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Update on REBCO accelerator magnet technology development at LBNL

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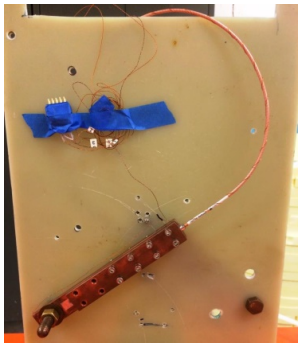
Connecting the conductor developments and accelerator magnet needs

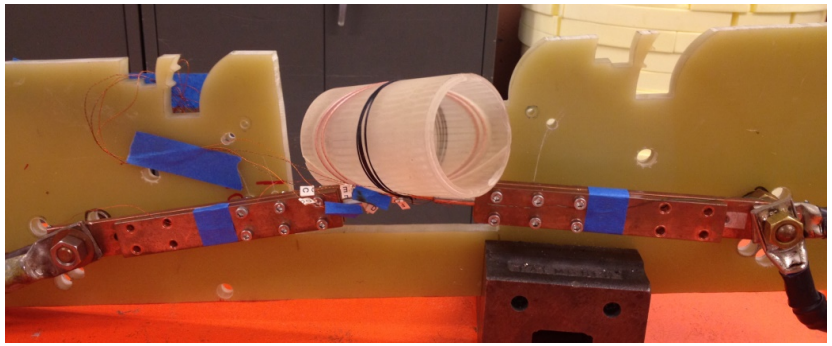
- REBCO conductor has significant potential: J_e and cost
- Two intertwined issues for REBCO accelerator magnets
  - Magnet technologies are under development
  - Guidance on conductor properties based on magnet performance and needs lags

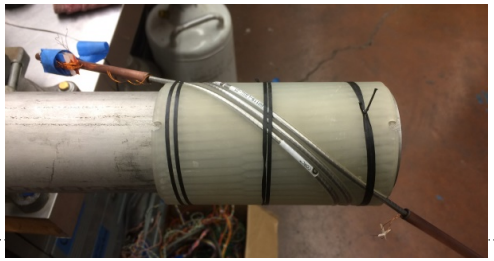
- Evaluating various conductor/cable concepts based on canted cosθ design
  - Conductor on Round Core (CORC®) wire
  - Tape stack (MIT and Roebel)

Working closely with vendor on short sample testing and wire optimization

- ACT has supplied several short samples of different designs for us to test winding on CCT grooves
- Excellent opportunity to learn wire handling







