

Development of CORC[®] cable terminations and low-loss joints for use in magnets for fusion

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Thu-Mo-Po4.04-02 [25]

CORC[®] conductors

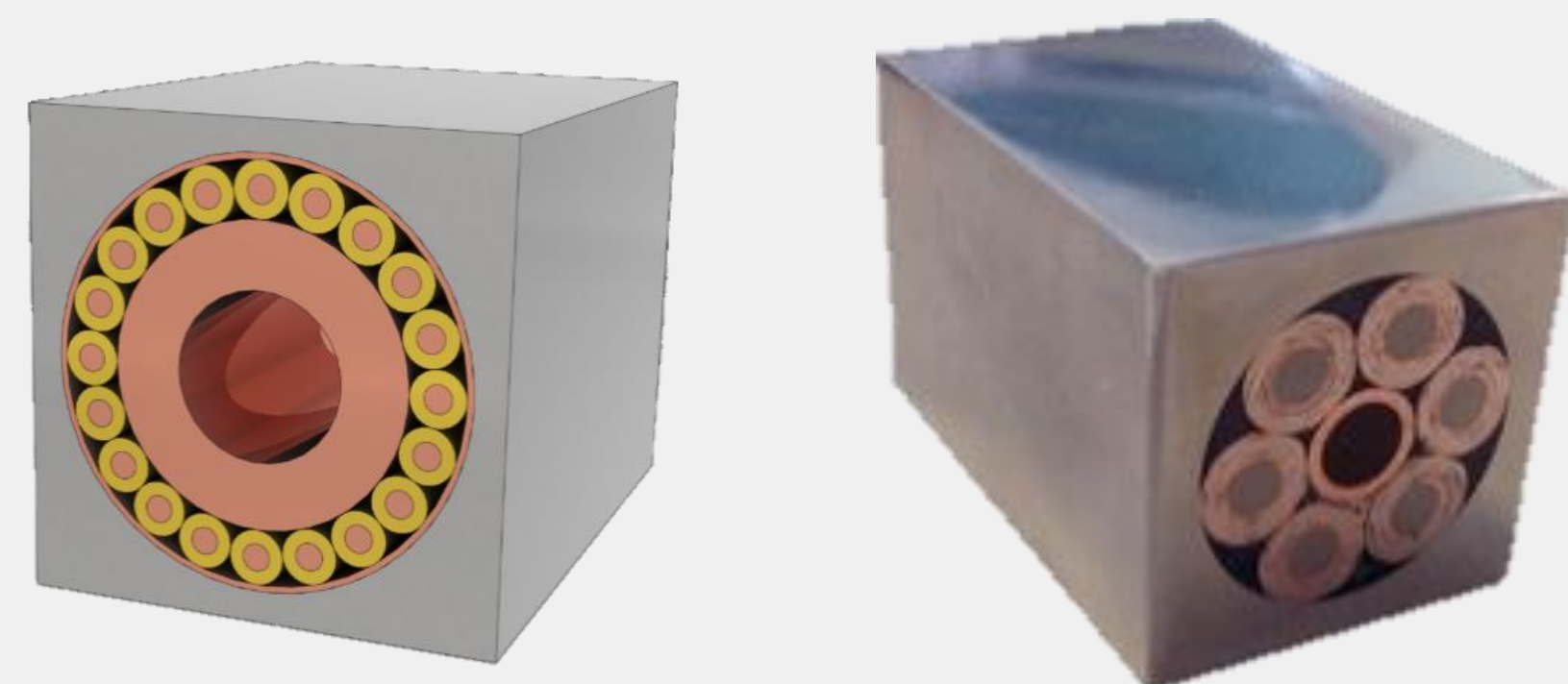


Conductor on Round Core (CORC[®]) cables and wires consist of High Temperature Superconducting (HTS) tapes wound helically around a small former

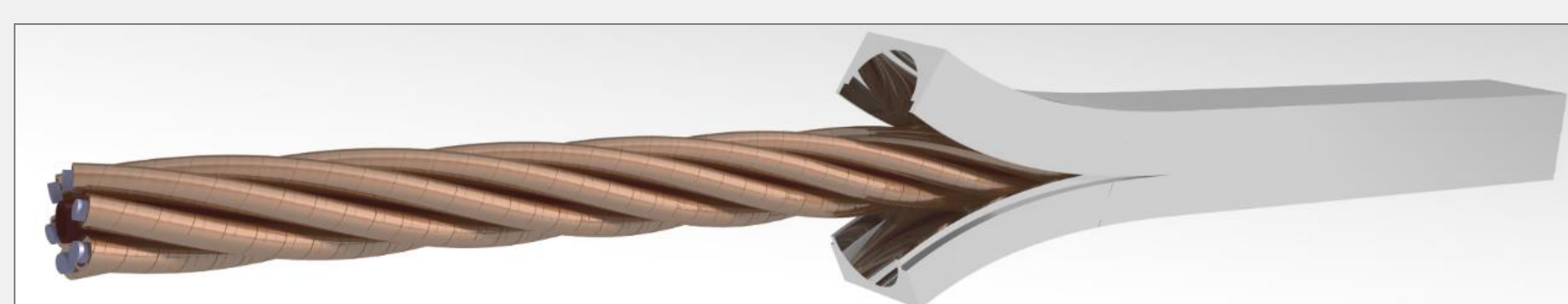
CORC[®] magnet cables and wires are being developed for fusion magnets with high in-field operating currents

