EuCARD Meeting
February, 24, 2009

Task 7.4

Very High Field Insert

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1. *Partner presentations*
   - *CNRS*
   - *INFN*

CNRS

Grenoble INP

cnrs

⌘4 laboratory grouping

NÉEL institut

- Superconducting magnets
- Cryogenics
- Superconductors

LNCMI

- Magnet design
- Very high field facilities

G2E lab

- Simulation tools (Flux®)

CRETA
Consortium de Recherches pour l'Émergence de Technologies Avancées

- Characterisation benches

LNCMI

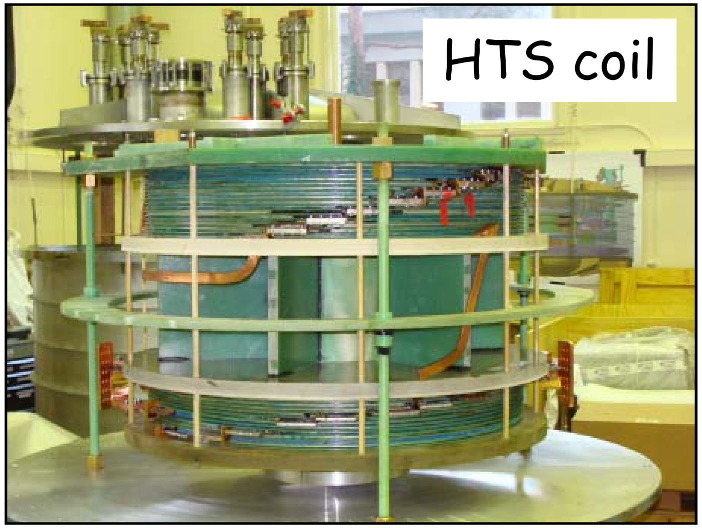
NÉEL institut

G2Elab

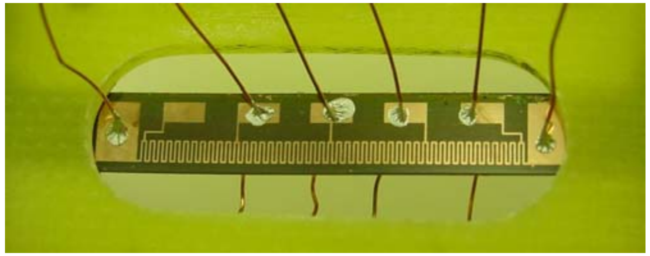
CRETA
Consortium de Recherches pour l'Émergence de Technologies Avancées