Advanced Conductor Technologies
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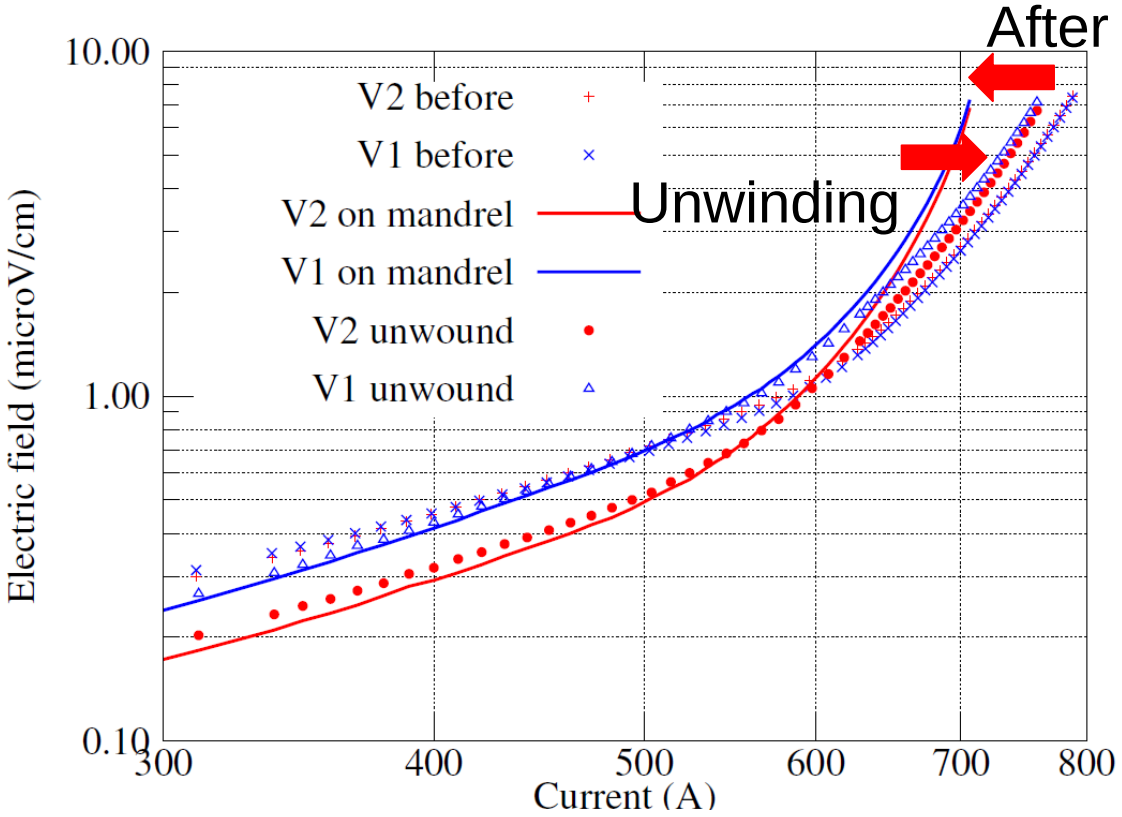
5% - 10% I_c degradation after being wound to the CCT grooves



- As expected
- Negligible self-field impact on I_c reduction
- *n* value increased after winding

Advanced Conductor Technologies
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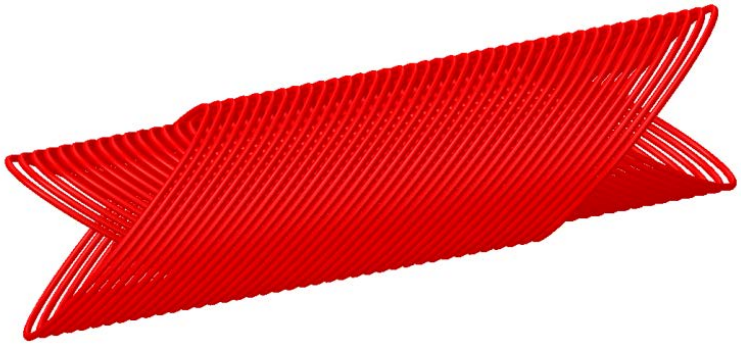
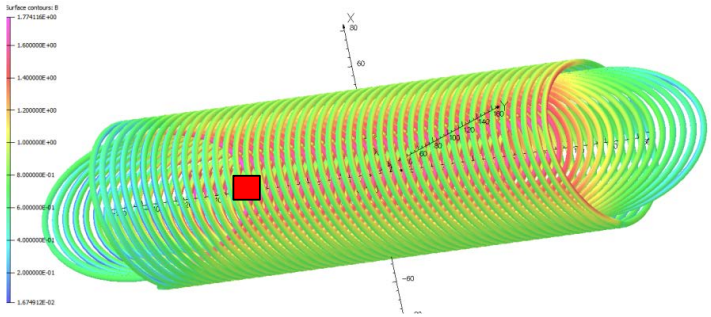
A subscale CORC® CCT dipole magnet

