Realization and First Tests of the EuCARD 5.4-T REBCO Dipole Magnet

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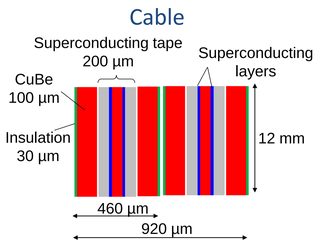
FRAMEWORK – EuCARD High Field Magnet

The design of the HTS dipole magnet began within the framework of the European Coordination for Accelerator Research and Development (EuCARD), in collaboration with CNRS of Grenoble, INFN of Milan, University of Tampere and CERN. It has been pursued and completed under the first collaboration agreement between CEA-Saclay and CERN on research and development for future LHC superconducting magnets.

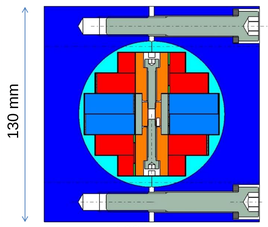
OBJECTIVE – REBCO Tape Stacks

This dipole prototype is the first step towards the use of HTS for accelerator magnets.
Its objective is to demonstrate the possibility of using a REBCO type HTS ceramic tape to generate 5-T field in the 13-T field of the Nb_3Sn FRESCA2 dipole, for a total field of 18 T.
The cable is a stack of two conductors. Cable transposition is made pole by pole.

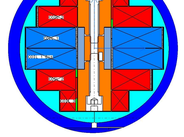
Magnet Design



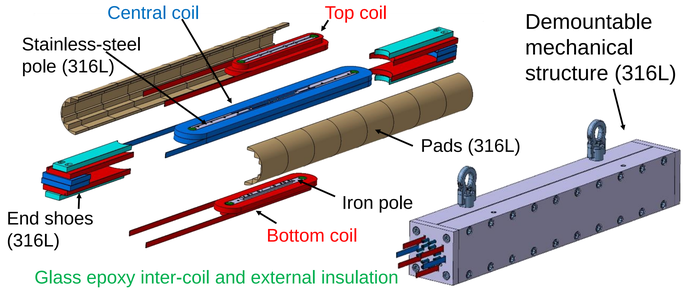
3 double layers coils
Layer 1 : 30 turns
Layer 2 : 24 turns
Layer 3 : 10 turns



Standalone configuration



Insert configuration
(5.5 mm Nitronic® tube)



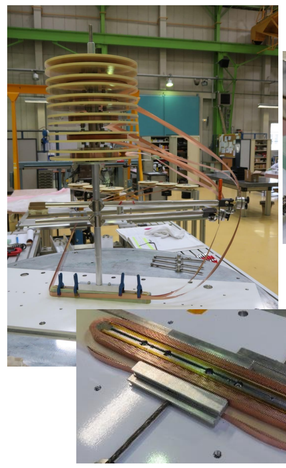
Glass epoxy inter-coil and external insulation

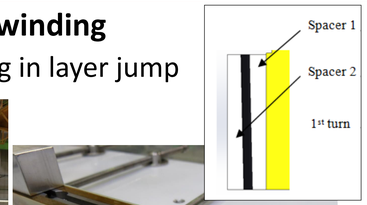
Background field	T	0	13
Nominal current	A	2800	
Magnetic field at the centre (no persistent currents)	T	5.38	
Expected field at the centre (with persist. currents)	T	4.67	4.66
Temperature	K	4.2	
Winding current density @ I_n	A/mm²	250	
Magnetic force F_x (one quadrant) *	kN/m	210	2750
Self-stored energy*	kJ	10.4	
Self-inductance	mH	2.7	
Estimated temperature margin	K	28	12
Estimated margin on the load line	%	45	30