Grenoble INP

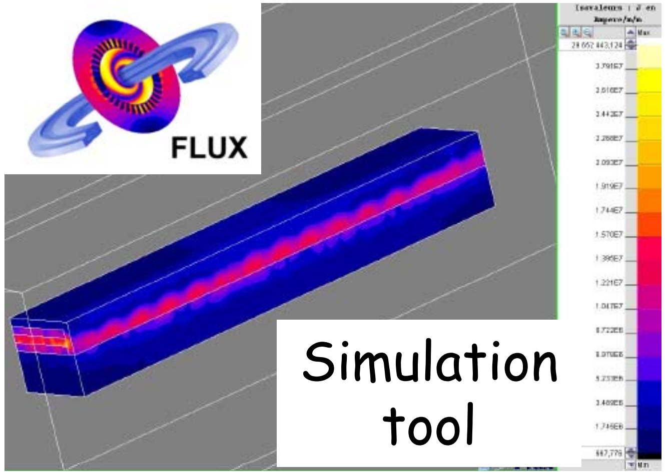
cnrs

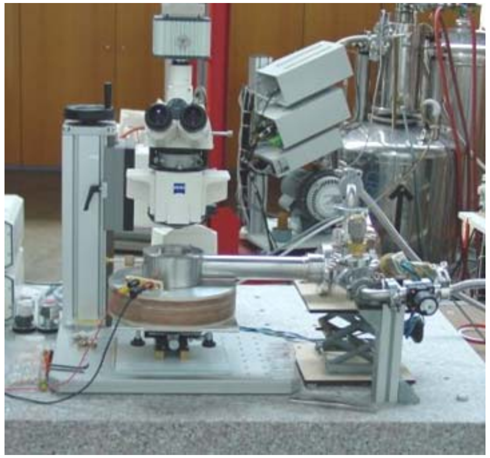


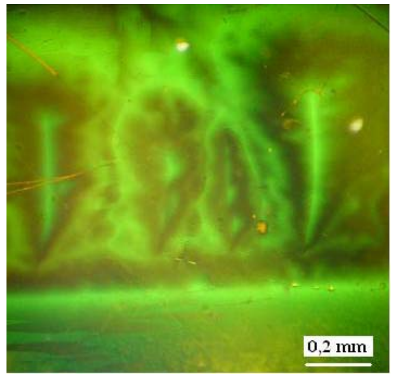
==== Investigation tools ====



Thermal sensors deposited on the conductor
Excellent thermal coupling







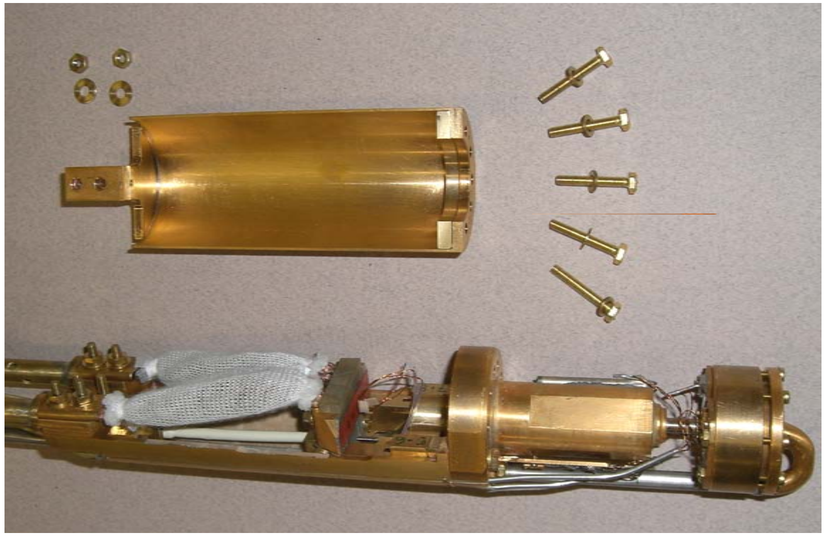
Magneto-Optics on Coated Conductors

Jc(B) measurements at the GHMFL

LNCMI

Nb-based superconductors ➔ ITER, JT-60 SA
Cu oxides, HTS ➔ SMES , Borides (MgB_2) ➔ IRM

Measurements at variable T and field anisotropy (0 ➔ π/2): ***Var. Temp. Cryostat up to 300K (Néel Institute, GHMFL)***

