VLHC- Magnet Workshop
FNAL, May 24-26,2000

HTS for Accelerator Magnets

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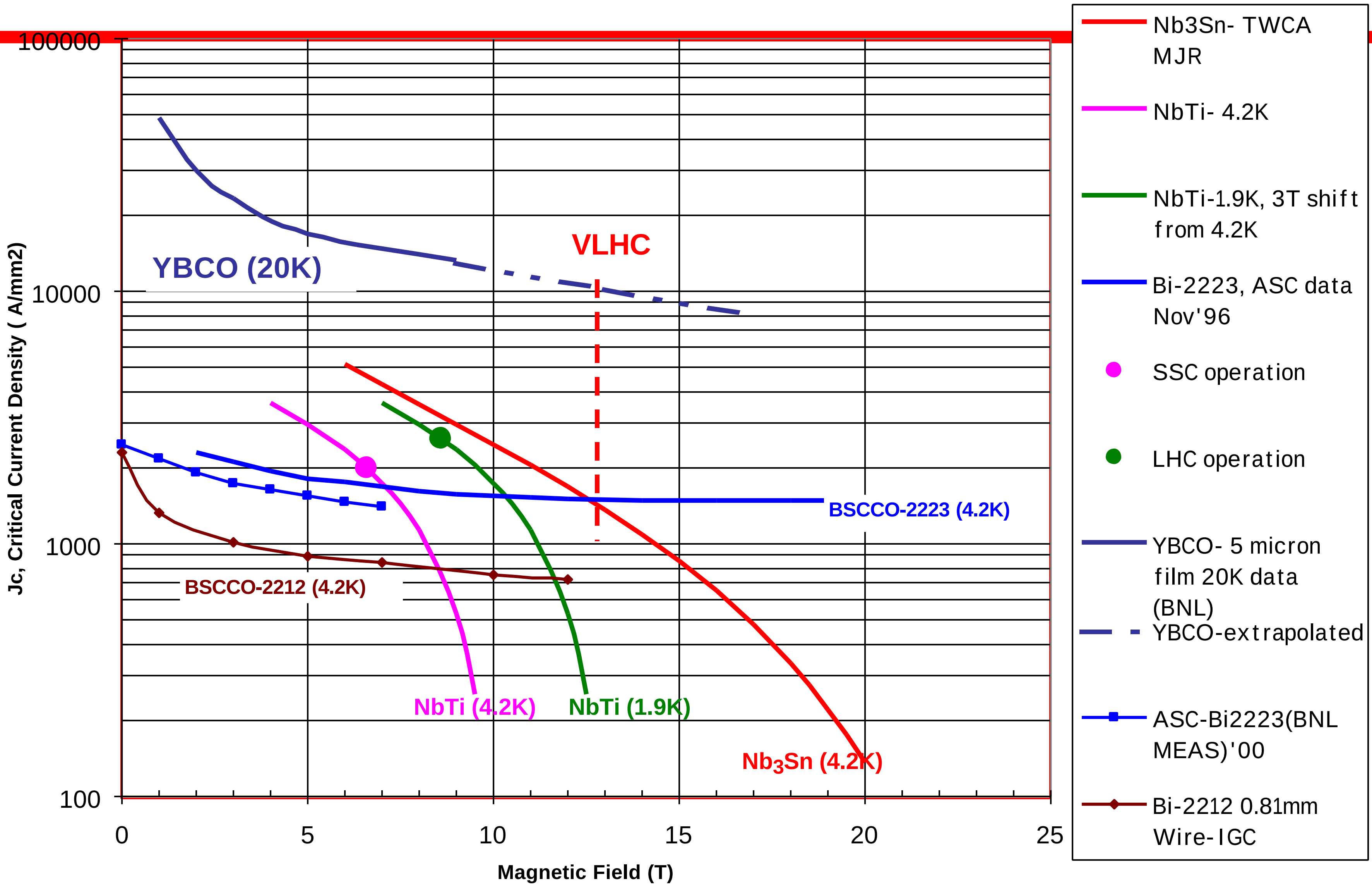
Why HTS for dipole magnets