	CORC [®] magnet cables		CORC [®] magnet wires	
Diameter	5 to 8 mm		2.5 to 4.5 mm	
Temperature, Field	4.2 K, 20 T	30 K, 8 T	4.2 K, 20 T	30 K, 8 T
Current	> 10,000 A	> 7,500 A	> 5,000 A	> 3,500 A
Current density	Up to 600 A/mm ²	Up to 450 A/mm ²	Up to 450 A/mm ²	Up to 340 A/mm ²

CORC[®] cables or wires can be bundled together into cable-in-conduit conductors (CICC) rated for currents of 50-100 kA or more



CORC[®] bundle O.D. 22 – 24 mm

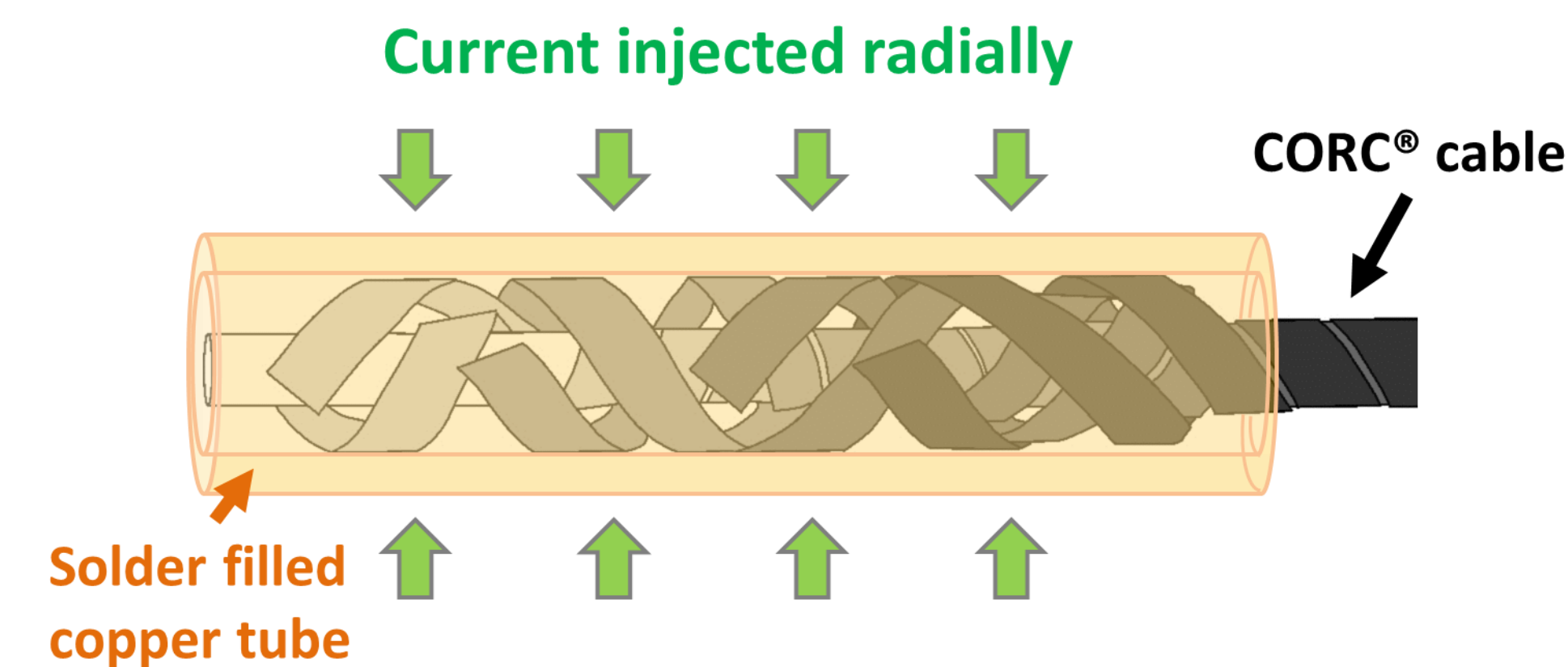


This work was in part supported by the US Department of Energy under agreement numbers DE-SC0013723, DE-SC0018125, DE-SC0014009

Consistent contact resistance between terminations and every tape in an HTS cable is essential to energize the cable to its full capacity

