Superconductors for fusion magnets

Centre for Materials Physics

Superconductivity Group

www.durham.ac.uk/cmp

Durham University

Presentation by

Prof. Damian Hampshire and Dr. Mark Raine

Structure of the talk

1. Applications that use superconducting materials.
2. The critical current (Ic) of superconducting materials.
3. The high temperature superconductor (HTS) $GdBa_2Cu_3O_7$.
4. Basic superconductivity.
5. The flux-line lattice, fluxons and supercurrents.
6. Reference Laboratory measurements.

7. Industrial Superconducting Materials.
8. Advanced measurements on superconductors.
9. The Icy Durham practical course lectures.

10. Post lecture discussion

Questions to discuss after the end of the 'Superconductors for Fusion Magnets' Lecture

i) What is the structure of HTS ReBCO tapes and Nb_3Sn superconducting wires and?

ii) What is the highest magnetic field inside the ITER, STEP and SPARC/ARC tokamaks?

iii) What is the approximate energy stored in the magnets in the ITER fusion tokamak ?

iv) Name the superconductors that are used to build (any) commercial magnets – state their critical temperature and upper critical field (at zero temperature).

v) Name the superconductors (to be) used in ITER, STEP and SPARC/ARC.

vi) What is the typical current density in a magnet? How can we make it larger? What impact would it have if we increased current density in superconductors by a factor 5.

vii) Either : If a room temperature superconductor was discovered would it affect your thesis research/ the magnetic confinement system for STEP and SPARC/ARC ?
or: List the important properties of the current superconductors used to build fusion magnets.
Rank a five-fold improvement in the important state-of-the-art properties of a superconductor for fusion applications.

Professor D P Hampshire, Durham University, d.p.hampshire@durham.ac.uk