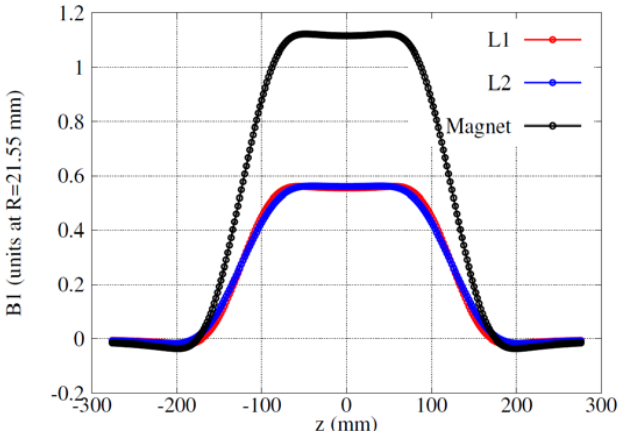
- 2 layers, 40 turns using single CORC® wires
  - 70 mm aperture, 500 mm long, 40 m long conductor
  - Wire minimum bending diameter 46.5 mm (10% I_c degradation)

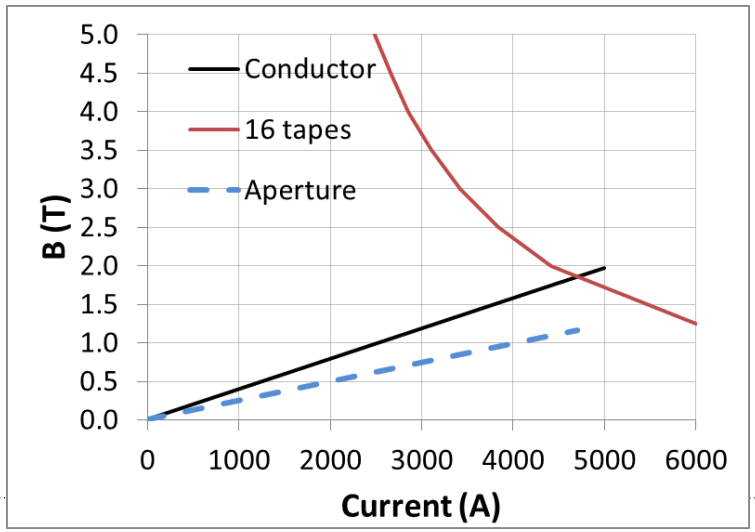


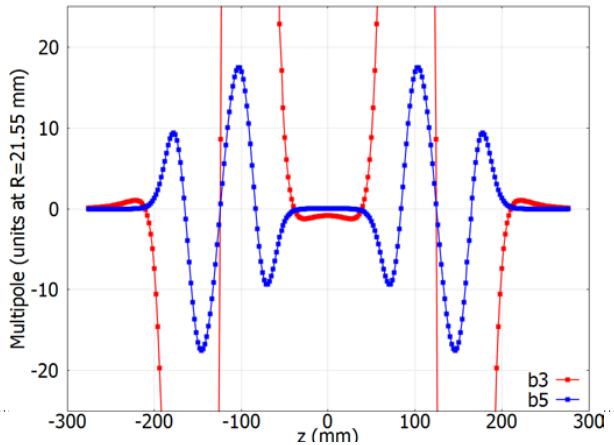
- Establish a magnet platform to provide feedback on conductor development