Tapering of tapes allows even current injection

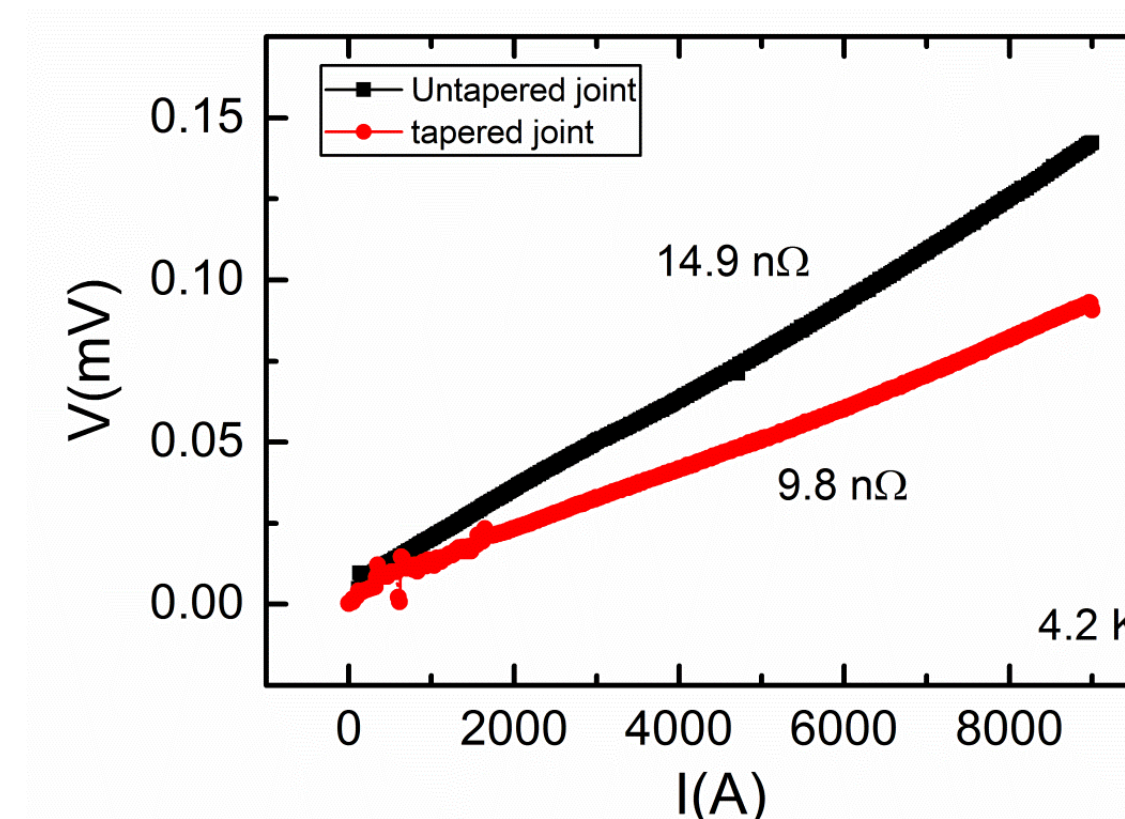