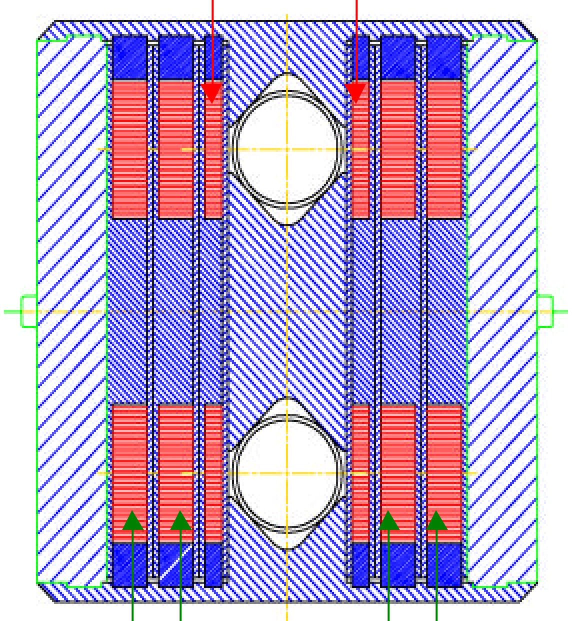
- VLHC is 10+ years away
- **Explore alternate concepts and technologies**
- **Explore new conductors (HTS) for high fields,**
- **Explore higher operating temperatures**

Why HTS for dipole magnets...



HTS in a Hybrid Magnet

Common Coil Design
R. Gupta



- Use HTS in a Common Coil Magnet.
  The HTS coil is subjected to forces similar to that which would be present in an all- HTS magnet. Technical issues relating to the use of HTS in high field magnets can be explored.
- Field in outer layers is ~2/3 of that in the 1^{st} layer. Use HTS in the 1^{st} layer (high field region) and LTS in the other layers (low field regions).
- Good design for specialty magnets where the performance, not the cost is an issue. Also future possibilities for main dipoles.

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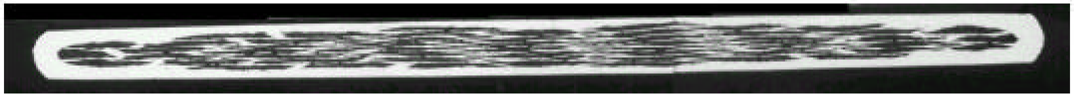
YBCO Conductor Development

Jc(77K)~ Jc(20K, 10T)

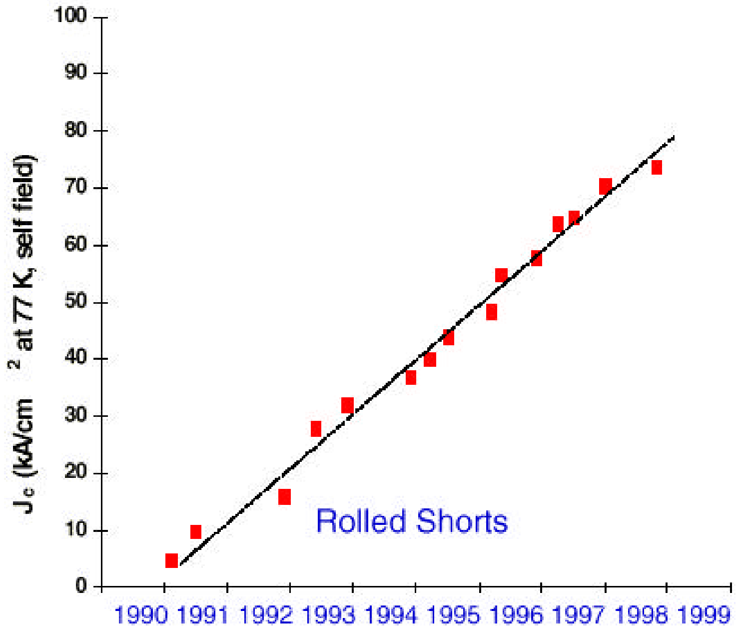
- I_c > 120 A: 1 m long tapes J_c > 10000 A/mm^2
  - by Laser Ablation Deposition technique on buffered metallic substrates……. LANL
- J_c > 10000 A/mm^2 for 5 mm thick YBCO
  - by a post deposition reaction process (BaF_2 process) on $SrTiO_3$ ….BNL
- A number of groups focusing on scaling up the processes using different fabrication methods

