50 Tesla Solenoids

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Friday NFMCC Meeting

Fermilab Wilson Hall 2E

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Five Existing BSCCO Solenoid Inserts

Location	BSCCO	ID/OD/Length	B	IEEE T.A.S.
Florida	Bi-2212	41/165/209mm	20+5=25T	13 (2003) 1396
Karlsruhe	Bi-2223	50/185/177mm	12+5=17T	15 (2005) 1484
MIT	Bi-2223	78/126/402mm	1.7T	15 (2005) 1299
Tohoku	Bi-2223	90/180/250mm	19T goal	15 (2005) 1512
MIT	Bi-2223	40/108/113mm	22.5+1.5=24T	67 (1995) 1923*

* Applied Physics Letters

Proposed NHMFL 30 Tesla NMR Solenoid for Florida

- **IEEE Trans. Ap. Supercon. 16 (2006) 1523**
- **Uniform NMR 30 T → 1.3 GHz protein size**
- **Cylindrical and Pancake coils**
- **Bi-2223 Oxford Superconductor wire or Bi-2223 American Superconductor tape**
- **Dispersed SS reinforcing + Stronger Silver alloyed with Mg, Sb, Ti, or Nb nanoparticles**

B	Temp	ID	OD	Length	Energy
30 T	4.2 K	100 mm	1100 mm	1750 mm	90 MJ

BSCCO	Strain	J_c	Nb_3Sn	NbTi
304 kg	0.275%	70%	1882 kg	1552 kg

Proposed NHMFL 30 Tesla NMR Solenoid for Florida

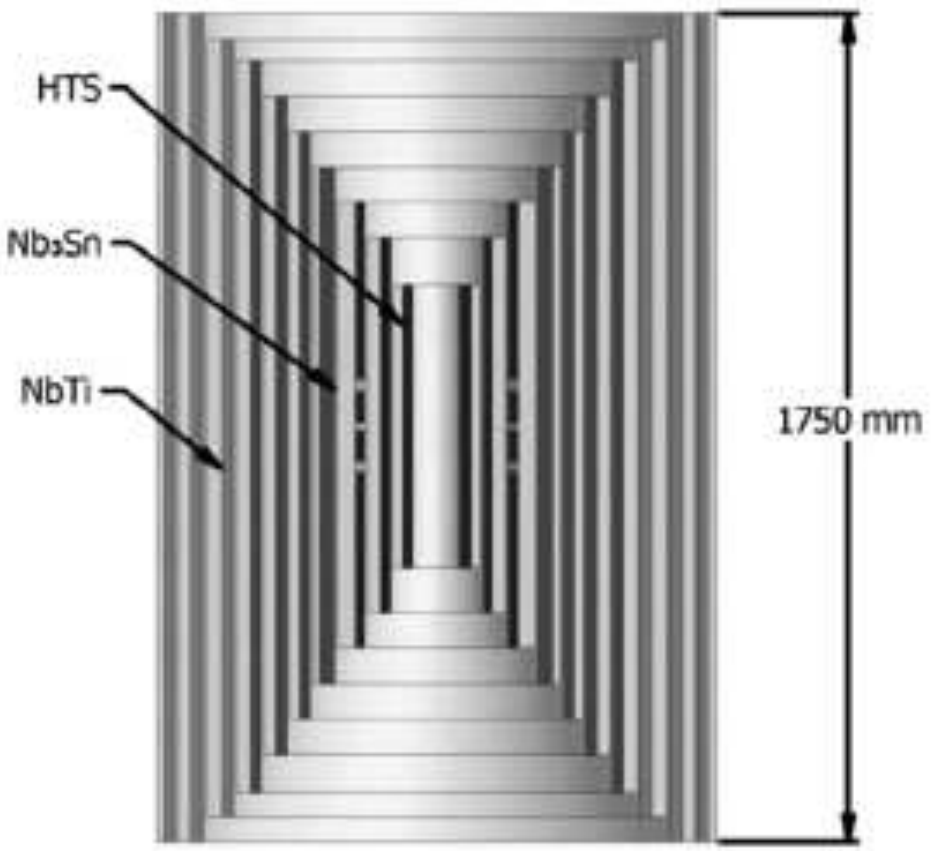


Fig. 2. Cross section of 30 T, 1.8 K magnet, showing coil windings and reinforcement, and a compensation coil set at intermediate diameter.

