

Applications of superconductivity

Vortices in Superconductors

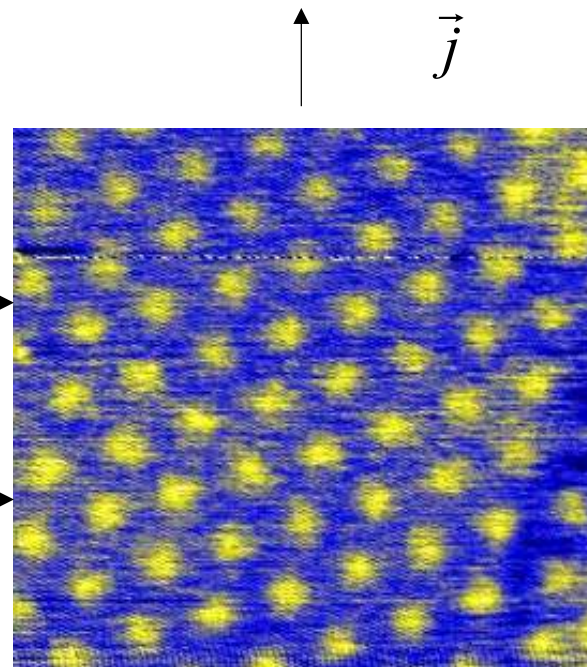
Lorentz force $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

