

Magnet Length, Margin, etc.

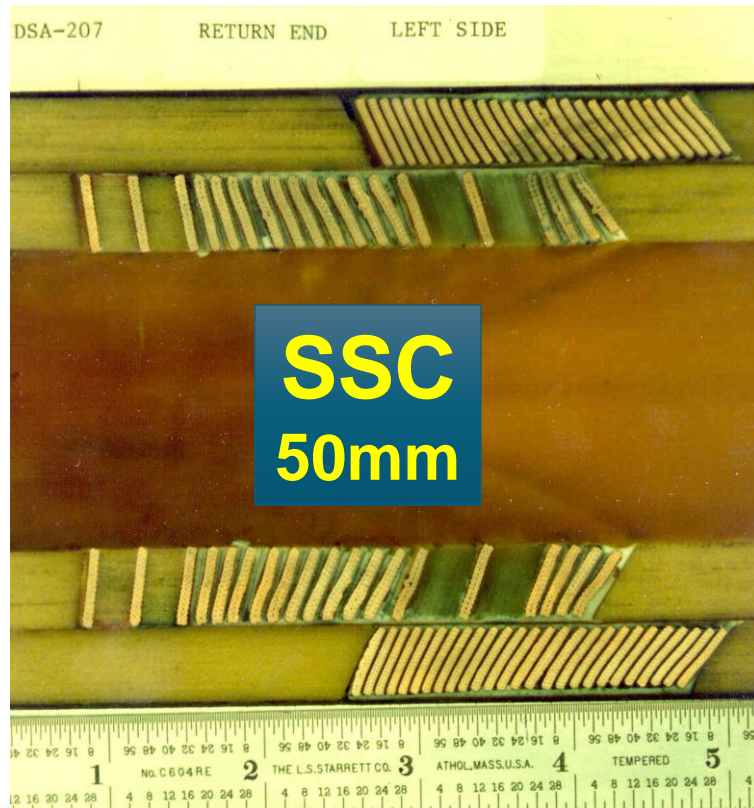
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Peak Field and Harmonics Reduction in the Ends

- Most end design of EIC magnets are now having peak field close to the 2d field (within 5% of the 2d).
- Everyone is working to reduce it further. The aspirational target would be to make the peak field in the Ends less than that in the straight section.
- We are also optimizing them to reduce End harmonics (often defined in Unit-meters).
- In an optimized design, typically, first couple of blocks determine the peak field (spacers are very effective) and harmonics determine the length. In a two-layer design, one can also play with the SS of two coils.