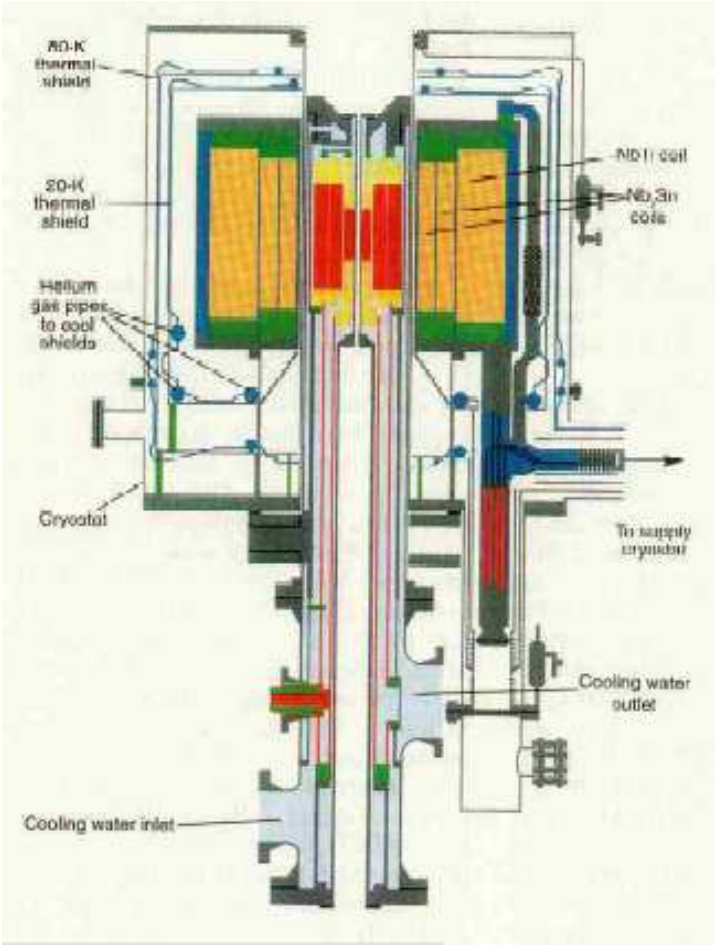
BSCCO Wire Critical Current Measurements at 4.2 K

			Critical Current			
			Bi-2223		B–2212	
Location	B	IEEE T.A.S.	$\parallel$	$\perp$	$\parallel$	$\perp$
Tsukuba	28T	12 (2002) 1136			340	
Florida	33T	11 (2001) 3956	300	200	180	120
Tsukuba	30T	15 (2005) 2470	128			
Oxford	41T	5 (1994) 1313				

- **Lu Li, Yayu Wang, Nai Phuan Ong... (Princeton...), Underdoped Cuprates at 45T March 2006 APS Meeting, Baltimore**

Florida 45 Tesla Hybrid Magnet

- **Physics Today (Dec 1994) 21**
- **32 mm bore, 20 Mwatts, Cu/Nb_3Sn/NbTi**



- **MIT Hybrid III magnet, 35.2 → 38.7 T**

Cold Holmium pole tips with 2 mm gap

Possible Near Term Goal

- **Measure BSCCO at 45 Tesla in Florida**

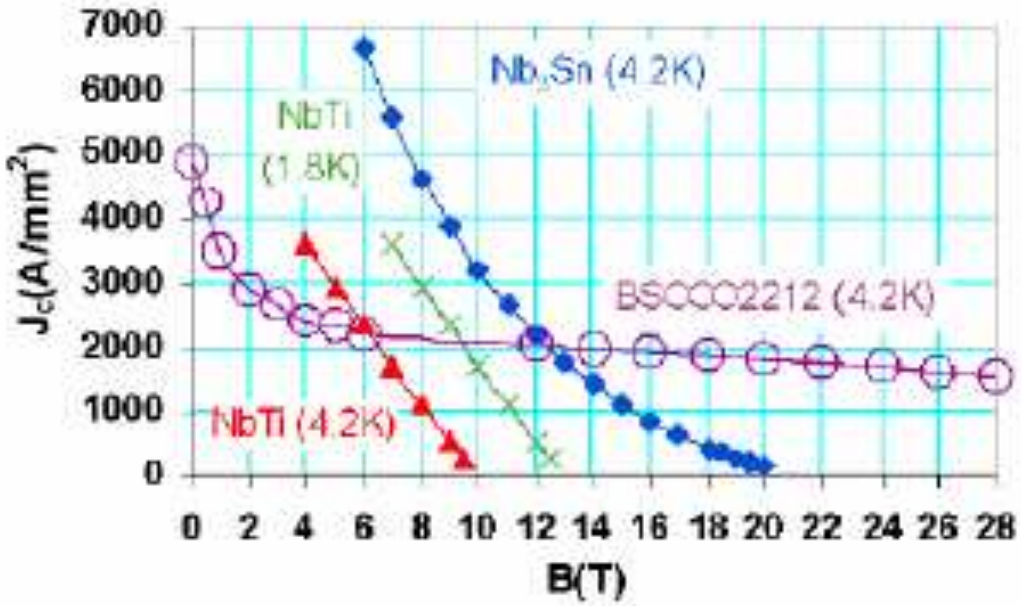


Fig 1: Critical current as a function of field for NbTi, Nb_3Sn and BSCCO 2212.