



HFM
High Field Magnets

Work Package WP2.2

(HTS conductor, cables & associated technologies)

Author: Christian Barth on behalf of the TE-MS-C-HSD section

Date: 02.05.2023



Introduction

Objective:

Demonstrator of **5 T** in a background field of **15 T**

Work Package 2.2:

- Specification and procurement of tape.
- Generate **material database**
- Development of **electrically insulated** cables.
Target: 10 kA @ 20 T, 5 kV .



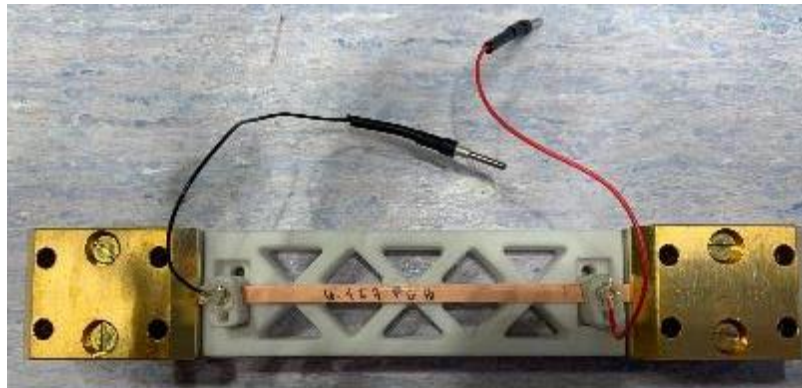
Scope of Work Package 2.2

- Exploration of REBCO tapes for suitability for fields > 16 T.
 - Establish REBCO characterization capabilities
 - Derive tape specifications, procure tape
- Development of cables, cabling and other associated technologies including insulation
 - Establish cabling & insulation capabilities
 - Establish cable characterization capabilities



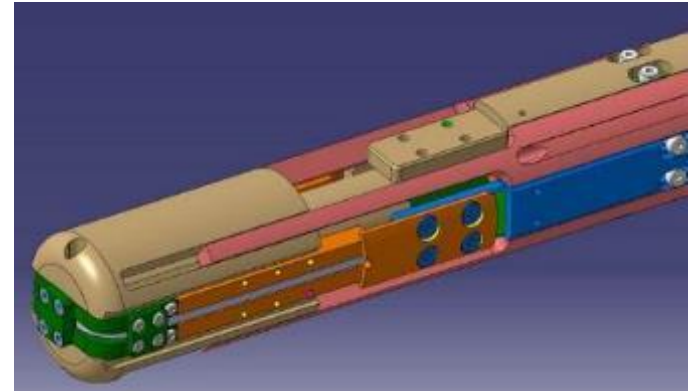
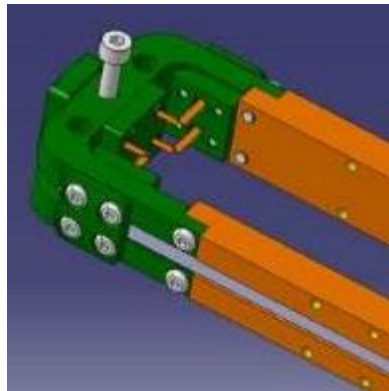
Characterization of REBCO tapes #1

- Automated 8-channel, 77 K, self-field, I_c test station developed
 - in operation, also used for HL-LHC
 - for REBCO cable QC: extracted tapes I_c measurements
- Reel-to-reel tape QC system in development
 - will be used to precisely map I_c along tape length



Characterization of REBCO tapes #2

- ‘U’-shape adapter to characterize REBCO tapes in 15 T wire test station developed (B || c)
 - in operation
- ‘1-turn’ adapter to characterize REBCO tapes in 15 T wire test station developed (B || ab)
 - in fabrication