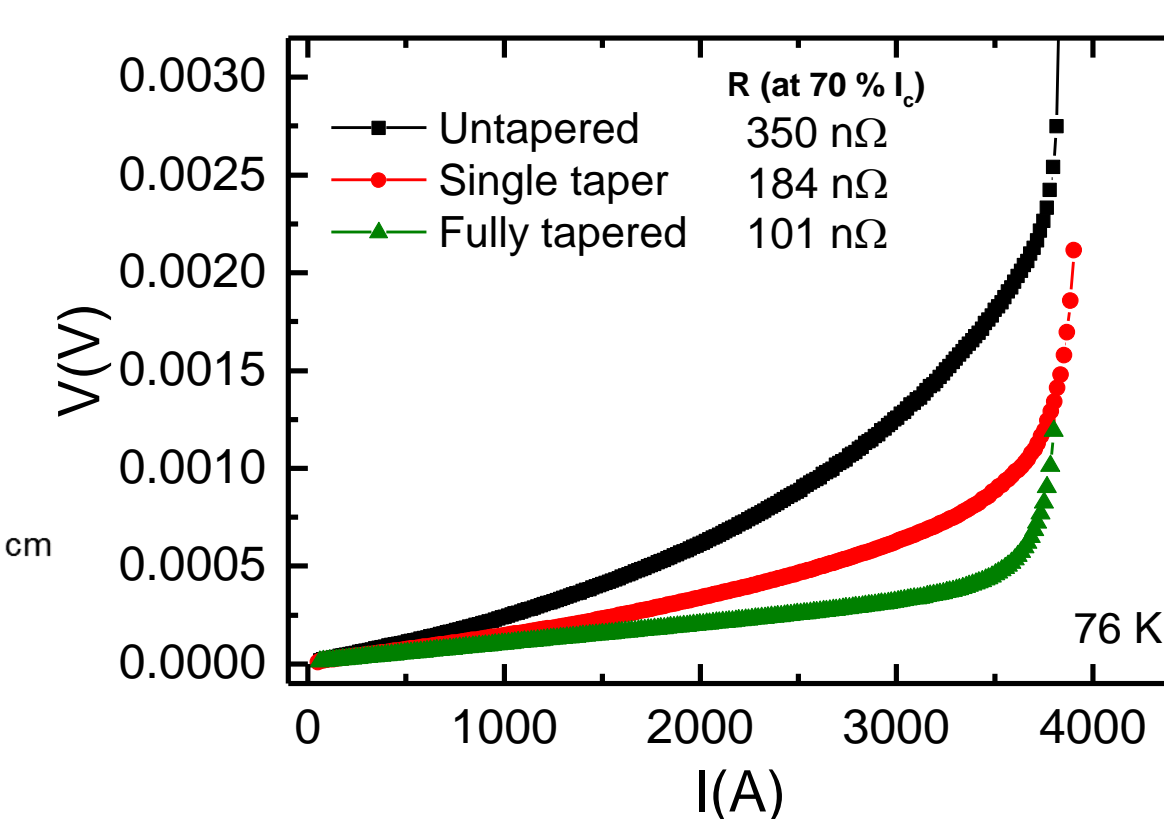
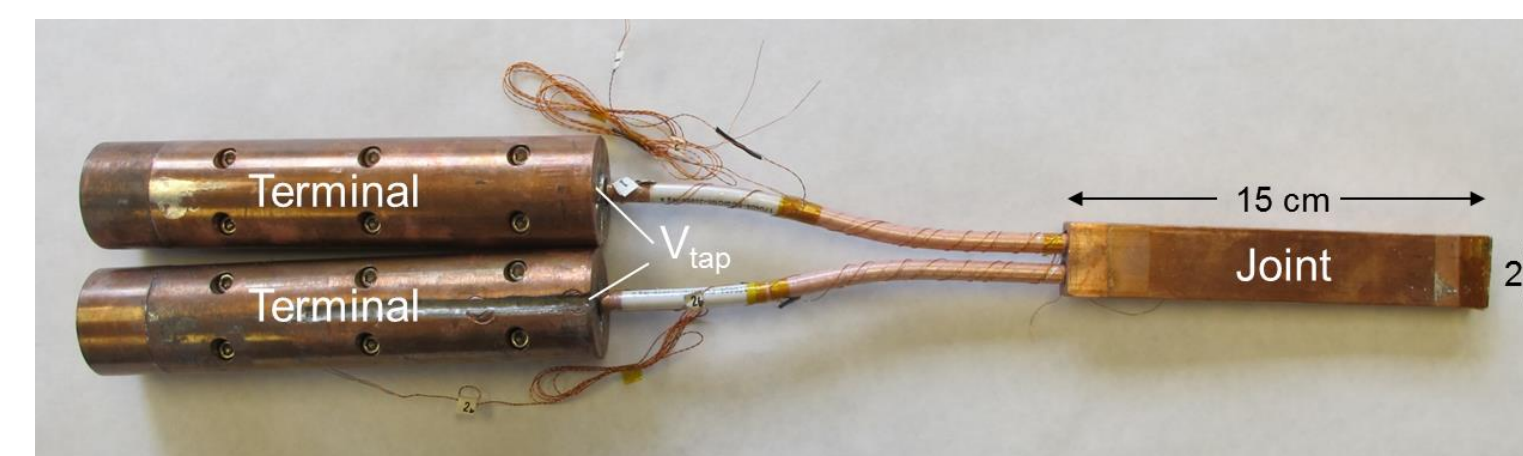
Tube terminals: R (76 K) = 5 to 50 nΩ



