Superconductor for ITER

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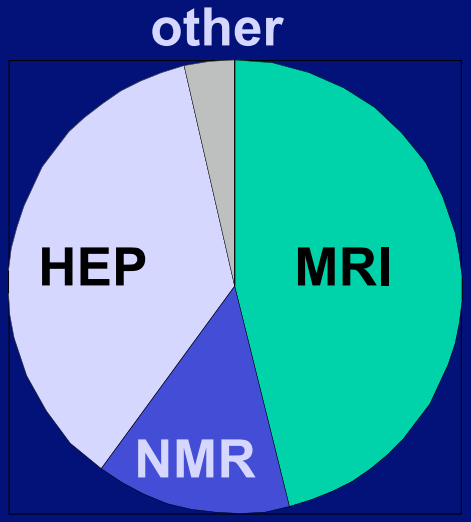
Three Themes

1. US industry has a healthy competitive position in the supply of superconductors to international markets.

2. Nb_3Sn technology has seen marked advances in the last few years, helped by DOE sponsored development for High Energy Physics.

3. A program to optimize yields of ITER conductors ahead of production would pay large dividends.

2002 Superconductor Markets
(estimated)



~ $170M/ yr total

- Magnetic Resonance Imaging: dominant application
  - ~ 2500 tonnes/ year; NbTi
- NMR: main commercial Nb_3Sn application
  - ~ 10 –15 tonnes/ year
- High Energy Physics
  - mostly CERN's LHC, now in peak production

ITER: ~500 tonnes over 3-4 years, mostly Nb_3Sn

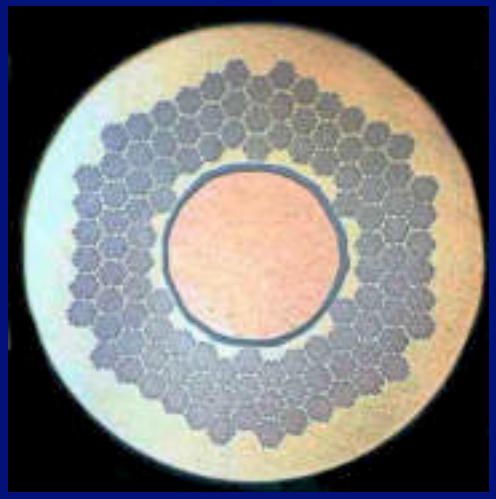
OXFORD INSTRUMENTS

US S/c Industry Shares of World Market
(estimated)

- 60-65% of MRI
- 35-40% of Nb_3Sn
- 6% of HEP

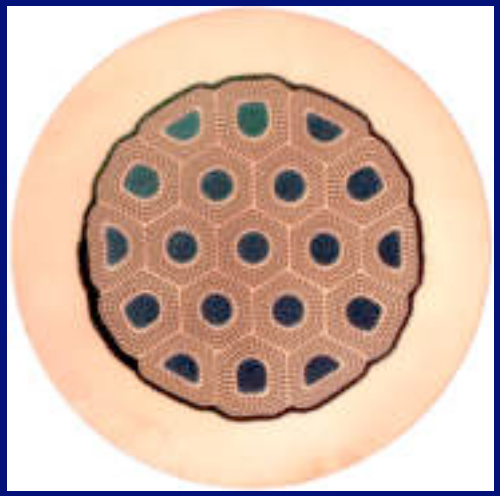
- ~36% overall
  - *Despite limited access to CERN*

Nb_3Sn Types



- Bronze process
  - Majority of present NMR
  - Jc limited by tin fraction in bronze

- Internal tin
  - Higher current density
  - Lower $/ ka-meter
  - Now qualified for NMR and winning share
  - Being developed further for HEP



Both types used in ITER EDA

High Energy Physics and Nb_3Sn

For a future "Very Large Hadron Collider" ?

- Snowmass '01: priority to linear collider
- Chances slim in near/ medium term

Upgrade interaction region quadrupoles at LHC?

