VHFSMC

Very High Field Superconducting Magnet Collaboration

The VHFSMC Collaboration

Fermilab

THE APPLIED SUPERCONDUCTIVITY CENTER · NHMFL · FSU

NATIONAL HIGH MAGNETIC FIELD LABORATORY · FSU · UF · LANL

FLORIDA STATE UNIVERSITY · 1851

Los Alamos NATIONAL LABORATORY EST. 1943

BERKELEY LAB

AFRD ACCELERATOR & FUSION RESEARCH DIVISION

BROOKHAVEN NATIONAL LABORATORY

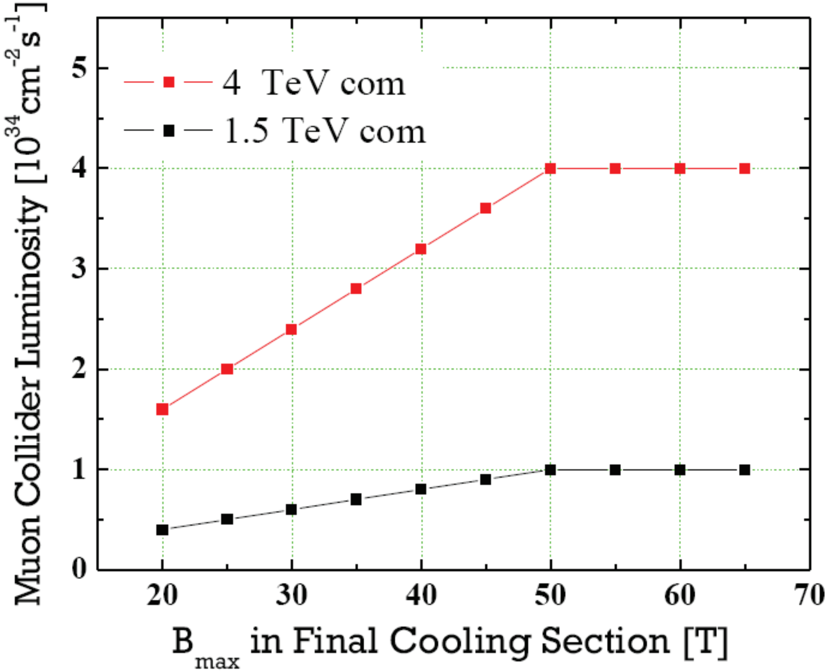
NIST

TEXAS A&M UNIVERSITY

VHFSMC Goals

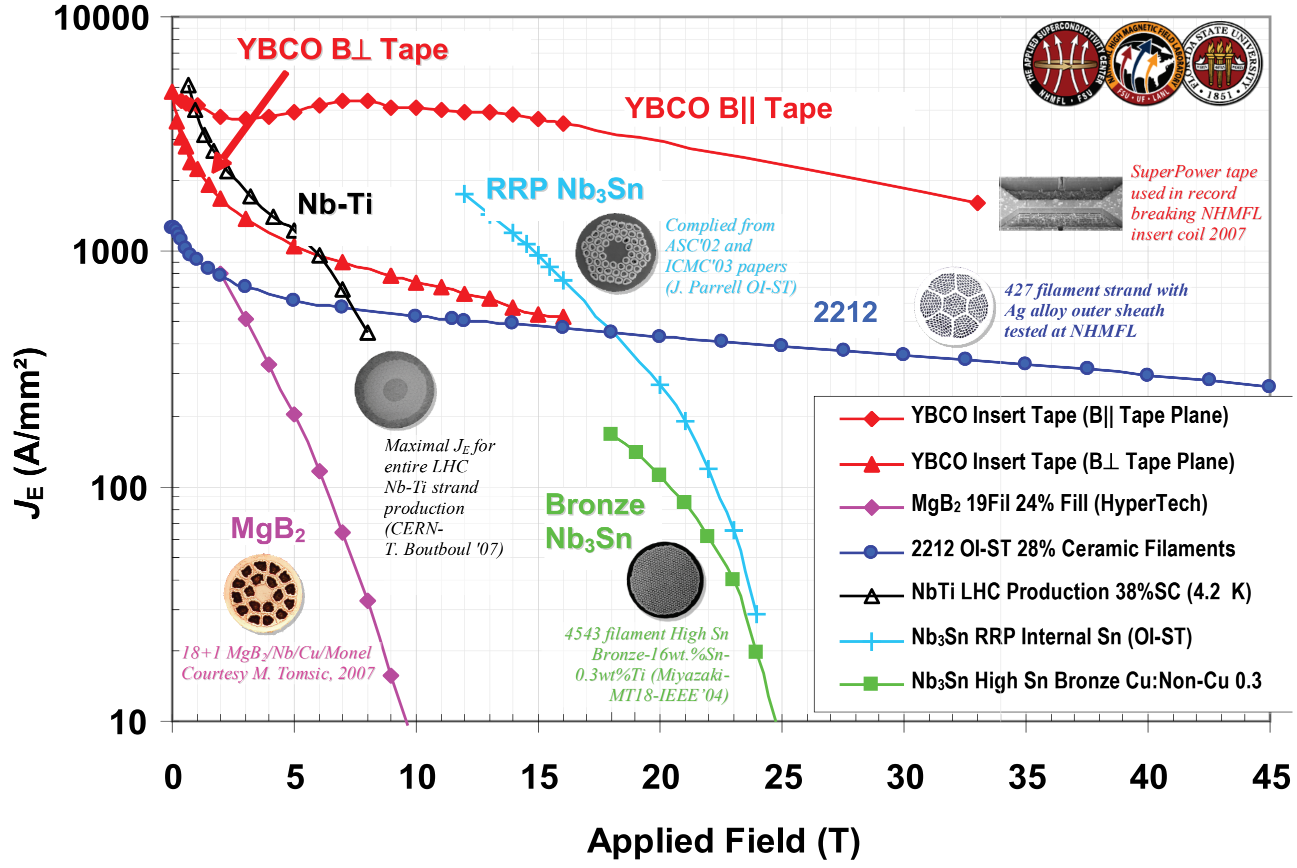
- **The primary goal is to develop the Technology of High Temperature Superconductors for use in magnets at fields beyond those available for Nb based conductors.**
- **This supports the needs of the muon collider R&D as well as the NMR community (see National Academy COMAG report)**