Joints tested with and without tapering

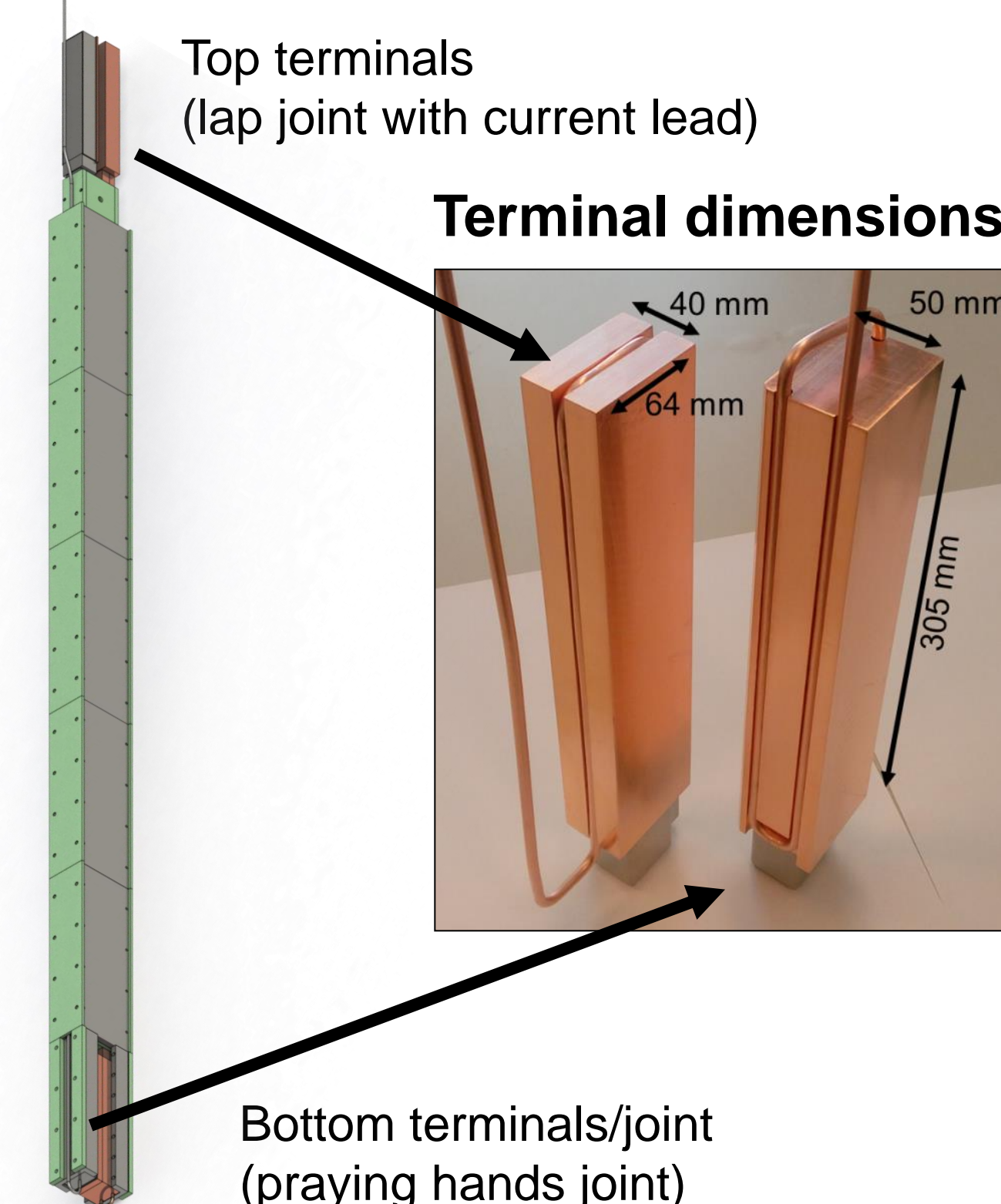
Uneven current injection from terminals with untapered tapes results in higher overall contact resistance and non-linear V(I) transitions below the critical current