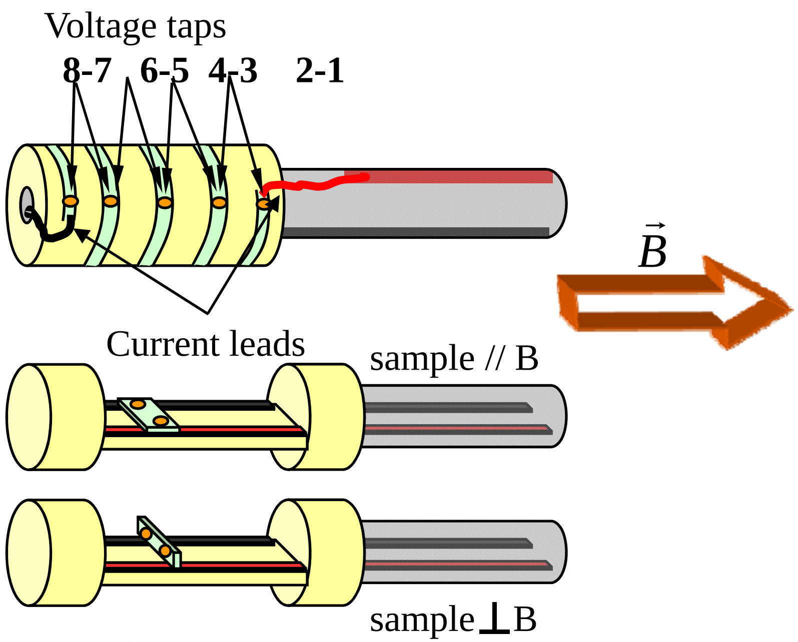


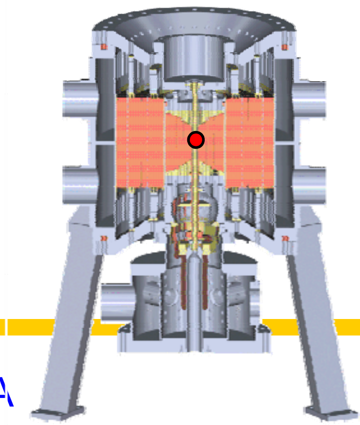
Measurements in high B :

➔ 30 T, 50 mm diameter bore

➔ 19 T, 160 mm diameter bore

➔ 10 T, ~ 400 mm diameter bore





With currents up to 1500 A

Magnets

SOLEMI 1		
	Central field	8 tesla
	Free bore	550 mm @ room temp.
	Technology	NbTi
	Vertical clearance below magnetic midplane	480 mm ca
	May be fitted with an independent cryostat with a 480 mm free bore	
SOLEMI 2+3		
	Central field	15 tesla
	Free bore	100 mm @ LHe
	Technology	Nb3Sn
	Gas-flow VTI 4-300 K with 75mm free bore	
	SOLEMI 2 can be operated standalone, with 12 T in a 240 mm LHe free bore	
SOLEMI 1 and SOLEMI 2+3 could be in principle operated in series, allowing up to 18 tesla. This operating mode is not presently foreseen, and it would require an extensive ancillary equipment upgrade.		
Supercompatto		
	Central field	13.5 tesla
	Free bore	50 mm @ LHe
	Technology	Nb3Sn + NbTi
Cryofree magnet		
	Central field	8 tesla
	Free bore	60 mm
	Technology	Nb3Sn, cryocooler operated
Dipole		
	Central field	1.5 tesla
	Free gap height	120 mm
	Technology	Resistive, water-cooled

Test equipment & Prototype development tooling

Power supply up 30 kA 6V (swicthing)
“ 2 kA 4V (low noise, battery based)

Ic on wires up to 2kA

Winding machine for lab-scale solenoids

Oven up to 700 C in vacuum
Oven up to 900 C in inert atmosphere
Oven for vacuum resin impregnation

Cryogenic Mechanical test equipment:
- Strength test up to 200 kN
- Cyclic test up to 200 kN, 10 Hz

Can be operated at cryogenic temperatures with reduced force range

Effect of tensile stress on J_c of superconducting wires

The Walters Spiral

Strain ε: applied by an axial rotation

- Max current 1'000 A
- Wire length up to 0.8 m
- Max voltage tap distance 50 cm
- J_c criterion 0.01μV/cm

