

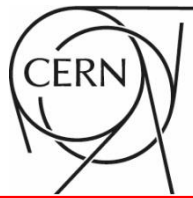


Superconductivity Practical Days at CERN

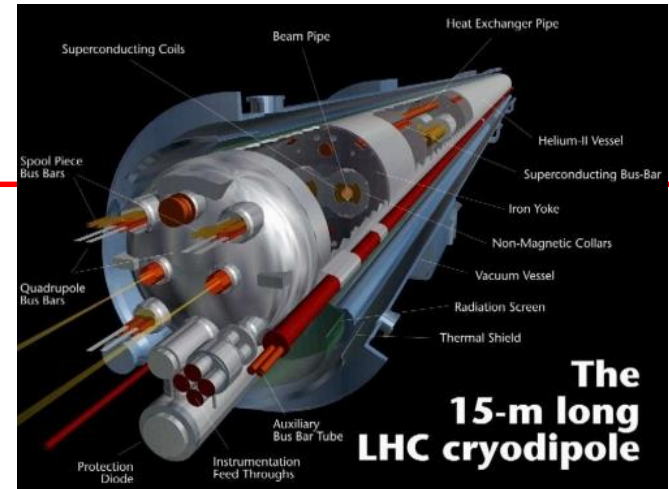
5-6th March 2020

Jerome Fleiter

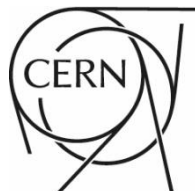
Superconductivity Applications



- **Generate high DC field: (MRI, NMR, particle Physics)**
- **Current leads**
- **Radio Frequency cavities**
- Current limiters
- Electronics, detectors (SQUIDS)
- Power transmission
- Magnetic levitation (Maglev)

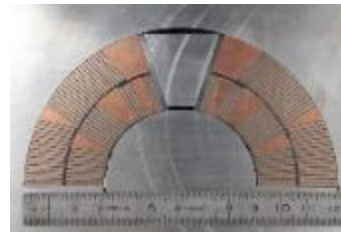
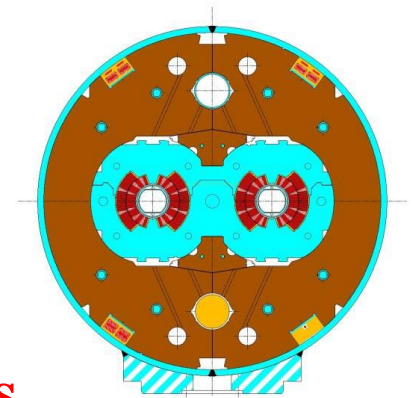


Superconducting devices in LHC



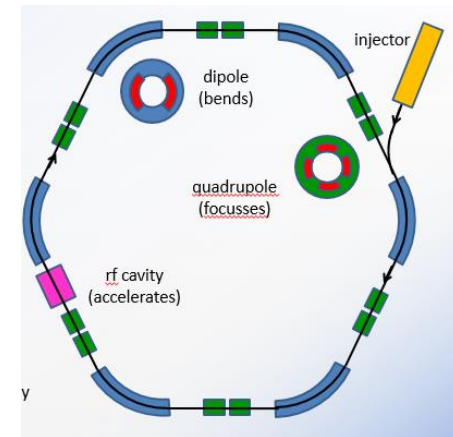
Magnets

- **LHC ring magnets (Nb-Ti): Rutherford cables**
 - 1232 main dipoles: 8.3 T x 15 m
 - 392 Main quadrupoles 223 T/m (7 T) x 4 m
 - Zoo of 7600 others (cable or wire)
- **LHC detector magnets (Nb-Ti): Rutherford cables**
 - ATLAS: Toroid 4 T, 25 m x 20 m
 - CMS solenoid: 4 T, 12 m x 15 m



Other devices

- **LHC current leads (HTS BSCCO): stack of tapes**
 - ~1000, rated for transport current 0.6-13 kA
- **RF cavities (Nb coating)**
- **Superconductivity is a key technology of LHC**