Joints tested between two CORC[®] cables with 30 tapes each

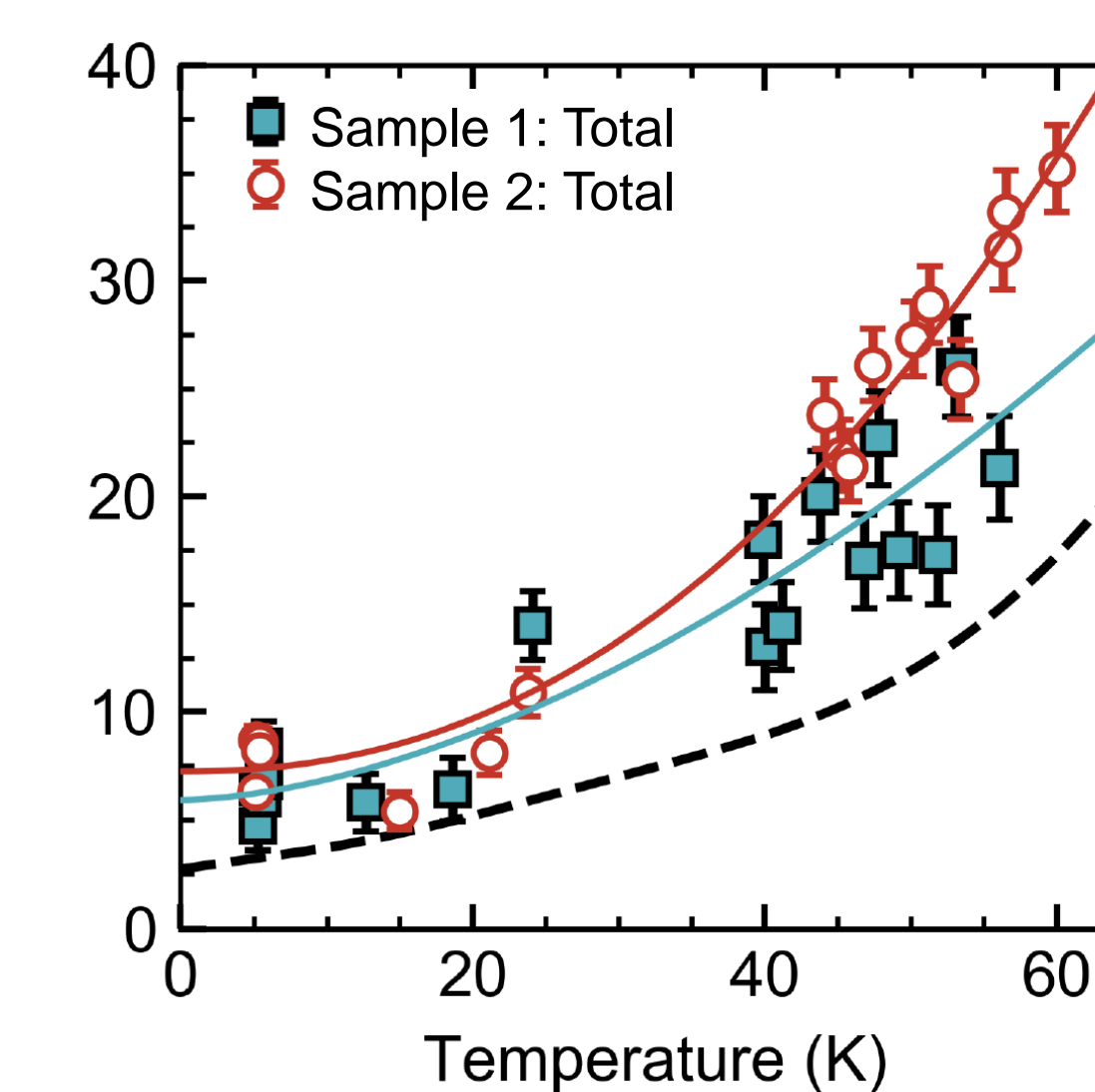
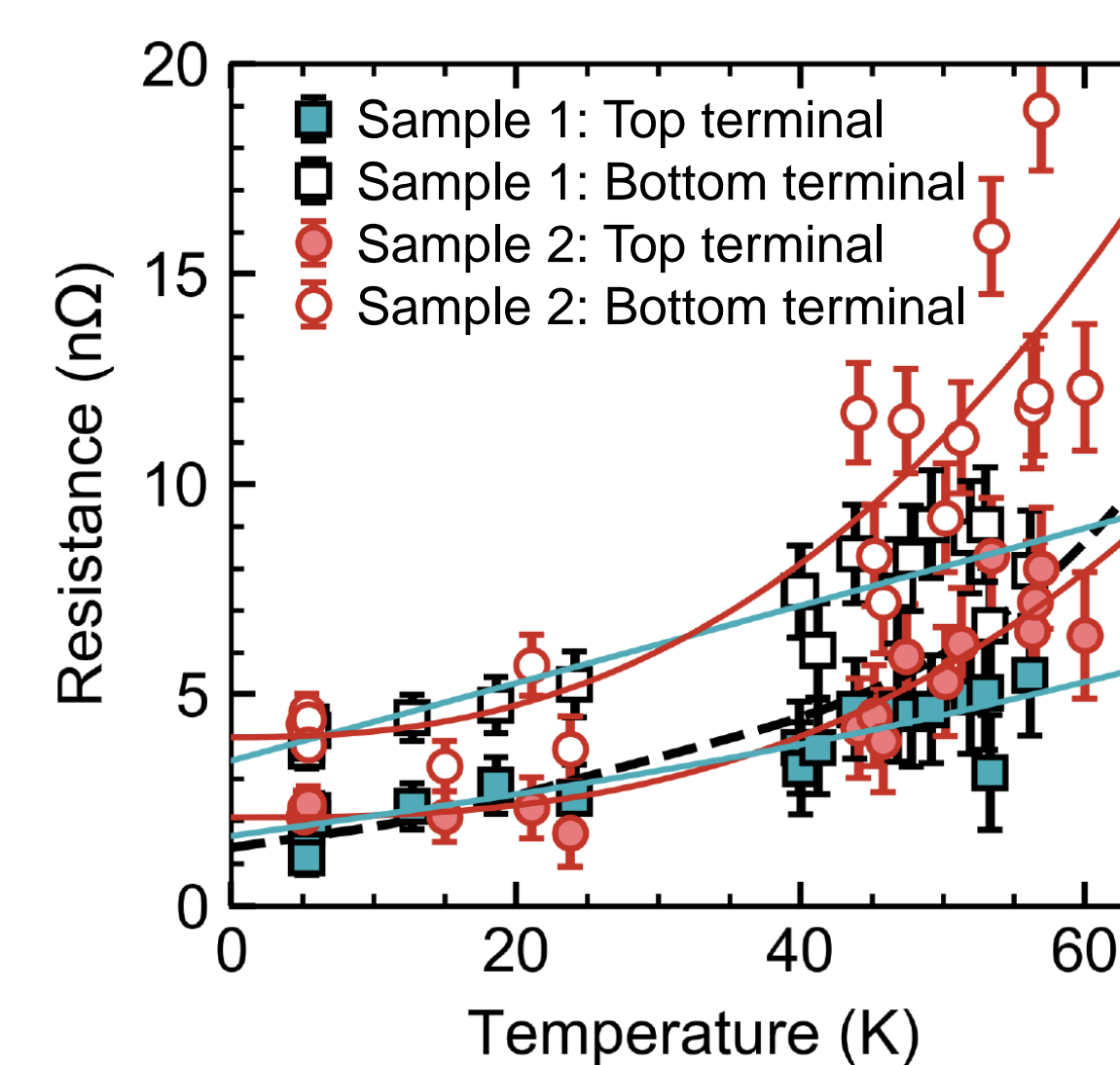