1. L ~ B solenoid
2. L ~ B in collider ring
3. HTS Conductors may be Rad Hard. (BNL & CERN reports)



Quick Overview of Bi 2212
Why the excitement?

MCTF



Goals and Tasks

The immediate goal (2 years) is to understand if Bi 2212 is a suitable vehicle for this task. The work has been broken down into 6 tasks:

1. **Understand the material science of Bi 2212.**
2. **Measure and understand the response of Bi 2212 to axial and transverse loads.**
3. **Develop the cabling technology.**
4. **Understand the stability and quench behavior of the conductor and coils.**
5. **Test Bi 2212 in wind and react environment.**
6. **Integrate Industry into collaborative R&D.**

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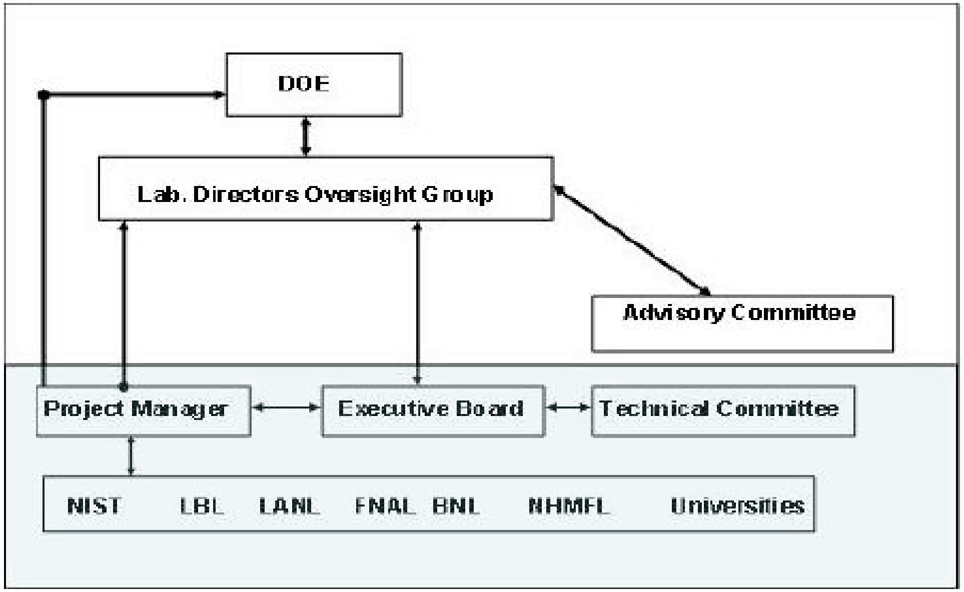
Organization of VHFSMC