Moderate 1 T dipole field at 4.2 K

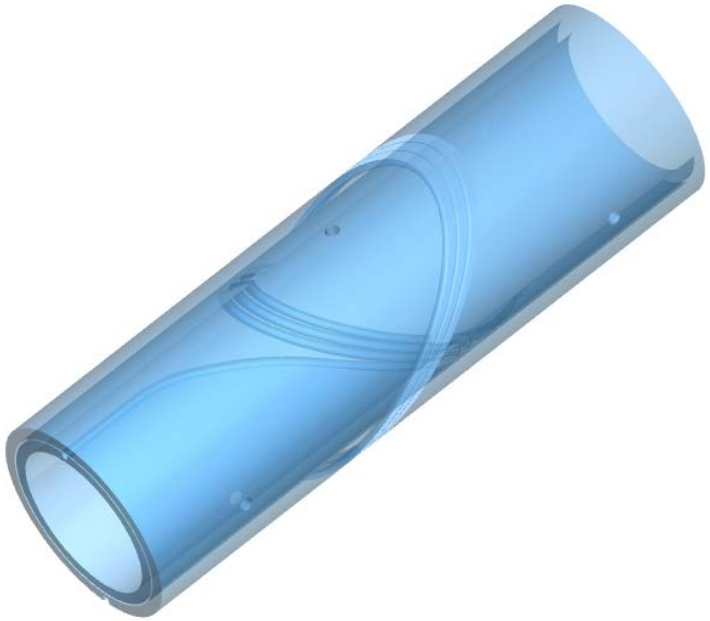






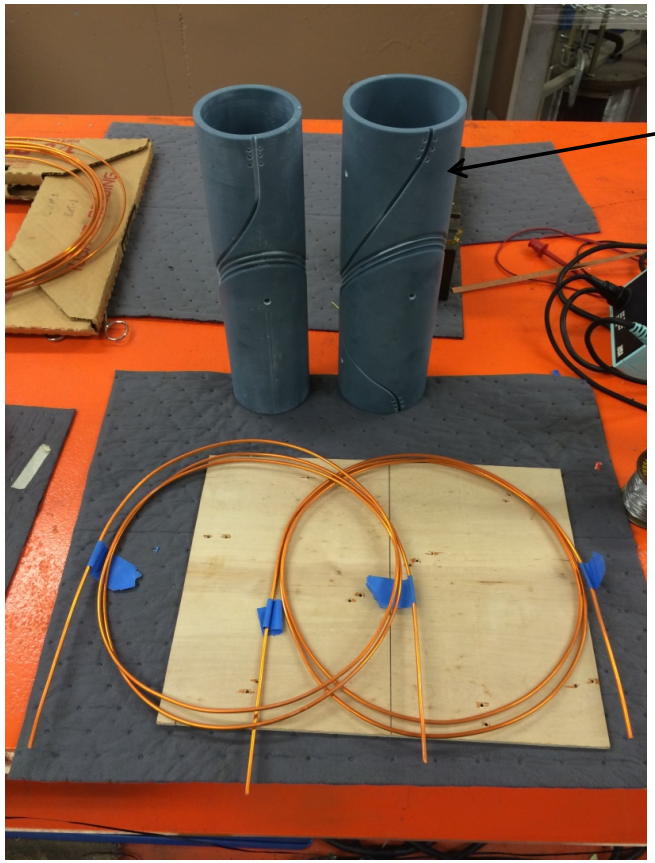


We started with a 2-layer 3-turn mini-coil



- Same design as the subscale except with only 3 turns
- An affordable and quick turn-around vehicle to develop magnet technologies: winding, assembly, joints, impregnation, test and etc.