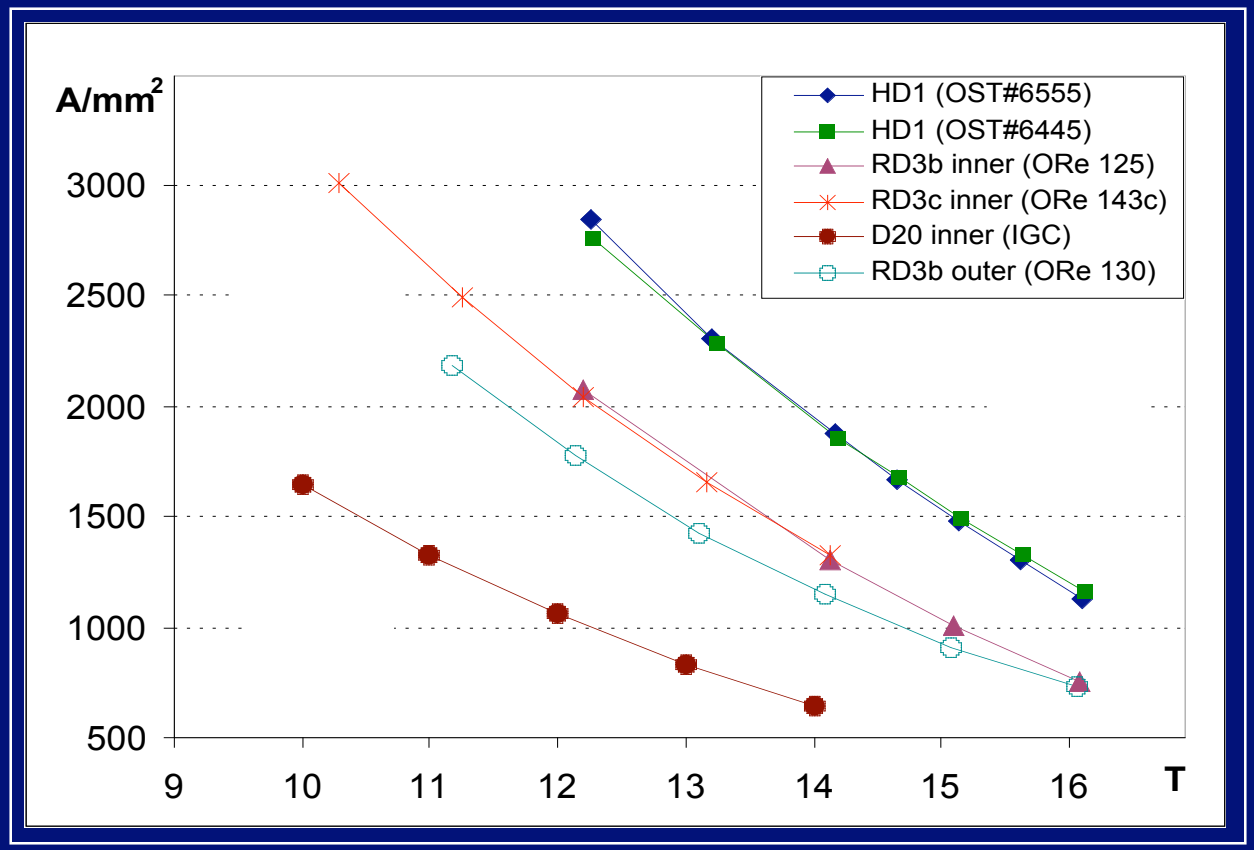
- Boosts luminosity
- Nice leverage of entire LHC investment

While fusion research supported Nb_3Sn advancement in early '90's, more recently HEP has carried the ball.

