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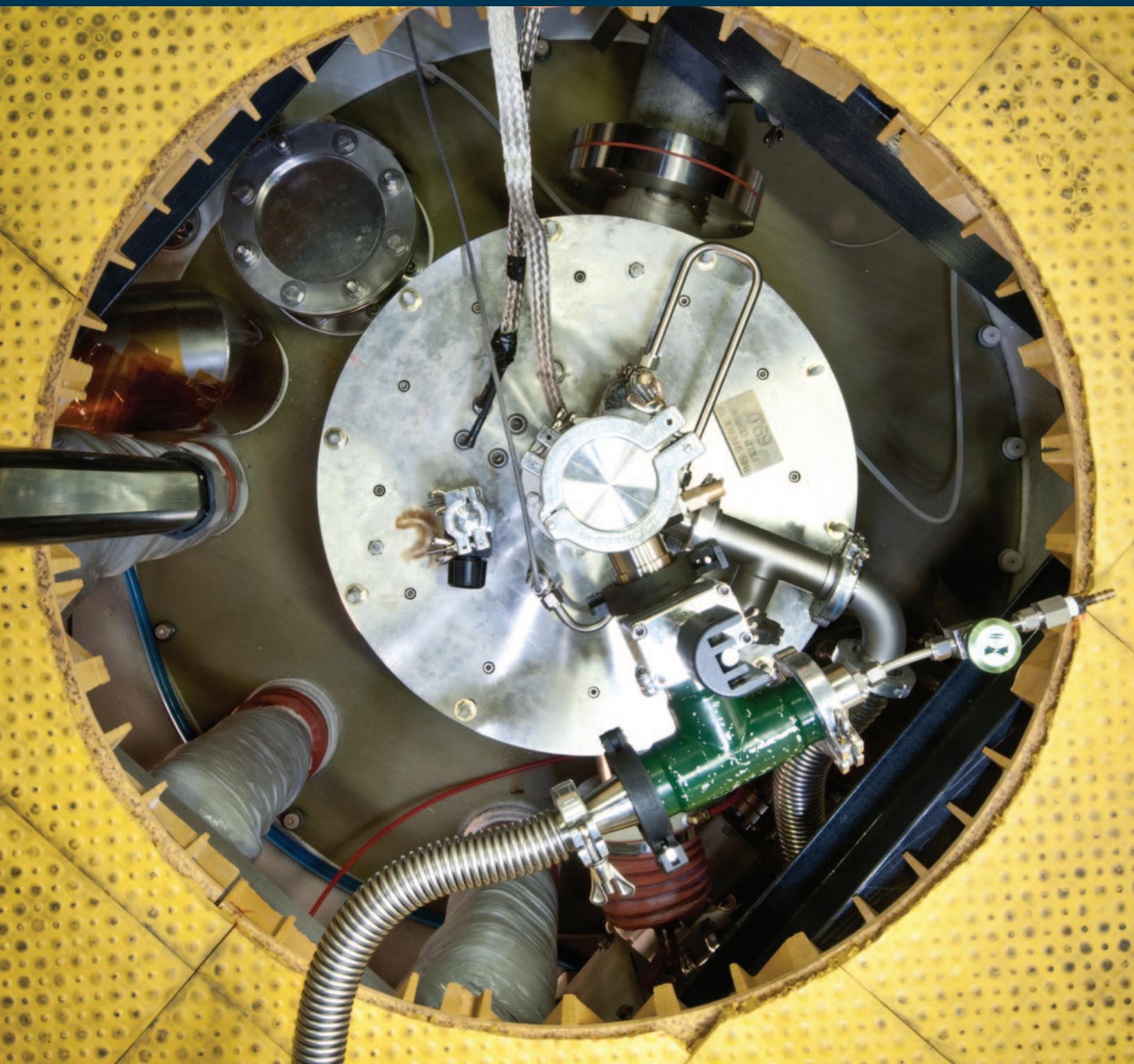

High-temperature superconducting magnet cables reach a record current at a magnetic field of 20 T

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A joint research team from the National High Magnetic Field Laboratory, the University of Colorado, and the National Institute of Standards and Technology has successfully demonstrated the world's first multi-layer electromagnet that was wound from a high-temperature superconducting cable at a field of 20.0 tesla. They also demonstrated a record winding current of 4100 amperes in a single-turn magnet at a background field of 19.81 tesla. The magnets were wound from superconducting cables that consisted of 20 to 40 strips of tape made with YBCO.

The results are an important milestone in the development of next-generation, low-inductance superconducting magnets. Such magnets carry a relatively high winding current and can be energized at a very fast rate. Current generation low inductance, superconducting magnets consist of metallic, so-called low-temperature superconductors that are fundamentally limited to magnetic fields of about 18 to 20 tesla.

Future accelerator magnets for high-energy physics experiments and magnets for fusion require magnetic fields that exceed 20 tesla, which can only be reached using high-temperature superconductors. These ceramic materials are produced in thin tapes or wires that need to be bundled into high-current, flexible cables when used in low-inductance magnets. Cabling of high-temperature superconductors is quite challenging due to the brittle nature of the ceramic superconducting material. Dr. van der Laan from the University of Colorado and the National Institute of Standards and Technology has developed a new method to cable YBCO tapes that leaves the fragile superconducting layer intact[1]. Many superconducting tapes are wound in a helical fashion on a flexible core to form Conductor on Round Core Cables (CORCC).

The multi-layer magnet consisted of 12 turns in 2 layers and had an inner diameter of only 9 centimeters. It was tested in a background field of 19.81 T at a temperature of 4.2 K in liquid helium, where it carried a current of 1950 amperes and raised the magnetic field to just above 20 tesla. The winding current density at 20 tesla was 50 A/mm2.

A second magnet was tested to demonstrate the potential of even higher winding current densities in these cables. A single-turn magnet was wound from a cable that consisted of 40 YBCO tapes. It carried a world record current of 4100 A in a background field of 19.81 T, which is a winding current density of 93 A/mm^2.

The cable that carried a world record current of 4100 amperes in a background field of 19.81 tesla.

The high-temperature superconducting cable technology is currently being commercialized by Advanced Conductor Technologies LLC that was recently founded by Dr. Danko van der Laan. For more information, please visit www.advancedconductor.com.

REFERENCES

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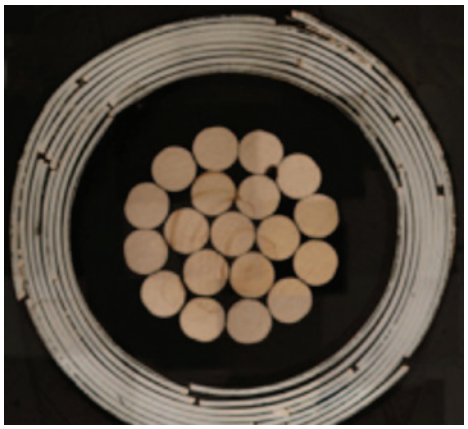
2. D.C. van der Laan, X.F. Lu, and L.F. Goodrich, *Supercond. Sci. Technol.* **24**, 042001, (2011);
3. D.C. van der Laan, L.F. Goodrich, and T.J. Haugan, *Supercond. Sci. Technol.* **25**, 014003 (2012).

The six windings that form the inner layer of the magnet.



Cross-section of a typical CORC cable that contains 24 YBCO tapes.

The cable that carried a world-record current of 4100 amperes in a background field of 19.81 T.