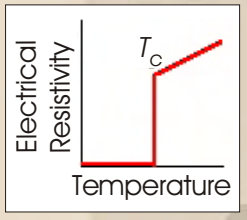
Royal Holloway University of London

Superconductivity

Many metals and compounds become superconducting at low temperatures

Superconductors

- Superconductors have zero electrical resistance below a transition temperature T_C.
- Superconductivity is destroyed above a critical magnetic field.
- Superconductors exclude magnetic fields (the Meissner effect) and levitate magnets.



The picture shows a sumo wrestler standing on a levitating magnet platform that floats above a high-temperature superconductor. The superconductor is cooled by liquid air and hidden below the platform.

Photos courtesy of the Yamanashi Prefectural Maglev Exhibition Centre

Magnetic levitation trains have superconducting magnets in the train itself, cooled by liquid nitrogen or liquid helium. The track has conventional electromagnets to provide levitation and guidance.

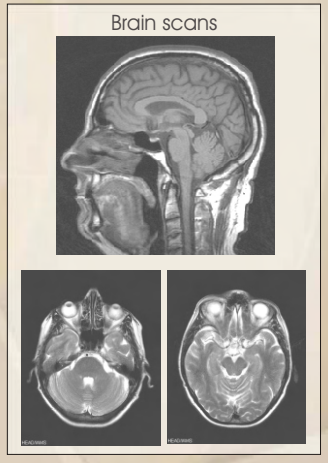
Typical superconductors

- Pure metals such as niobium, T_C = 9 K, lead (7.2 K), tin (3.7 K) and zinc (0.88 K).
- Metallic compounds such as Nb_3Sn (18 K) and MgB_2 (39 K).
- High-T_C superconductors such as yttrium barium copper oxide (YBCO) with T_C = 92 K.

Superconducting magnets

are coils of superconducting wire carrying supercurrents, which generate a constant magnetic field.

Courtesy of OMT/Siemens Medical Soulutions



Oxford Instruments pioneered superconducting magnets for MRI (magnetic resonance imaging) using NMR (nuclear magnetic resonance), now widely used for whole-body imaging.

The highest known T_C is 164 K (-109°C, well above the temperature of liquid nitrogen at 77 K) in a compound of Hg-Ba-Ca-Cu-O under high pressure. The race is now on to discover superconductivity at room temperature.