Tantalizing Jc, however,far from being a practical magnet conductor

Bi-2223 American Superconductor



- BSCCO-2223
- 55 filaments



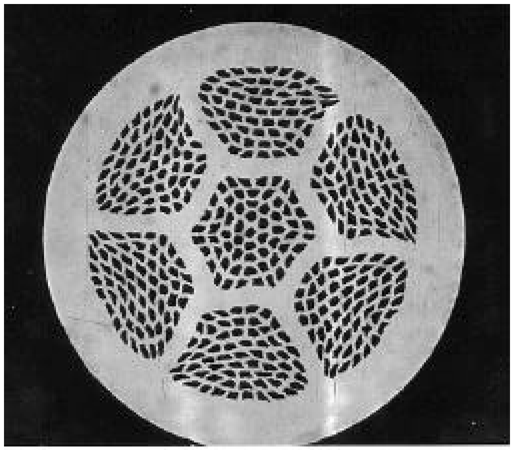
- R&D Results
- Champion performance
- Indicates continuing improvement

Type	Narrow	Wide
Thickness	0.168 (+/-0.02mm)	0.203 (+/-0.02mm)
Width	3.1 (+/-0.2mm)	4.1 (+/- 0.2mm)
Je	>12kA/cm²*	>12kA/cm²*
Ic	>62A	>100A
Max Stress	75MPa	75MPa
Max Strain	0.15%**	0.15%**
Min. Bend Dia.	80mm**	100mm**