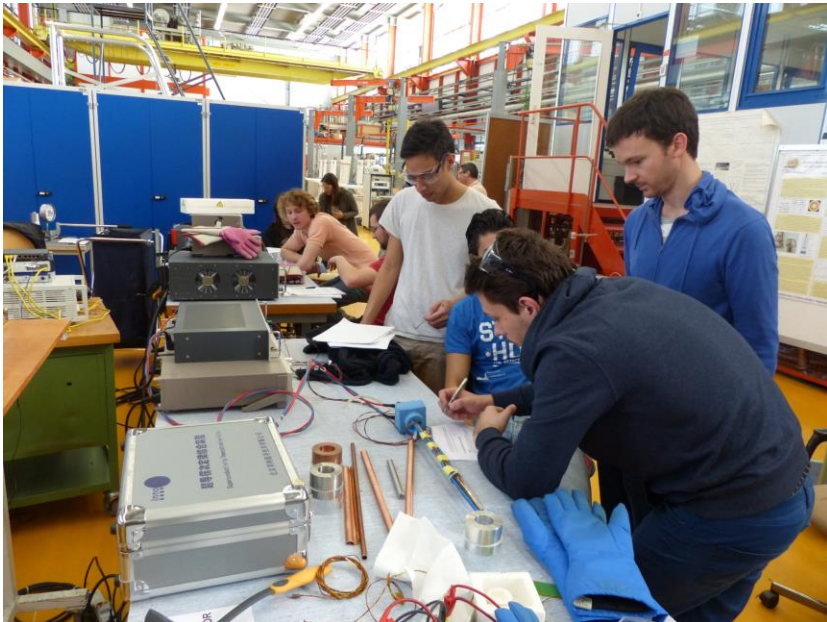
Scheme from M.N. Wilson

Practical work and visits



During the practical day on Superconductivity, you will get familiar with:

- main properties of superconductors for HEP application (electrical, magnetic and thermal characteristics) through practical work and visits.
- Superconducting devices of LHC and HL- LHC
- Test facilities for superconducting material/device



Superconductivity 5-6/03/2020

- Key features of Sc material will be reminded:
 - Critical temperature, critical field critical current, Meissner effect....
- Practical Sc materials for LHC/HL-LHC accelerator magnets, Sc link and current leads will be presented:
 - Nb-Ti
 - Nb₃Sn
 - MgB₂
 - HTS (REBCO BSCCO)

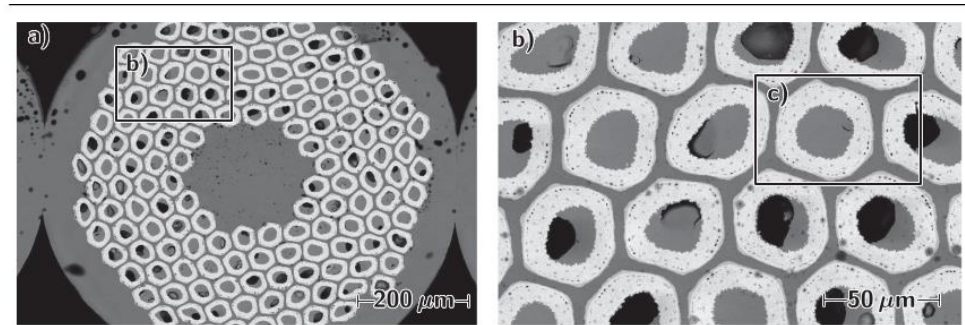
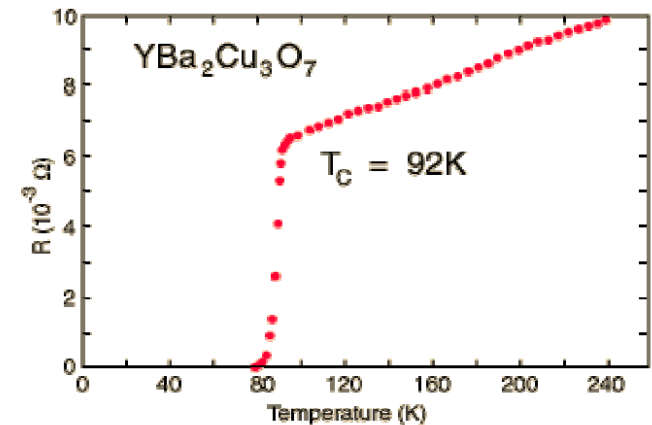
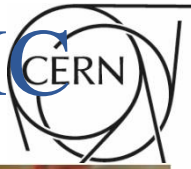