How it would look like – mandrels and conductors



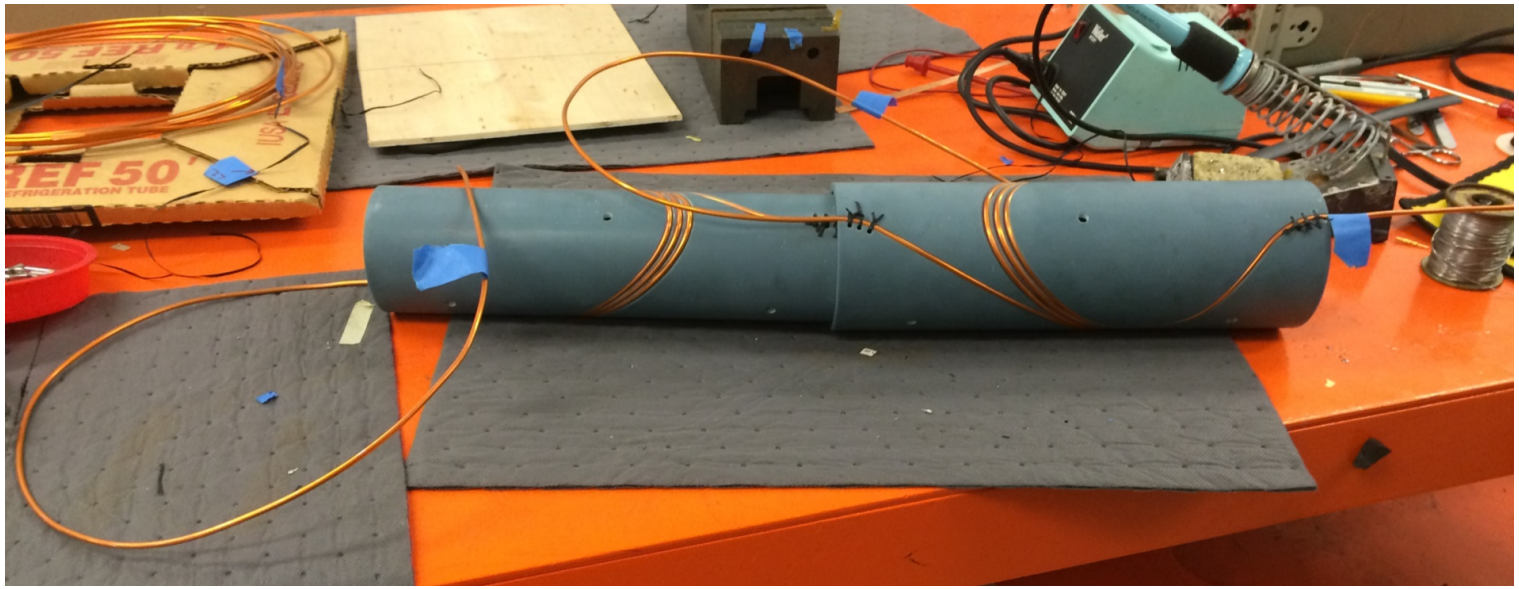
Mandrels printed with Accura® Bluestone

- Quick and inexpensive
- -0.6% contraction from room temperature to 4.2 K