$$\vec{j} = nq\vec{v}$$

$$\vec{F} = \frac{1}{n} \vec{j} \times \vec{B}$$

Faraday's law

$$V = -\frac{d\Phi}{dt}$$



Defects are used to pin the vortices

Superconducting Magnets



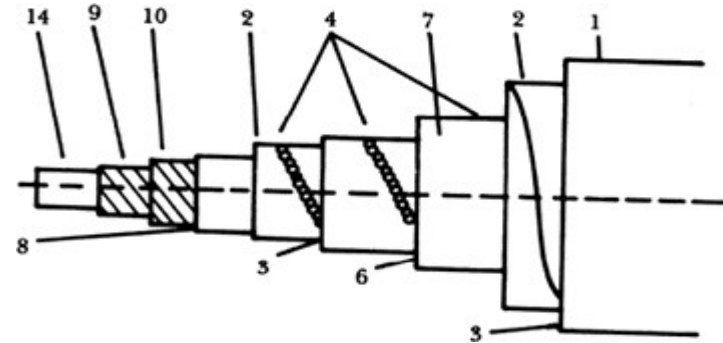
Whole body MRI



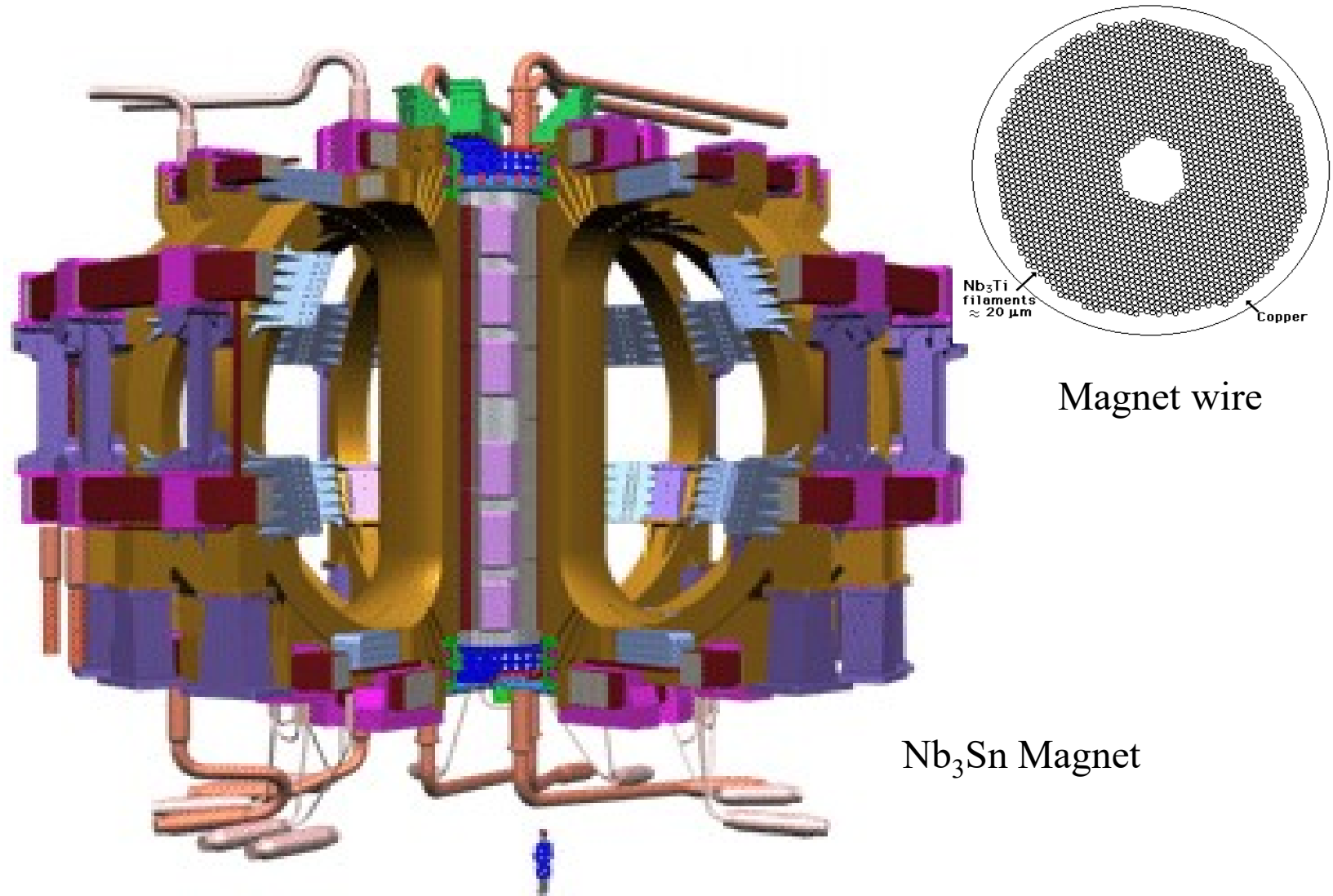