Measurements up to 21 T: J_c vs. B
J_c vs. ε

T ≤ 4.2 K: bore Ø 64 mm
T > 4.2 K: bore Ø 49 mm

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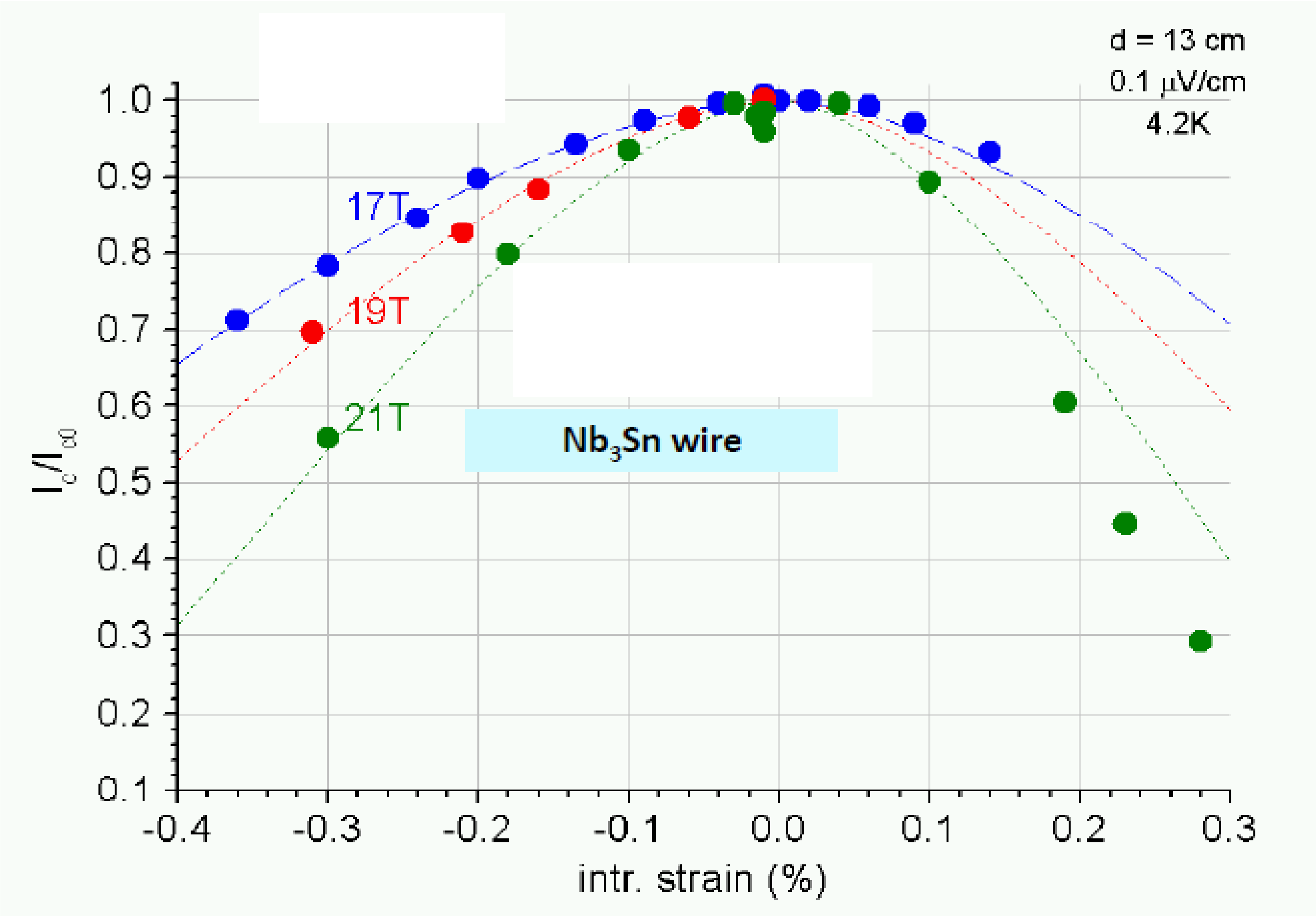