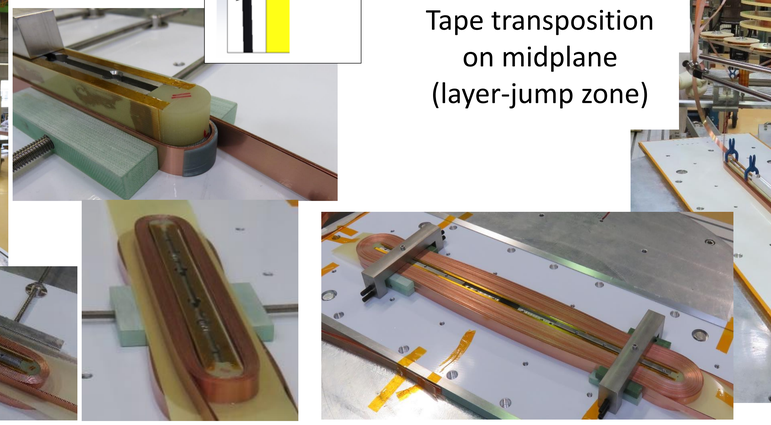
Coil Manufacturing

External coil winding

No hard way bending in layer jump

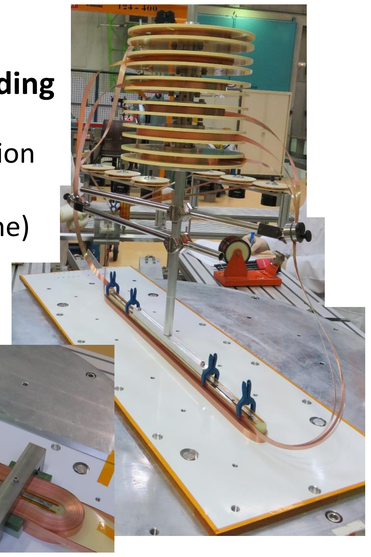




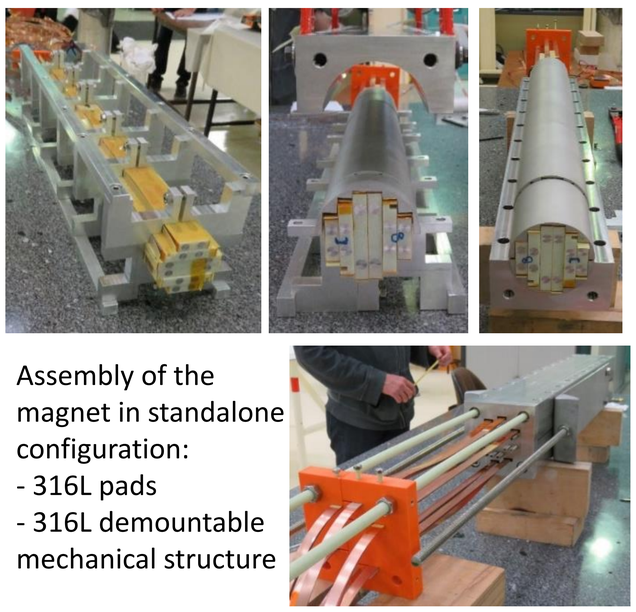


Central coil winding

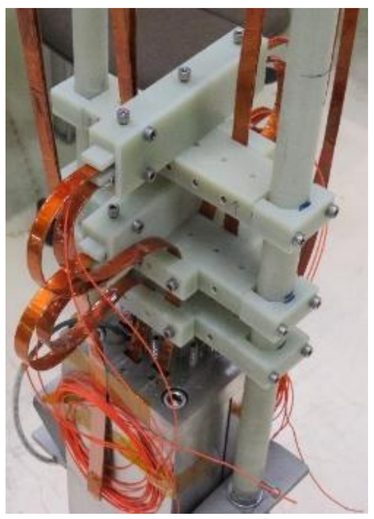
Tape transposition
on midplane
(layer-jump zone)



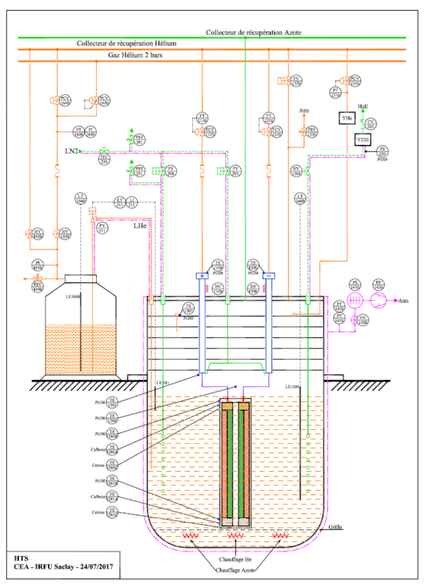
Magnet Assembly in Standalone Configuration (demountable mechanical structure) and Tests



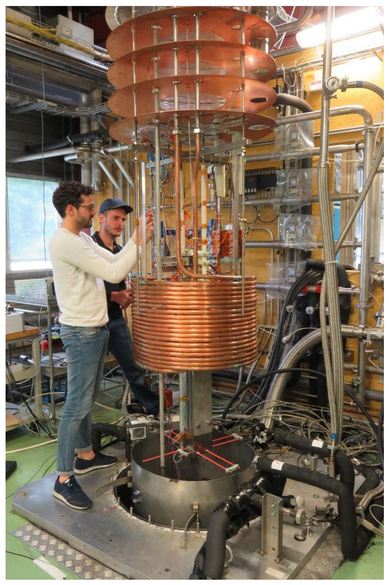
Assembly of the magnet in standalone configuration:
- 316L pads
- 316L demountable mechanical structure

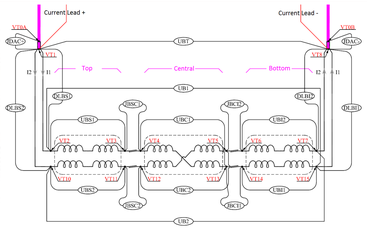


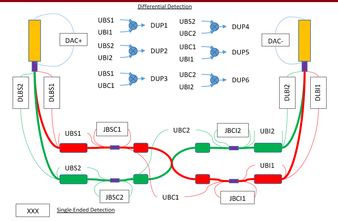
Demountable inter-coil connections:
160-mm long SnIn splices



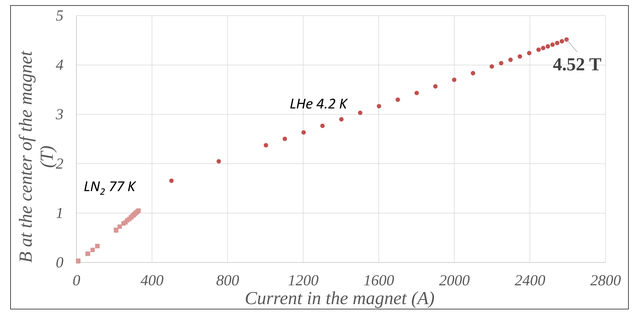
Test facility at CEA Saclay (GN_2 & LN_2 77K, GHe 4-10K, LHe 4K)







Magnet protection



First powering tests (standalone)

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