Oversight Group:

- Chair Greg. Boebinger, Director National High Magnetic Field Laboratory.
- Steve Vigdor, Associate Director for Nuclear and Particle Physic BNL
- Steve Holmes, Associate Director for Accelerators FNAL
- J. Siegrist, Director Physics Division LBNL
- Mike Kelley, Division Chief, Electromagnetics Division (ex officio) NIST

David Larbalestier NHMFL is Chairman of the Technical Committee.

Arup Gosh (BNL) is Project Manager



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Status and Reasons Why

We have received word from the DOE that this effort will be funded at $4 M spread over two years. Further funding will depend on performance and the results we achieve.

This program was necessary for two reasons:

Conductor

The major support of HTS conductor development is from the power industry. Their interest is in the high J_c , low B, and high temperature (LN_2 or higher) conductor. Support is necessary for the special needs of HEP magnets which involve very high fields, need high current density and which can only be achieved at LHe temperatures with the HTS conductors.

Magnets

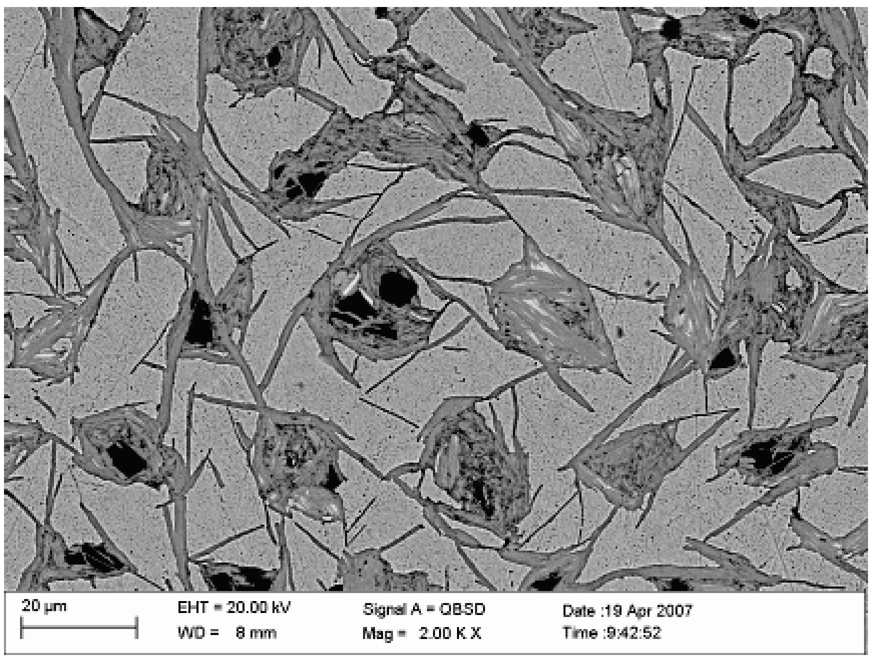
The use of the HTS material in HEP type magnets at very high fields will require both new theoretical understanding of the material as well as extending our technology for magnet construction.

