

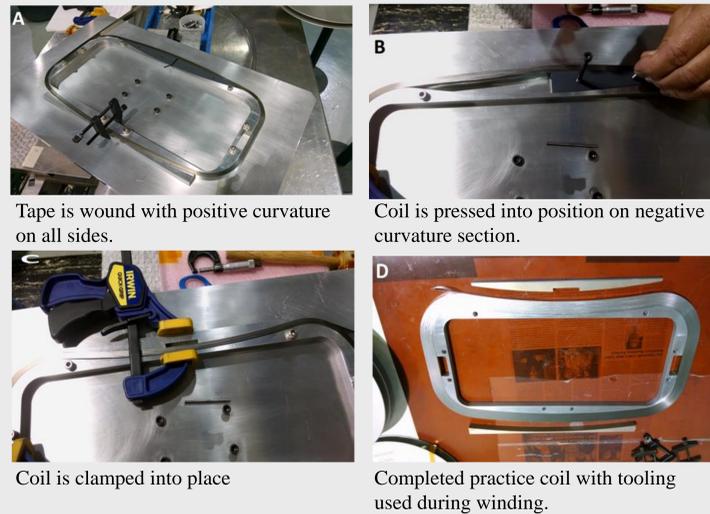
Introduction

This study addresses two issues for dipole magnets subtending large bend angles:

- Curved coils have difficulties during winding as the inner curved (concave) side with negative curvature tends to unwind.
- Heat removal for low temperature superconductors is difficult.
 - NbTi and Nb₃Sn operate at ~4.5 K.
 - HTS can operate at 35-50 K with Carnot greater efficiency.

Muons, Inc. and BNL were awarded an SBIR/STTR grant to develop the curved dipole technology using HTS conductor.

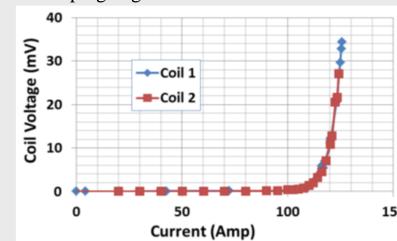
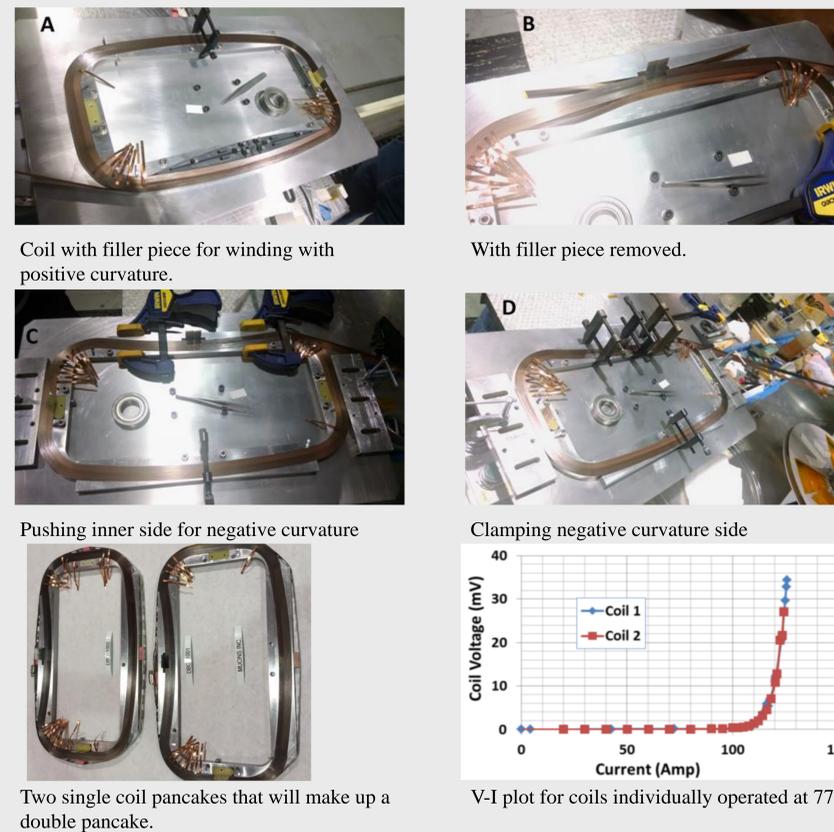
Test Winding with Stainless Steel Tape