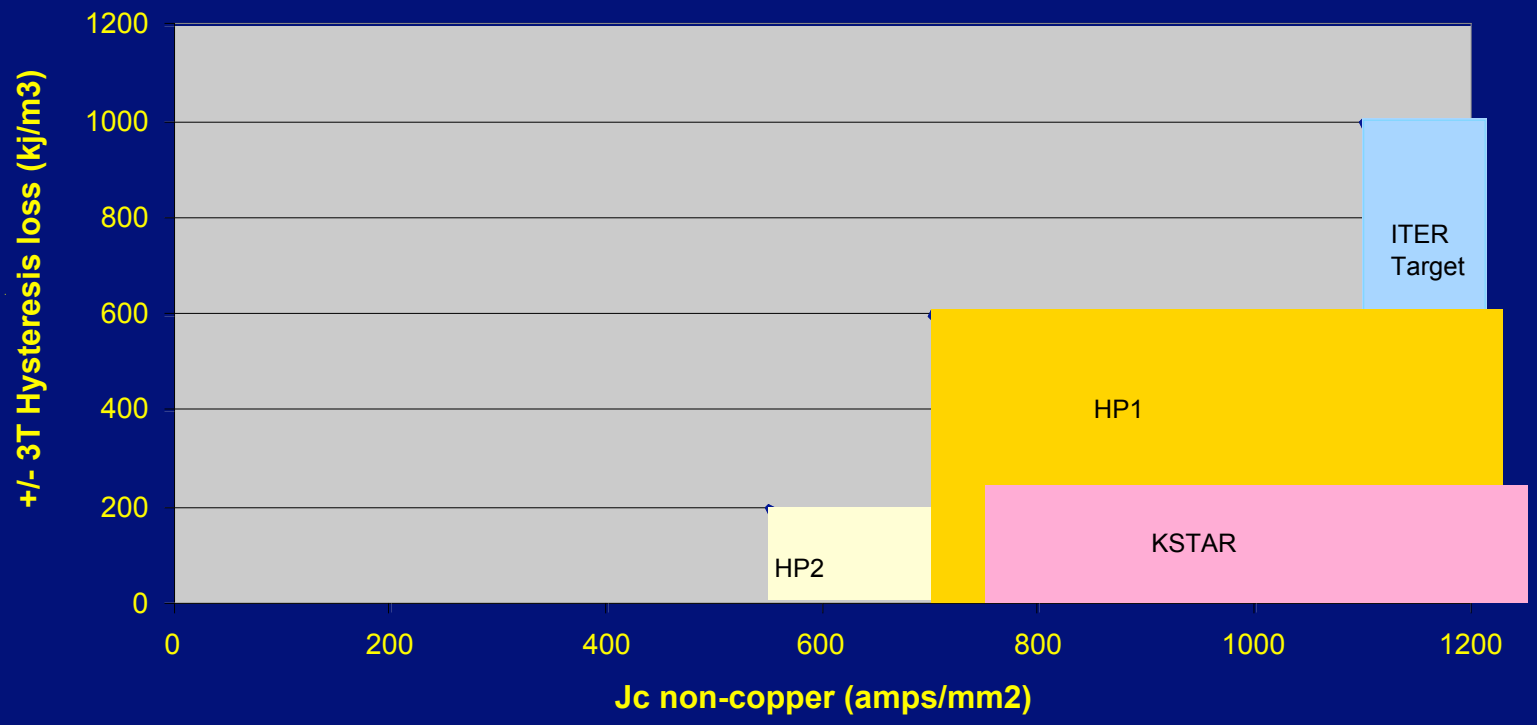
Time to hand off again, or carry it together?

Current density - How far can we go?

Nb_3Sn wires for High Field Dipoles, 1996-2002



Target ITER strand specifications



Higher spec strand can restore design margins in coils

Connecting Present Capability to ITER Requirements

- Tying down technical specifications
  - Understand Ic vs hysteresis loss vs copper content tradeoffs
  - Iterate designs, adapting new technical capability
- Yields
  - Important factor in the economics
  - Need for pilot production to optimize
- Capacities
  - Although ~30x increase in annual Nb_3Sn output is necessary, industry will respond to the challenge provided adequate preparation is planned.

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