6x1 CORC[®] CICC terminations and joints

Two samples tested in series at the SULTAN test facility



6x1 CICC terminations: R (5 K) = 2 to 4 nΩ
Splice between two samples: R (5 K) = 3.3 nΩ



Tim Mulder's thesis: *Advancing ReBCO-CORC Wire and Cable-In-Conduit Conductor Technology for Superconducting Magnets*
<https://doi.org/10.3990/1.9789036546164>

Demountable joints

CORC[®] tube terminals can easily be clamped together into joints

Clamped praying hands joint between tube terminals: R (4.2 K) = 7.9 nΩ

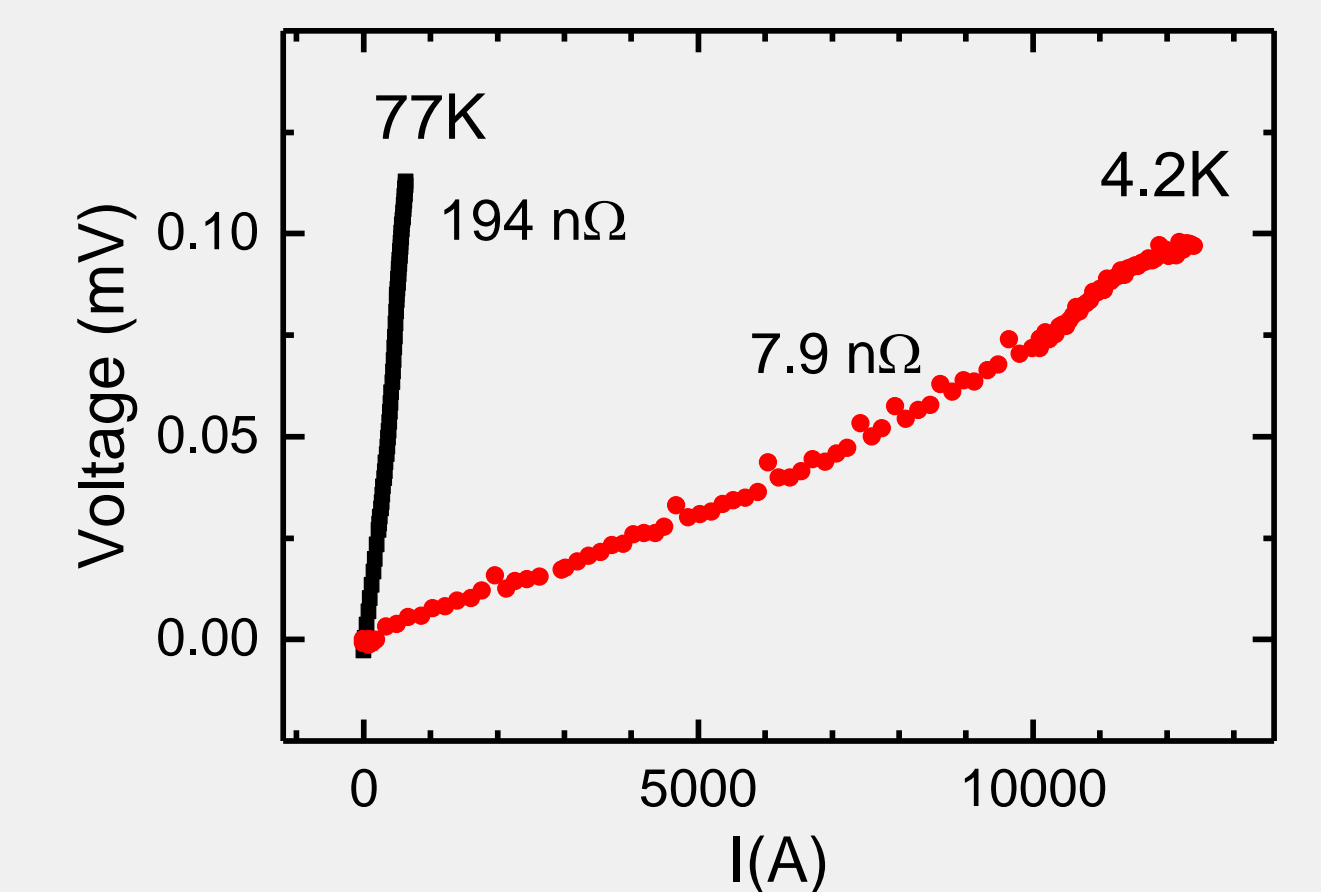
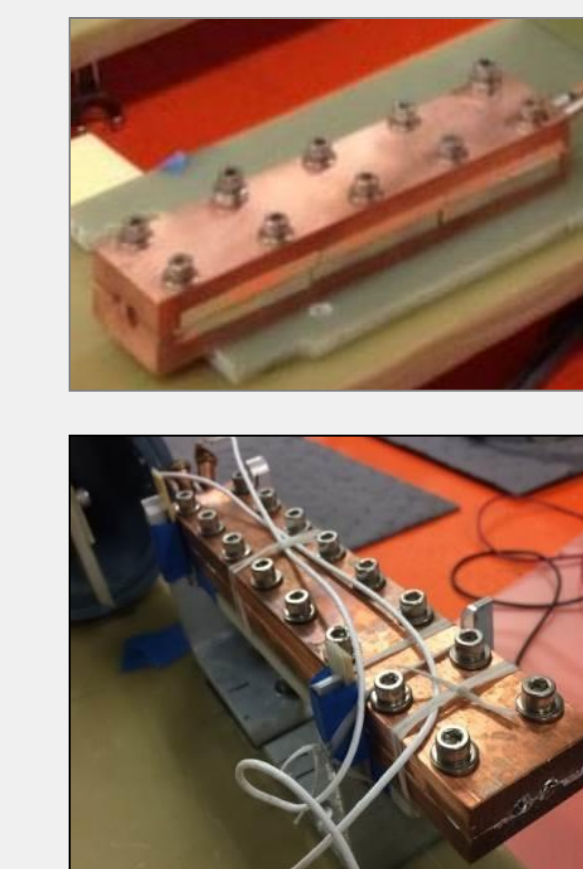