How it would look like – after winding each layer

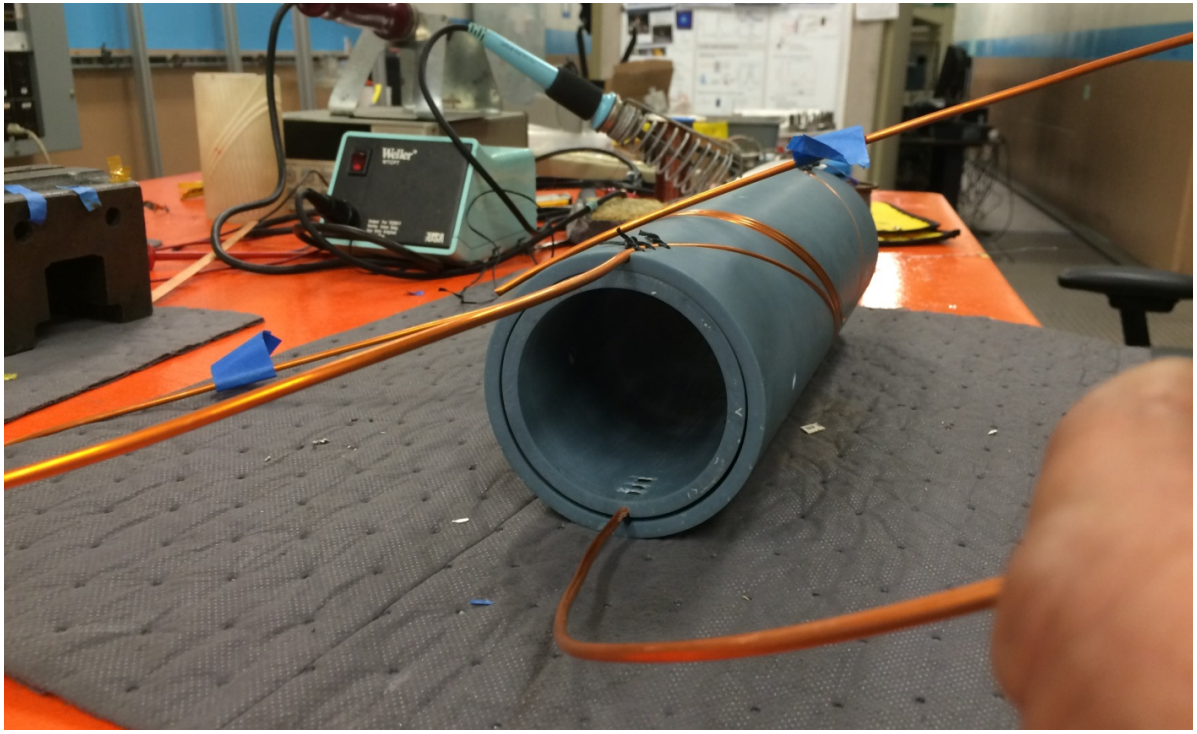
- Joints will be tricky
  - Low resistance. Enough length for current transfer
  - Clear for aperture. Support in background field