Proof of Principle Demonstration Coils

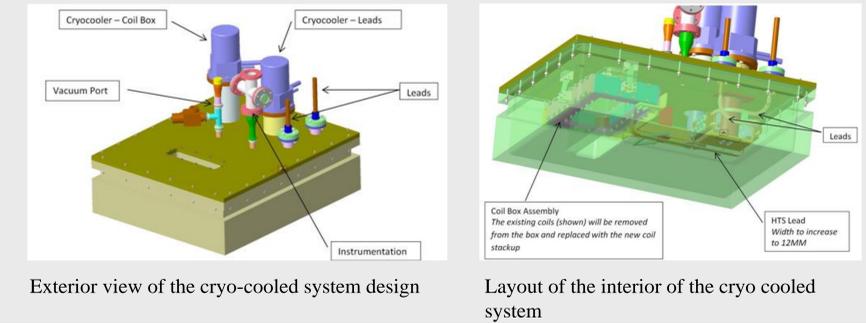
- Two coils are wound using Super Power 12 mm (SCS 12050-AP) conductor.
 - The coils are assembled into double coil pancake.
- Coils wound to have a negative curvature (concave) section. Techniques are developed for the coil winding procedure.
- We have taken advantage of using an existing cryostat available at BNL.
 - The geometry is chosen to fit into the cryostat.
- Two Cryocoolers are used for the refrigeration.
 - The coils and leads are cooled without using helium.
- The individual coils are tested at 77 K and assembled together in the cryostat for testing at 40-50 K.

Fabrication and Testing of Coils

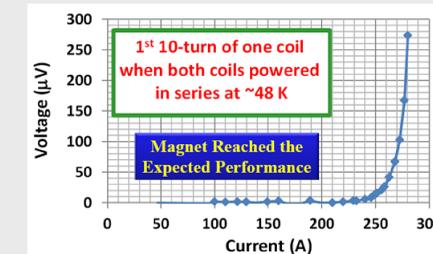
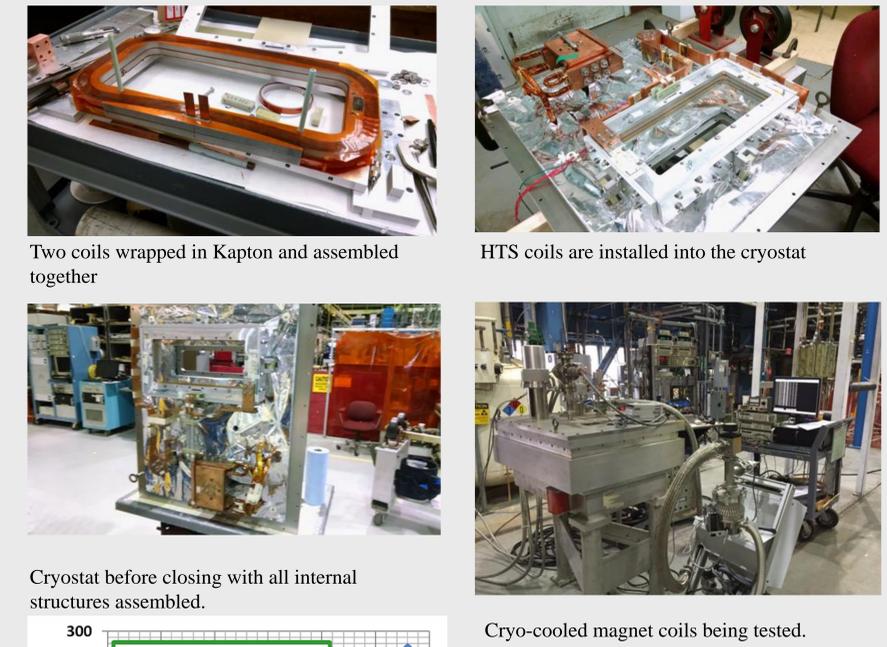


V-I plot for coils individually operated at 77 K

Cooling and Cryostat Design



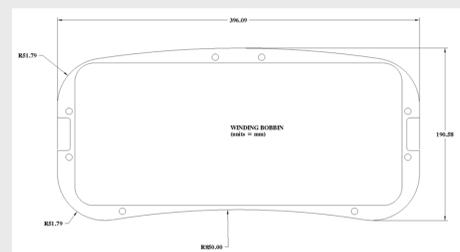
Assembly and Testing of the HTS Coils inside the Cryostat



Test results for the magnet cooled to 48 K. The ratio of quench current at 48 K to that at 77 K is consistent with the expected lift factor for the conductor

TABLE I:
GEOMETRIC COIL PARAMETERS

Parameter	Value
Height	190.58 mm
Width	396.09 mm
Thickness	12.7 mm
Coil Curvature	850 mm
Corner Curvature	51.79 mm



Conclusions

We have built and tested curved HTS magnet coils using cryocoolers. The fabrication techniques that were used to wind the coil with positive curvature and press the HTS conductor to the negative curvature configuration did not cause any observable degradation. This technology should be useful for other accelerator applications.

Acknowledgements

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