Characterization of REBCO tapes #3

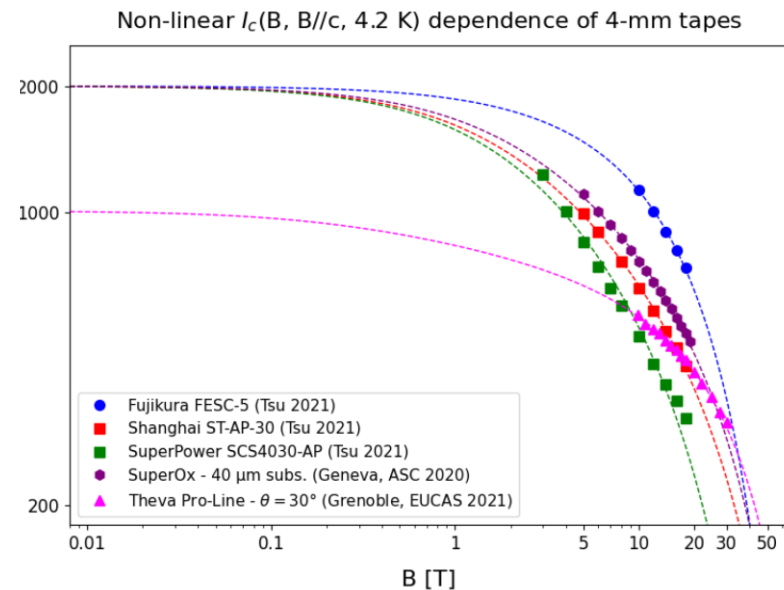
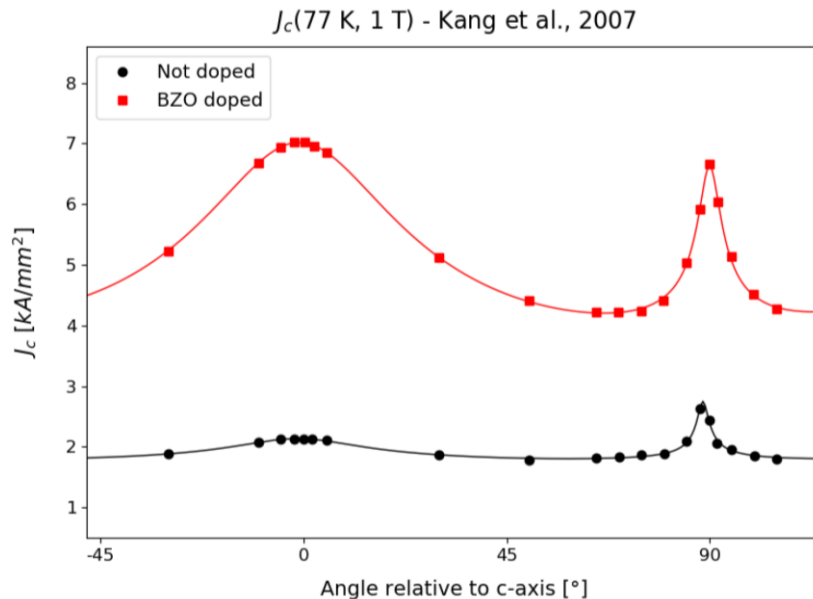
- ‘Compact sample holder for high-field tests (LNCMI) developed (B || c, or B || ab)
 - being assembled
- Large-bore, 20 T test station with VTI will be installed at CERN for high field characterizations
 - ~100 mm \varnothing targeted
- Split-coil test station with VTI will be installed at CERN for variable angle characterizations
 - ~10 T targeted, feasibility study with suppliers



Characterization of REBCO tapes #4

- Field, angle & temperature scaling relations for REBCO tape of different industrial suppliers
 - SuperPower, Fujikura, SST, SuperOx, Theva
 - Released as internal note (EDMS: 2747837)

Examples:



Other superconductors

- Future collaboration CERN/CNR-SPIN – Iron Based Superconductors
 - drawing machines
 - groove rolling machines
 - flat rolling machine



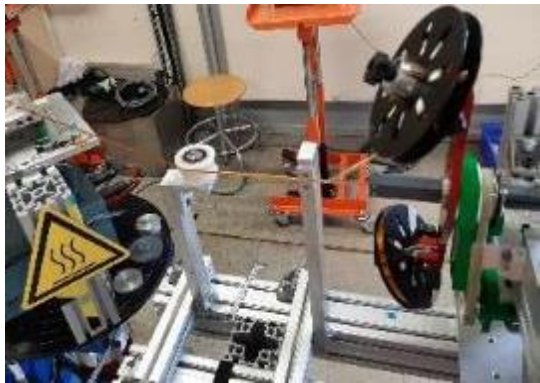
Cabling & insulation capabilities #1

- Round, insulated power transmission cables
 - operational, used for HL-LHC
- ‘Stack’ type cables
 - 14 tapes + insulation, torque control only: operational
 - 7 tapes, precise tension control: being upgraded to 15 tapes + insulation



Cabling & insulation capabilities #2

- Kapton tape wrapping for round and 'stack' cables
 - operational, long lengths possible
- 'c-shape' Kapton tape insulation for 'stack' cables
 - operational, long lengths possible



Characterization of cables #1

- Intertape resistance measurement setup (77 K, self-field) developed
- in operation



Characterization of cables #2

- In-field characterization of cables with the FRESCA & FRESCA2 test stations
 - FRESCA (9.6T, 1.9K & 4.2K): in operation
 - FRESCA2 (13T, 1.9K & 4.2K & gas-flow): being commissioned
- Dedicated test station for splice & current lead characterization
 - in development