How it would look like – assembly



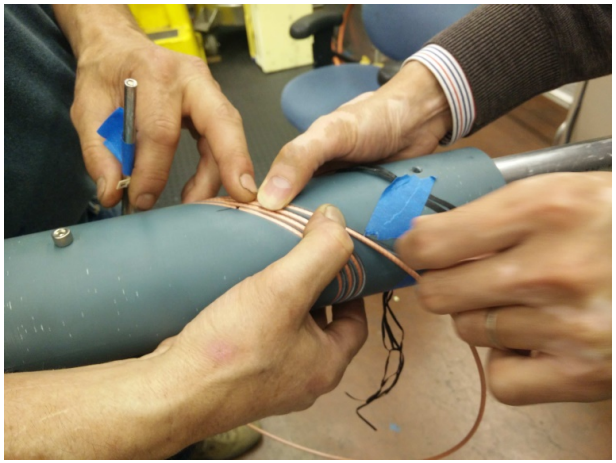
- Clearance and alignment between layers
- Impregnation
- Joint development

How it would look like

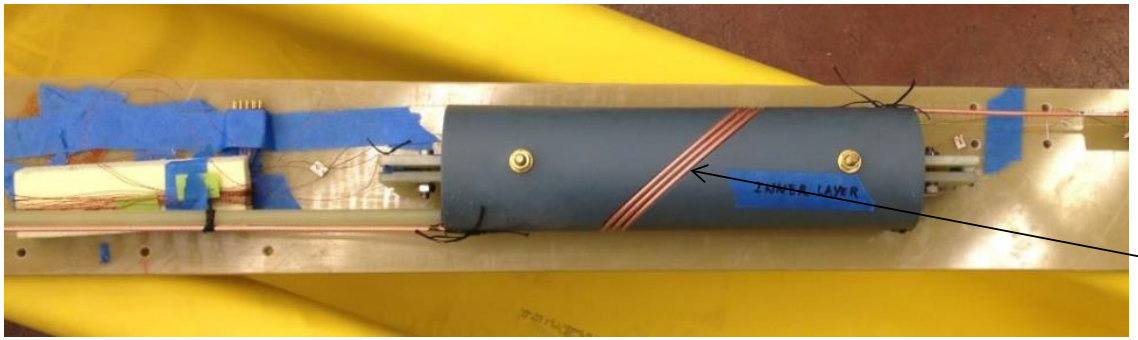


Now let's try the real conductor…

The 3-turn inner layer was wound and tested in LN_2

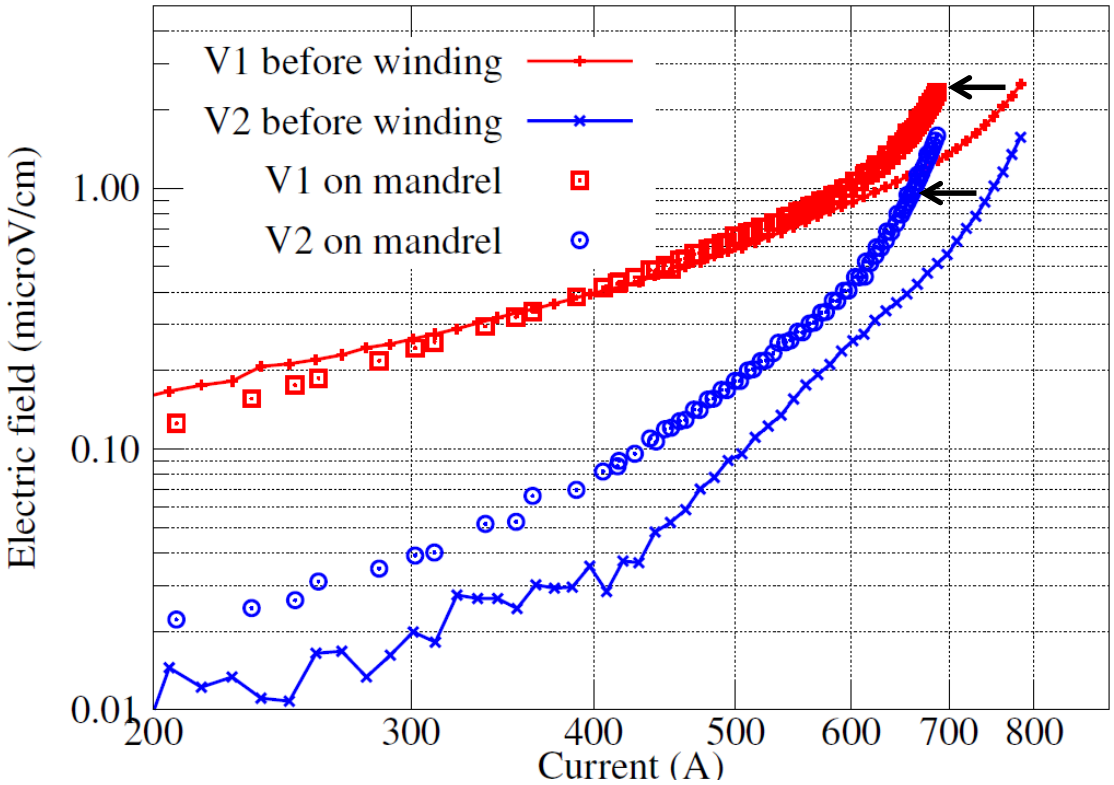


- CORC® wire diameter 3.09 mm
- 8 layer of SuperPower tapes
- Each tape 2 mm wide with 30 μm thick substrate