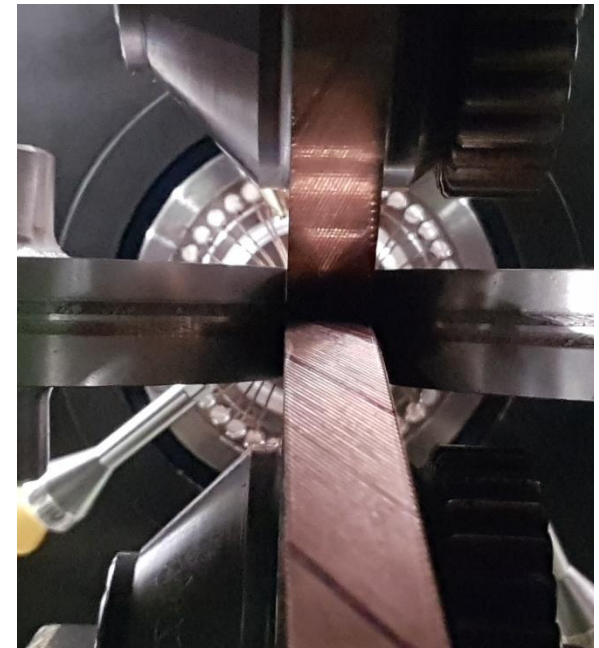
Figure 13. SEM micrographs of transverse metallographic cross section of an unclad conductor.

Superconducting cables for LH and HL-LHC

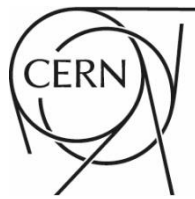


- Different types of Sc cables will be presented:

- Bus bar
- Rutherford cable
- Sc Link
- HTS cable of current leads

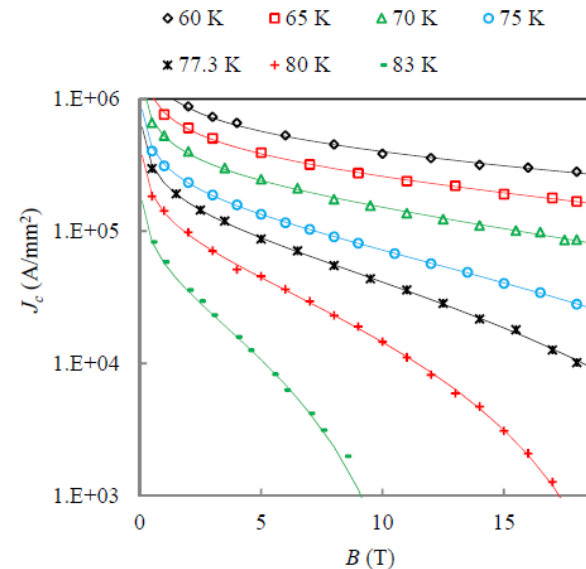
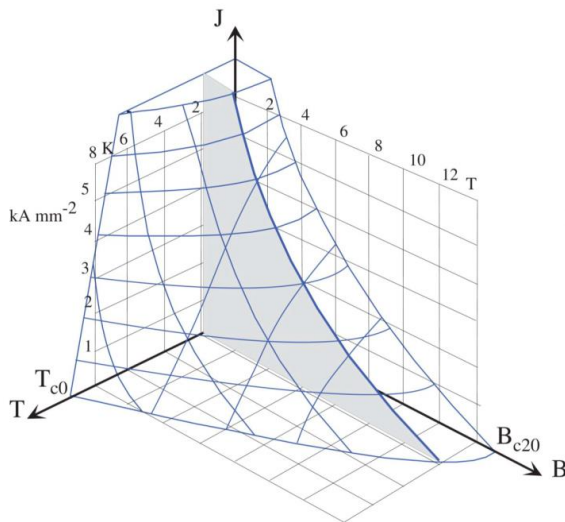


