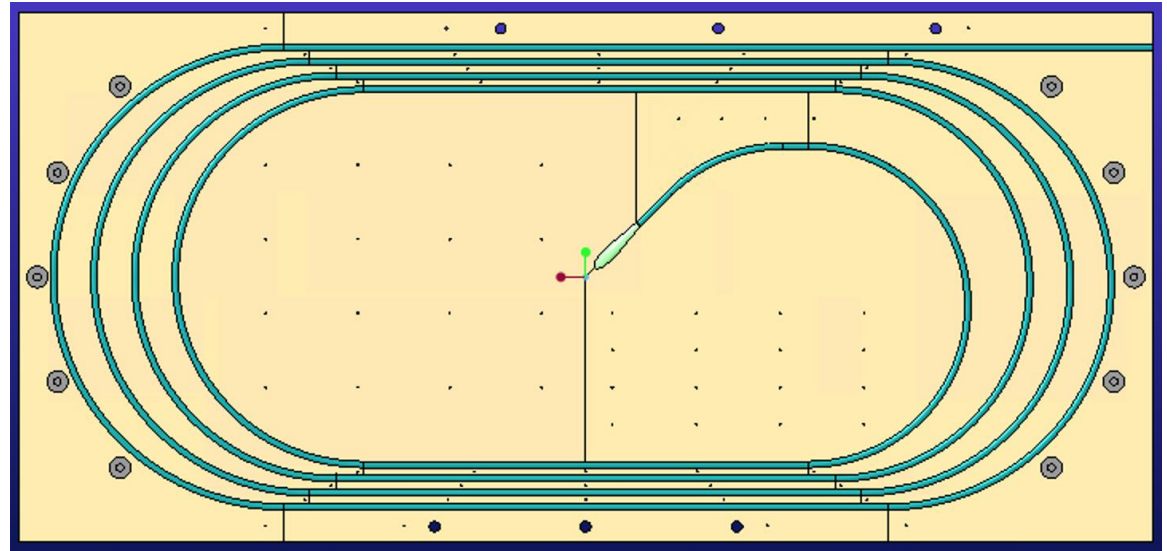


Coil Spacers

In the design there is empty space between the coils – there are spacers made which will take up that empty space & aid in the winding process