- This collaboration is much stronger than any one member:

1. **Industry where the conductor is fabricated.**
2. **The National Labs where the magnet building technology is located.**
3. **The material scientists in the universities who can help guide the improvement of the conductor.**

Collaboration Rich in Resources

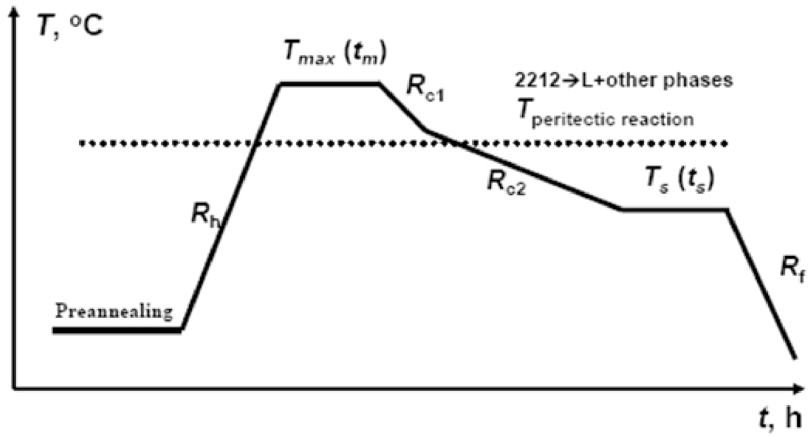
Major thrust is understanding heat-treatment-microstructure-chemistry relationship to the J_c of the conductor. This work is taking place at NHMFL-LANL. Great facilities for exploring conductor physics



Cross section of 2212 taken at NHMFL. Very sophisticated instrumentation now available for studying the conductor. Hope to increase J_c by improving connectivity which depends on the heat treatment.

Some Challanges

Wind and react has delicate temperature profile.

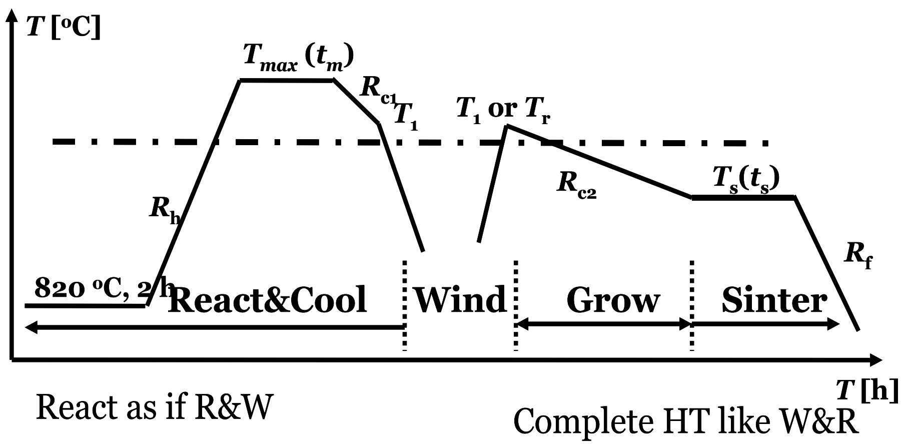


A typical heat treatment profile for Bi-2212 wire reaction. This empirical reaction procedure typically has tight tolerances ±2°C on *Tmax*, different specifications on the heating and cooling rates *Rx* and secondary hold temperature and oxygen partial pressures. There is a huge need to understand what occurs during each step of the process so as to better optimize it. Quenching samples from multiple points in the process and correlating microstructure and superconducting properties is one important tool to be applied to this goal.

Good progress lately on understanding the requirements at NHMFL.

Some Challenges Continued

React and wind may be a solution



React-wind-sinter heat treatment protocol. Proposed by Justin Schwartz. The horizontal dashed line represents the peritectic melting temperature, though there is evidence that peritectic melting begins at a lower temperature during the second heat treatment than in the first. Has the advantage that the critical parts of the heat treatment are done on the cable NOT the magnet.