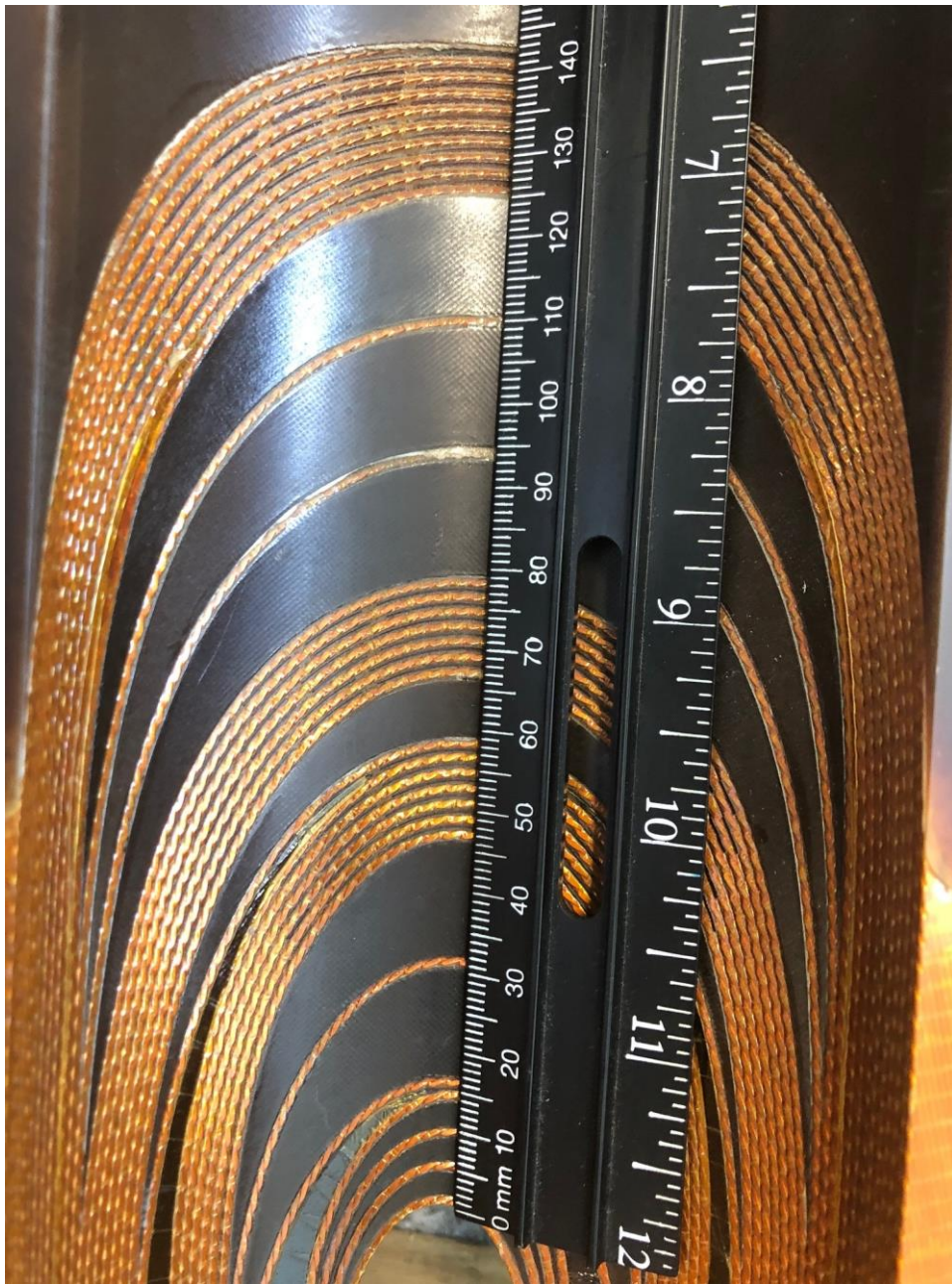
An Approach to Assure the Right Length

A typical prescription for the magnet length and operating current:

- First optimize the 2d design to minimize harmonics and to maximize the margin. Then make an initial estimate the length of the ends. Approximate physical length of ends: about 2X of id in dipole and one id in quad. Effective contribution to the magnetic length is about half of that.
- Then optimize the Ends for integral harmonics and peak fields. Try to make peak field in the Ends smaller than or close to the peak field in the SS. Also try to make End harmonics small. The two shouldn't degrade the performance of the 2d design significantly. This gives certain physical length (last turn of the coil). Further add the length of the End saddle. Compute the width of the End plates based on the forces. Adjust length of the SS in the 3-d magnetic model to meet the goal.
- Mechanical length of the magnets derived from the slot length in the lattice. Adjust length of the straight section and operating current such that one gets the desired integral field for the allowed mechanical length (including adjustments in the width of the End plates, etc.).
- Optimized 2d and 3d design allows one to change length and operating current, say within few percents (as much as 5%) without impacting the performance.

The final detailed design should be able to accommodate some changes in the length of the straight section (even 5% or so) chosen in the beginning of the design process. Therefore, if the slot length can be fixed say in a few months, we should be able to assure that the magnet is built with a correct length.

End Geometry



End Geometry



End Geometry