Coil wound around the spacers

Pictured are the 1st layer coil spacers

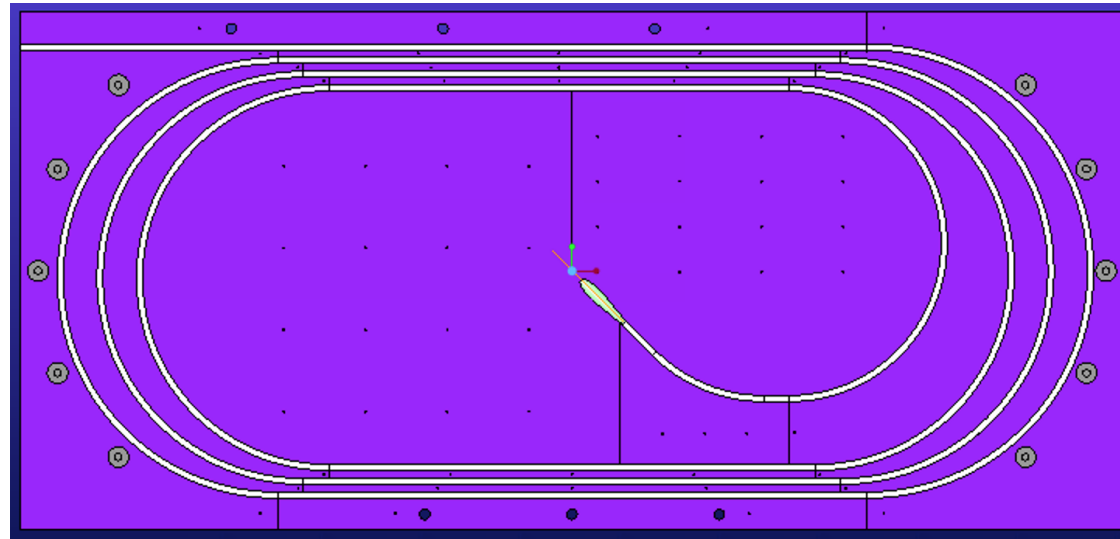




Coil Spacers

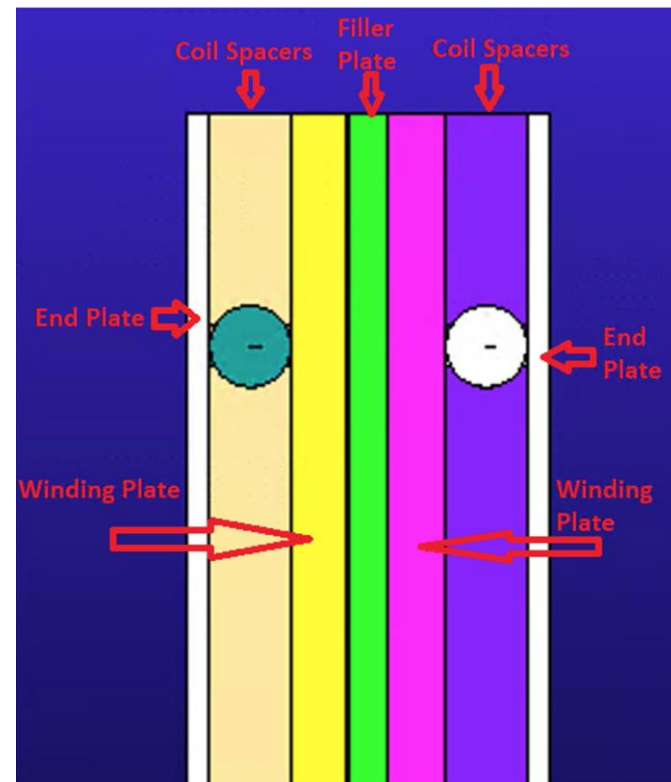
In the design there is empty space between the coils – there are spacers made which will take up that empty space & aid in the winding process

- Coil wound around the spacers
- Pictured are the 2nd layer coil spacers



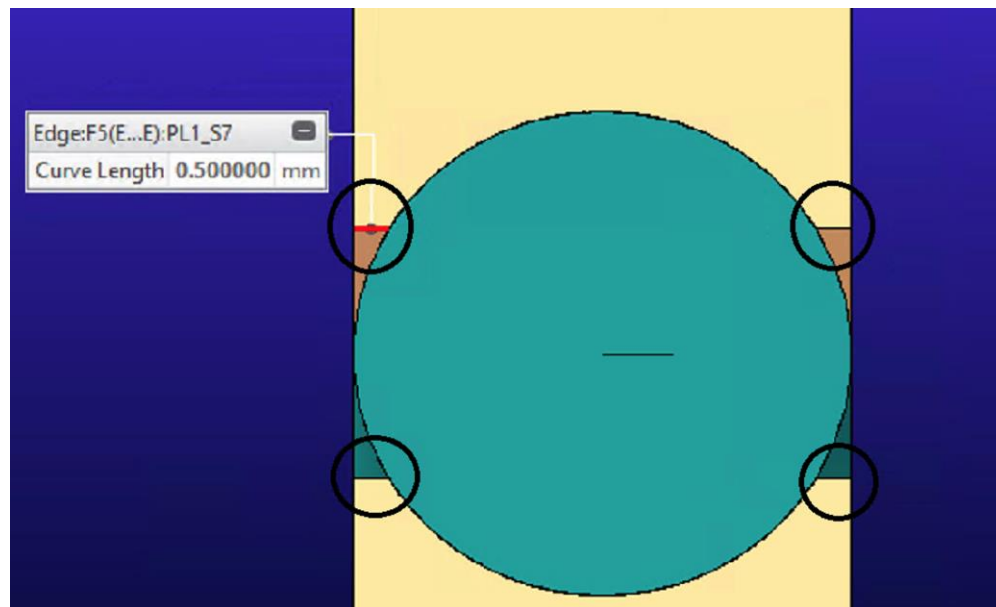
Side view of the assembly:

- Total of 7 plates
 - X2 end plates (2mm thick)
 - X2 coil spacer layers (7mm thick)
 - X2 winding plates (5mm thick)
 - X1 filler plate (3.6 mm thick)

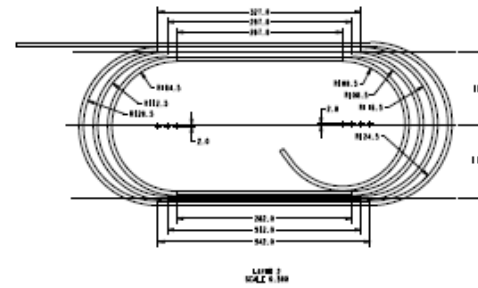
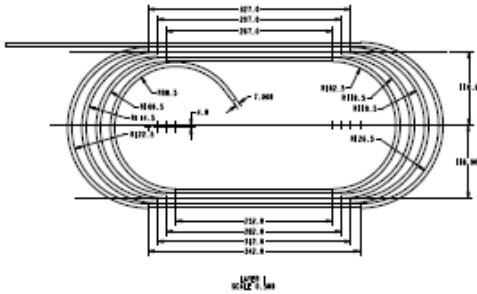


Spacer Overhang

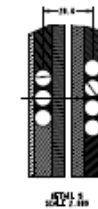
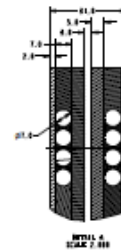
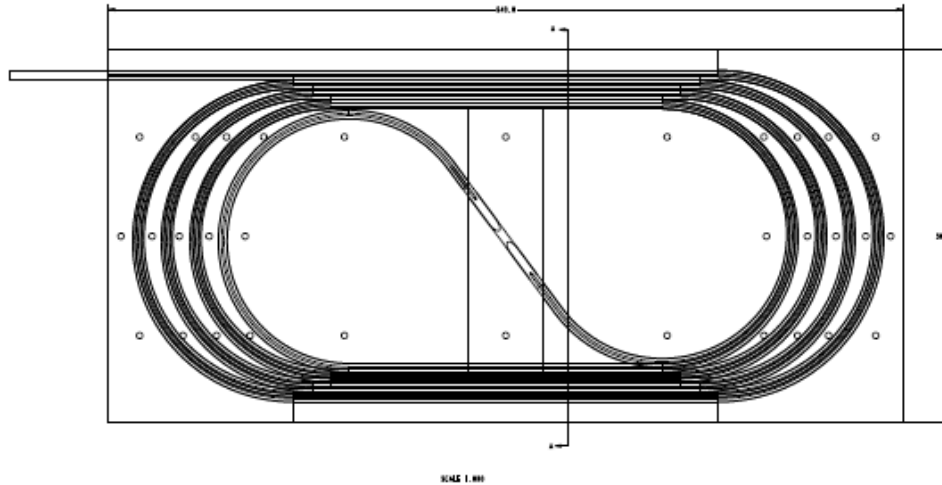
- Currently pictured, the dimensions is 0.5mm, but there is some discussion whether to change this value to 0.25mm
- Regardless of the value, the coil shall remain flush with the with where the spacer layer ends
- This is the same with the other coil layer



Current Design after several feedback from MDP and ACT Colleagues



From:
Jesse Schmalzle



CORC MDP COIL
SKETCH - 9/10/20



Current Status

- **ACT ordered a 3-d printed part for a short winding studies**
- **Part was out of spec so new part is being printed**
- **BNL will proceed with the final design and winding after the experience at ACT**