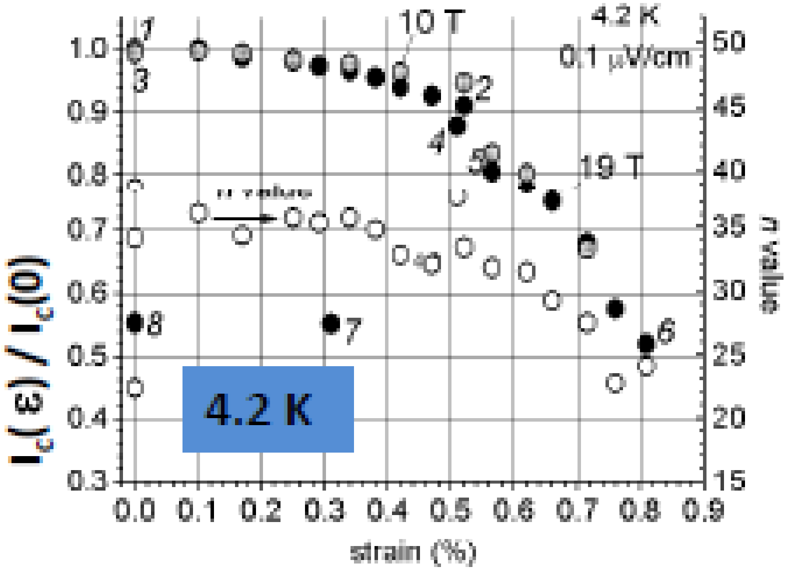
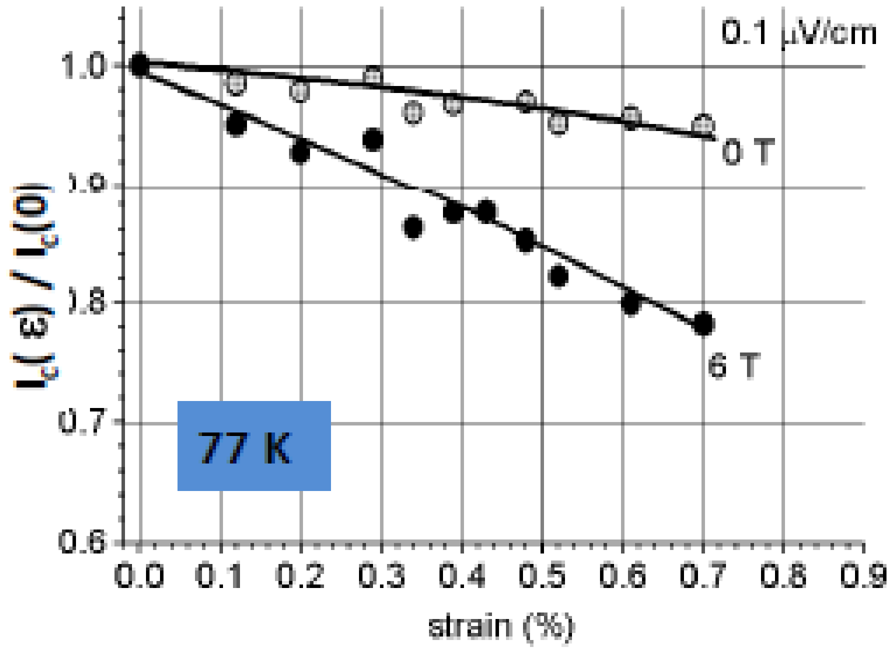
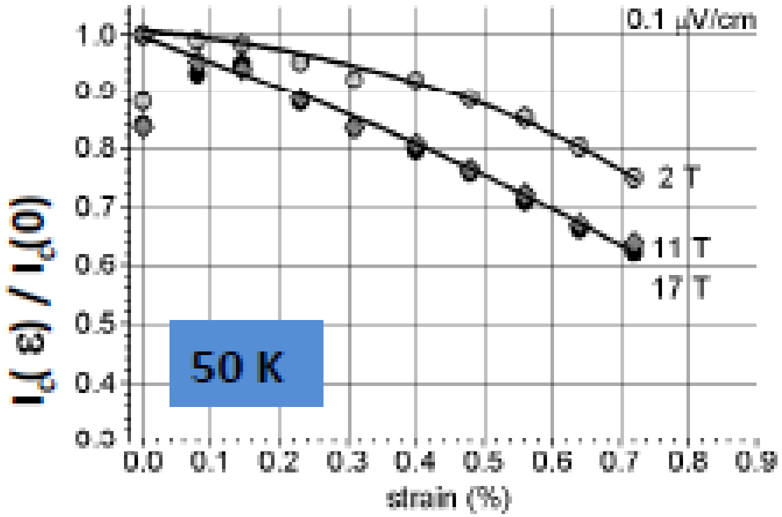
Effect of Tensile Stress on J_c of Nb_3Sn wires