Critical surface characterization

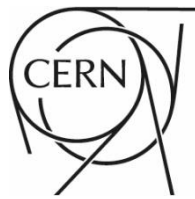


You will perform:

- the characterization of REBCO conductor:
 - Critical temperature (T_c)
 - Zero resistance
 - Critical current density (J_c)
- Extrapolation of conductor performances based on $J_c(B)$ parametrization

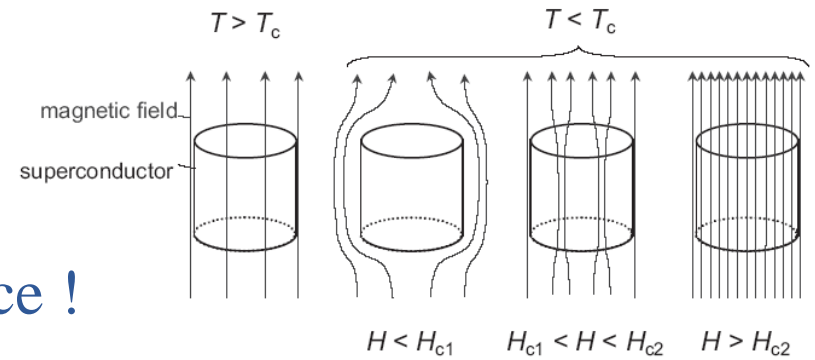


Levitation experiment



Enjoy Levitation:

- Meissner effect
- Flux pinning
- Intensity of the levitation force !



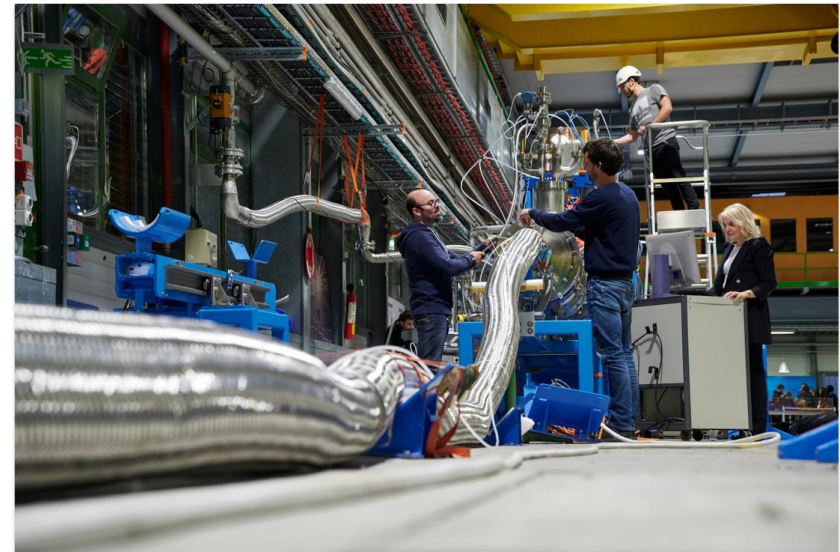
JUAS Practical days on
Superconductivity 5-6/03/2020

Visit of Superconductor Laboratory, Building 163

- **Critical current** of superconductors (strands and cables) at liquid He temperature (1.9 K and 4.2 K, up to 15 T and up to 32-70 kA);
- **Magnetic properties** of superconductors (magnetization curves) at variable temperatures and fields (VSM);
- **Electrical Resistivity** as function of temperature;

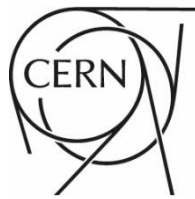
Visit of Sm18:

- **Sc Link and cryo magnets**



JUAS Practical days on
Superconductivity 5-6/03/2020

Program and Organization (1/2)



- **Up to 12** participants per day
- Hands-on **practical work** in CERN laboratories
- Guided by **experts**
- **We are looking forward to working with you at CERN**