* at 77K, sf, 1μV/cm
** With 95% Ic Retention

Courtesy of G. Snitchler, ASC

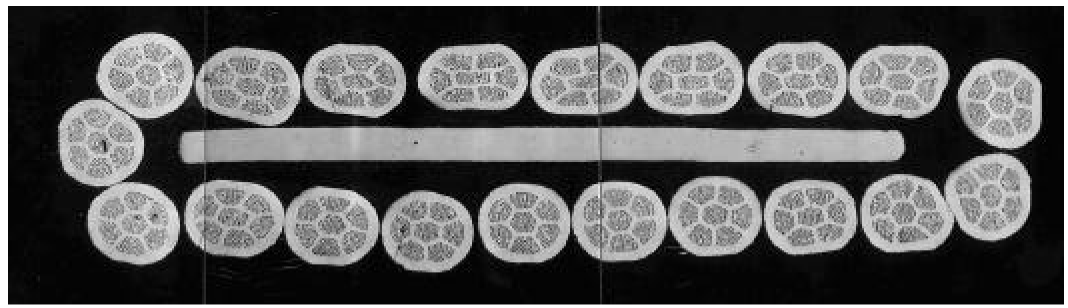
Bi-2212 IGC Advanced Superconductors

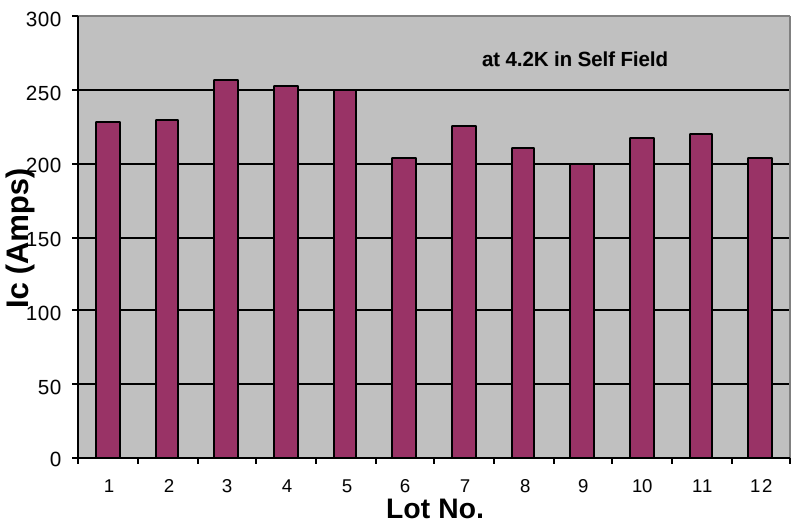


BSCCO-2212

0.81mm wire

427 filaments, 15μm filament diameter





L. Motowidlo, R. Sokolowski IGC-AS

T. Hasegawa, Showa Electric

R. Scanlan, LBL

80 m of cable fabricated

Ic in self-field 3000 A

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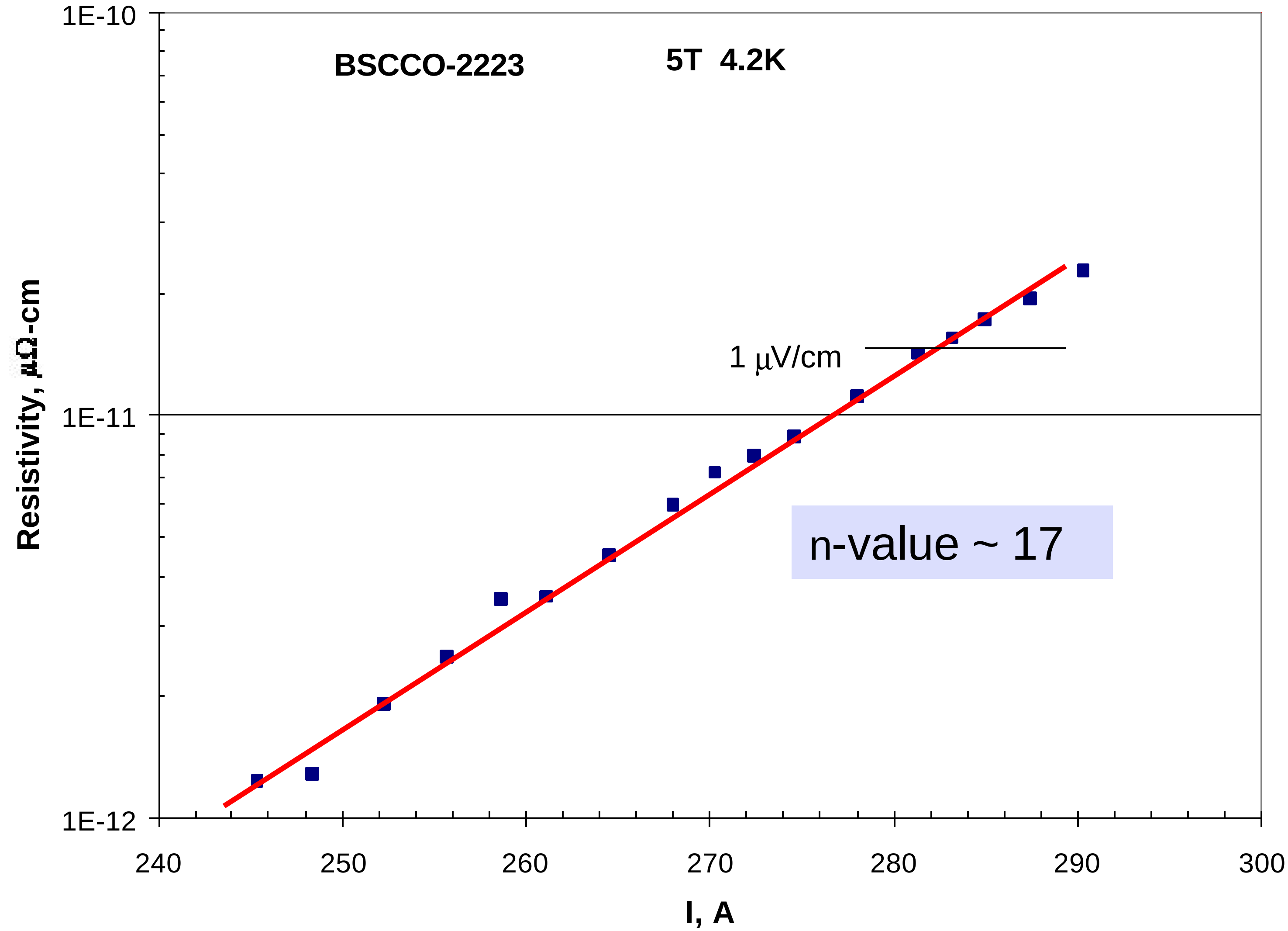
BSSCO-2223 Multifilament Tape

Conductors for BNL HTS coils

	Vendor	Length [m]	Width [mm]	Thickness [mm]	Ic (77K,SF) [A]	Je [A/mm^2]	Axial stress [Mpa]	Matrix
1998	IGC	6x100	3.55	0.22	25	32		Ag
1999	NST	210	3.02	0.238	27	38	150	Ag-alloy
1999	NST	590	3.02	0.238	31	43	150	Ag-alloy
1999	VAC	155	3.78	0.22	53	64	>90	Ag-Mg
1999	VAC	155	3.82	0.23	58	66	>90	Ag-Mg
1999	VAC	155	3.86	0.23	58	65	>90	Ag-Mg
2000	ASC	210	3.04	0.171	68	131	75	Ag-alloy
2000	ASC	210	3.04	0.175	71	134	75	Ag-alloy
2000	ASC	210	3.13	0.175	81	148	75	Ag-alloy
2000	ASC	210	2.93	0.163	70	147	75	Ag-alloy