Hall sensor in the aperture

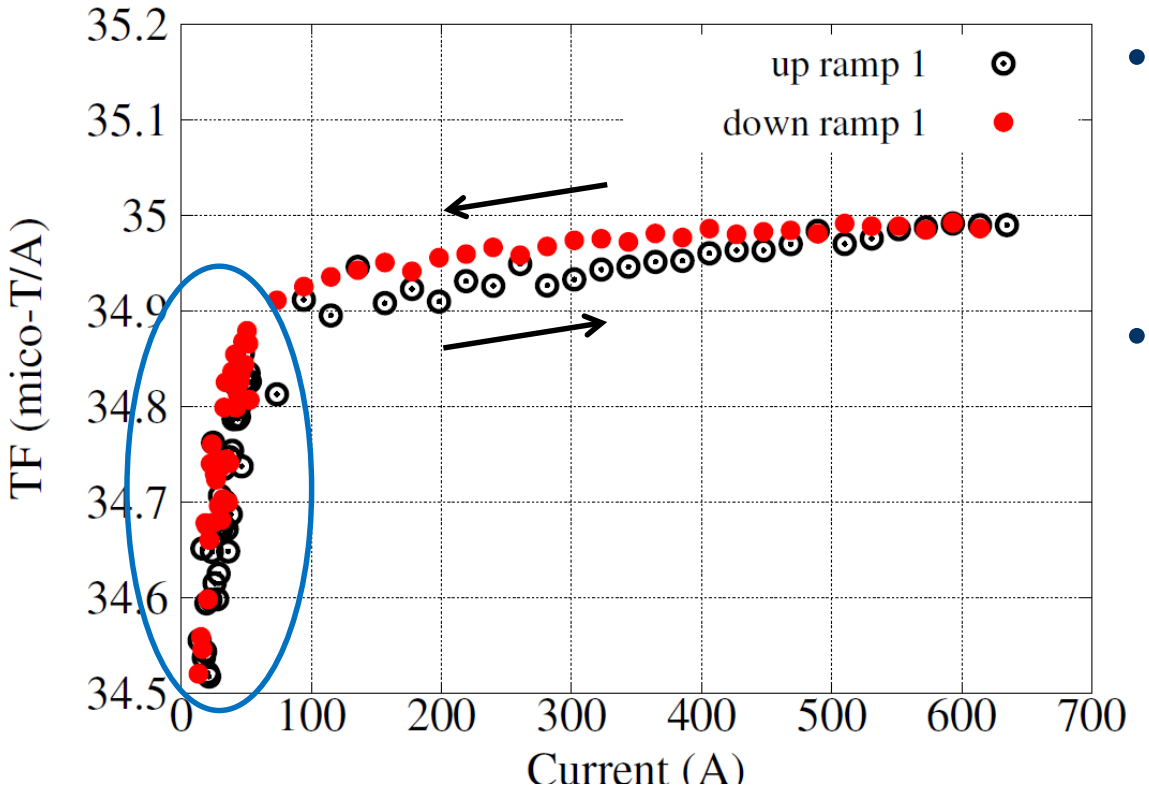
I_c degraded 11% after winding, consistent with vendor data



- 754 A to 673 A
- n value increased from 9 to 13

Image courtesy J. Weiss, ACT

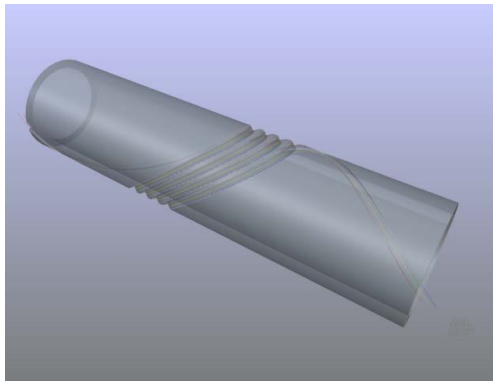
Signature of persistent-current effect (screening-current effect)

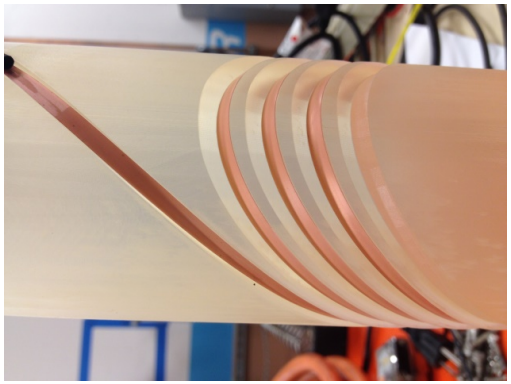


- Hysteresis between up and down ramps
- Non-linear behavior below 100 A

Next steps for the REBCO CCT magnet development

- Complete and test the 3-turn mini-coil at 77 K and 4.2 K
  - Continue to use the 3-turn platform to study the impregnation and other issues
- Develop the 40-turn subscale magnet
- Develop the tape-stack version





Summary

- LBNL is developing technologies for REBCO accelerator magnet applications
  - Connecting conductor developments with magnet needs
  - Provide feedback to the conductor development based on magnet performance

- A CORC CCT dipole coil is a first step toward this goal
  - Two 3-turn coils are developed and tested at 77 K
  - The coils will be assembled and tested at 77 and 4.2 K