Tensile Stress on J_c of Y-123 tapes







Irreversible strain value: 0.53 %

D. Uglietti, V. Abächerli, B. Seeber, R. Flükiger, 2005

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Effect of transverse compressive forces on J_c of superconducting wires

Specification

Transverse force: 40 kN

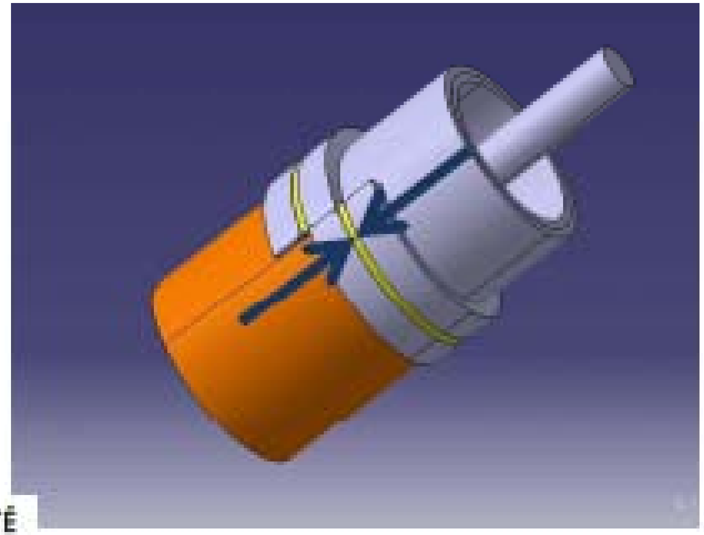
Gauge length: 120 mm

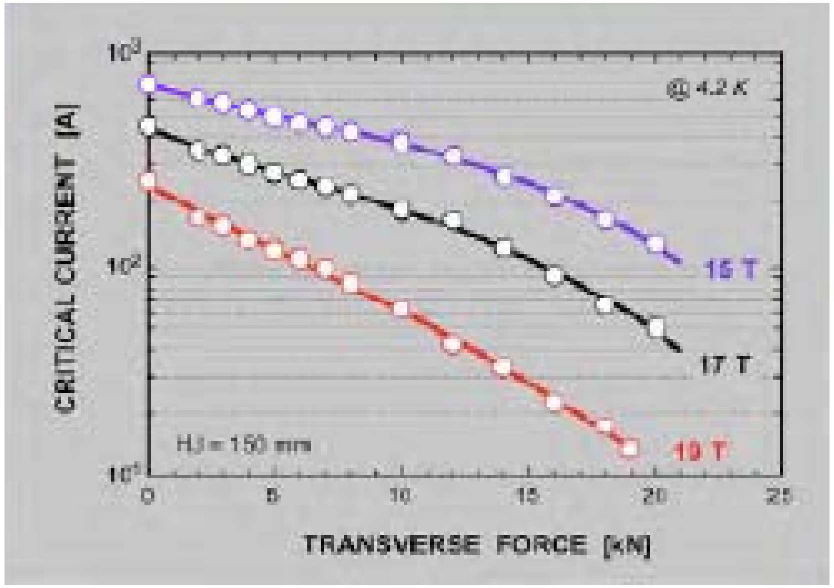
Magnetic field: ≤ 21 T

Temperature: 2.2 K - 100 K

Critical currents: ≤ 1000 A

Example: Nb_3Sn wires





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2. First year workplan

Work plan (year 1)

- Subtask 1
  - Strand characterisation
  - Conductor and strand specifications
  - HTS magnet protection

Strand characterisation

- Electrical and mechanical characterisation
- I_c (B, T, θ, ε(σ))

Involved partners:

- UNIGE
- CEA Saclay
- CNRS Grenoble

Issues:

- Bi-2212 supply (CERN)
- Thermal treatments
  - ✓ furnace (availability)
  - ✓ profile (UNIGE)

Conductor specifications

- Insert pre-design is required
  - Operating conditions for the conductor
    - Fields and stresses on the conductor
- Preliminary conductor design
  - Strand characterisation
  - Mechanical reinforcement
    - Strand level
    - Conductor level

Involved partners:

- CERN
- CEA/Irfu
- INFN
- CNRS Grenoble

Protection issues

- Review
- Modelling
  - Some quench data (Grenoble SMES)
  - Strand data
- Experiments
- Protection strategies

Involved partners:

- Tampere
- CEA/Irfu
- CNRS Grenoble
- UNIGE