Cost $25/m

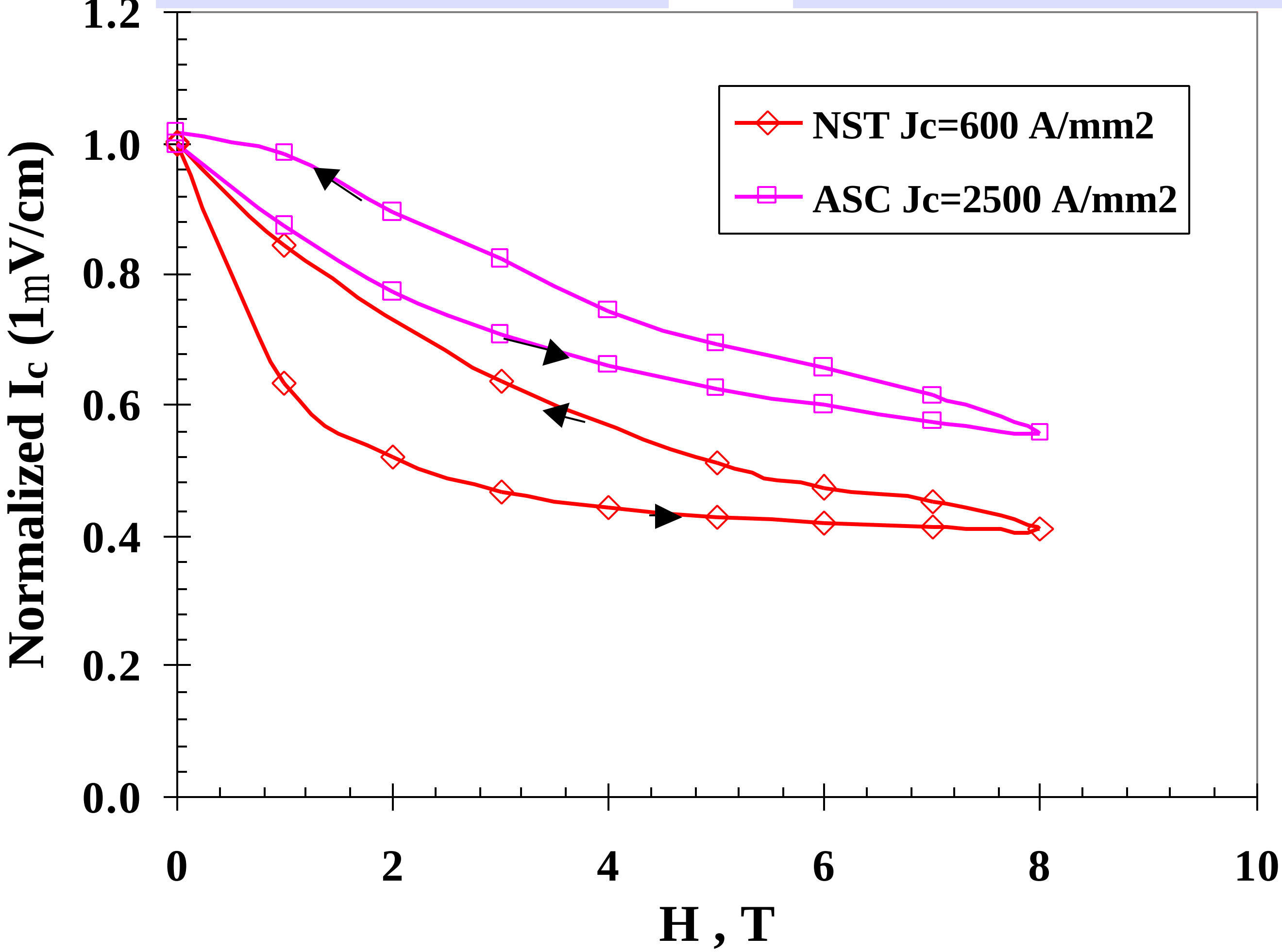
Starting to look like LTS



Jc vs H for BSCCO-2223 at 4.2K

Jc(4.2K)/Jc(77K)~ 6

In short lengths Jc~ 4000 A/mm²



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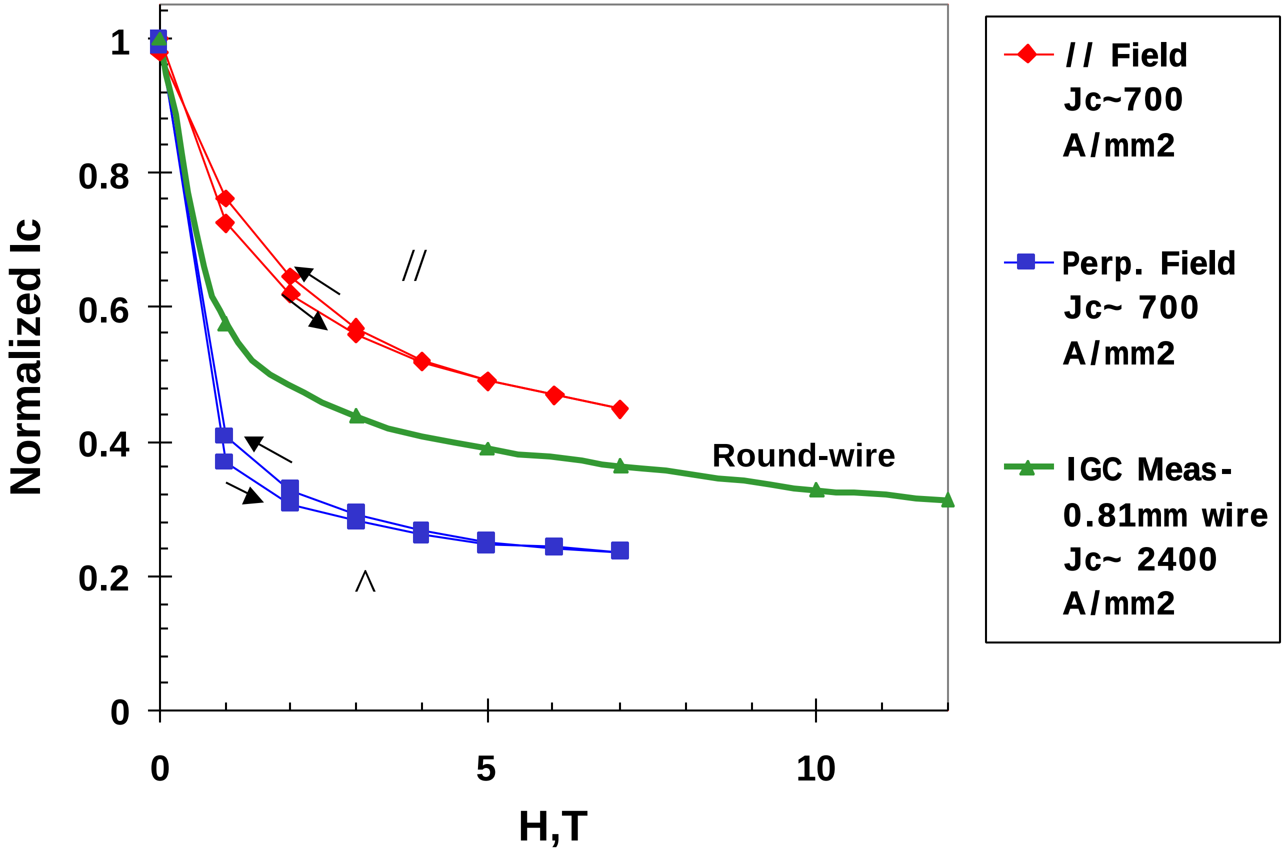
Jc vs H for BSCCO-2212 at 4.2K

Using the PAIR (Pre-Annealing and Intermediate Rolling) process, Jc(4.2K, 10T) ~ 5000 A/mm^2 in short pieces

100m long tape (5x0.2mm) Ic ~ 580A at 10T,4.2K, Jc > 3000 A/mm^2



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What does the future hold

- YBCO needs a lot of development before it can be a realistic conductor for magnets.
  - Conductor of choice for magnets operating at temperatures > 20K
- BSCCO-2223 has slowly but steadily improved. Km lengths of reasonable Jc are feasible. More uniform conductor now available with improved manufacturing techniques
- BSCCO-2212 is potentially a better choice than 2223 at 4.2K.
  - Probably will be less costly than 2223.
  - Can be fabricated as a tape or round wire suitable for Rutherford cables
  - Potential Jc at 12T exceeding that of Nb3Sn