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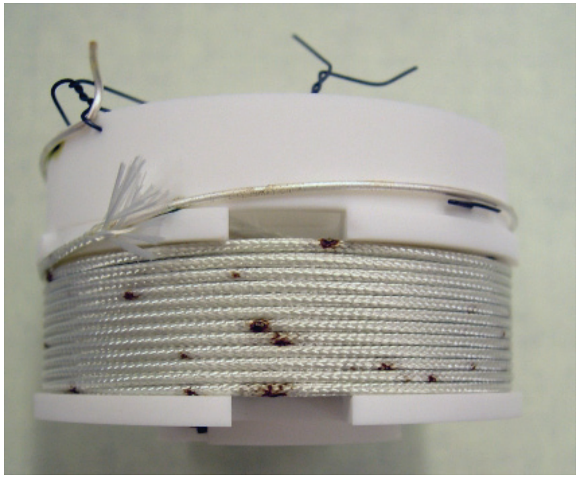
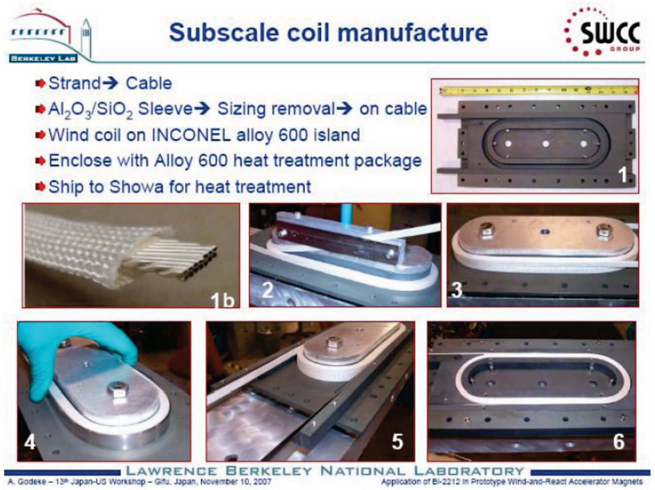
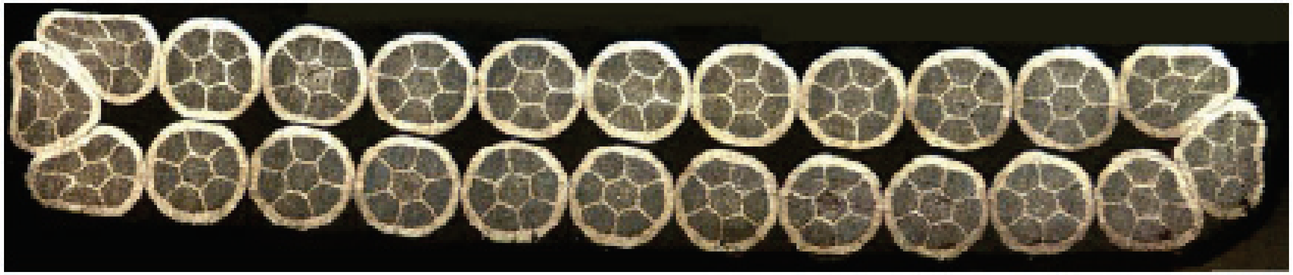
Test coils and cable can be fabricated



NHMFL test coil



LBL Test Coil



FNAL test cable. Test degradation of J_c in the cabling process

Status

- Work plans and budgets are being prepared under the guidance of the Technical Committee. These must be prepared before any dispersal of funds. Negotiations are under with industry in order to get both their help to develop a better conductor as well as to arrange for a supply of conductor to feed the program outlined above.
- Some funds will held back for use downstream in a manner that will be determined by our first results.

- Since this program provides an important source of support for the MC program, we are proposing that we use as a guide the design of a 30 T magnet with a size suitable for muon cooling. This will provide the focus for identifying where the critical problems lie and assure that they are addressed.

A future need!

- The goal of the program is to develop the technology to build magnets with B>30 T, hopefully on the time scale of 2 years. The program does not have funding to actually build a full scale magnet. This is a future need. A full scale test is crucial for verifying the work done by the VHFSMC.
- Could be collaborative with other agencies of divisions.