Image courtesy of X. Wang

Plug style Male to Female connectors: R (76 K) = 465 nΩ (old data, not-tapered)



Future work

Next generation of CORC[®] demountable joints aiming at < 1 nΩ resistance at 4.2 K

Plug style joint with tapered cables

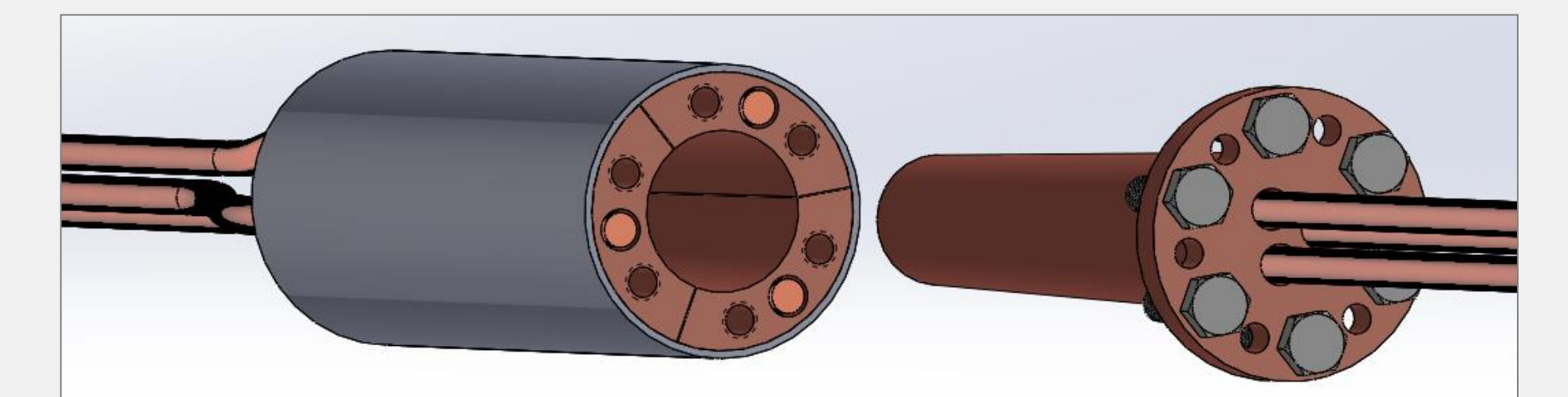


Plate style joints