Magnets and cables



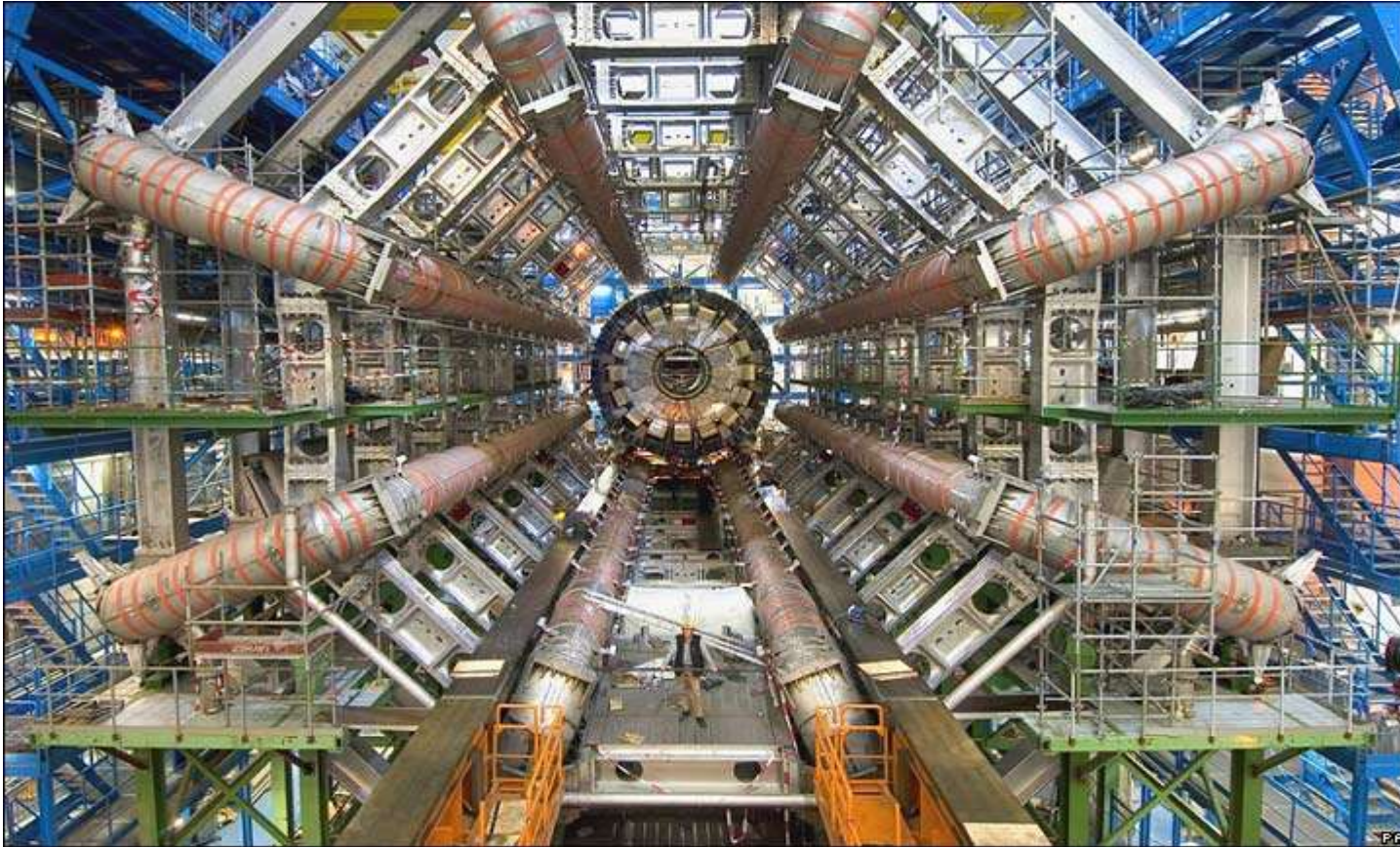
Maglev trains



ITER



Superconducting magnets

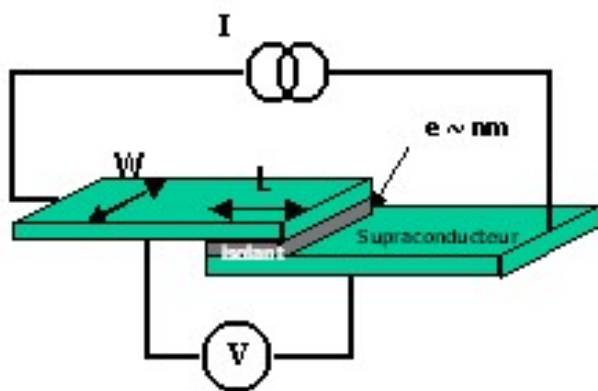


Largest superconducting magnet, CERN
21000 Amps

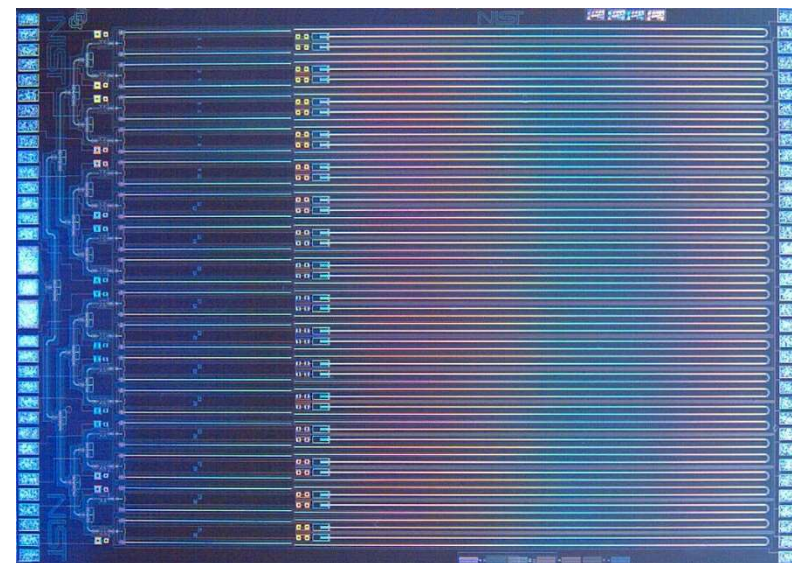
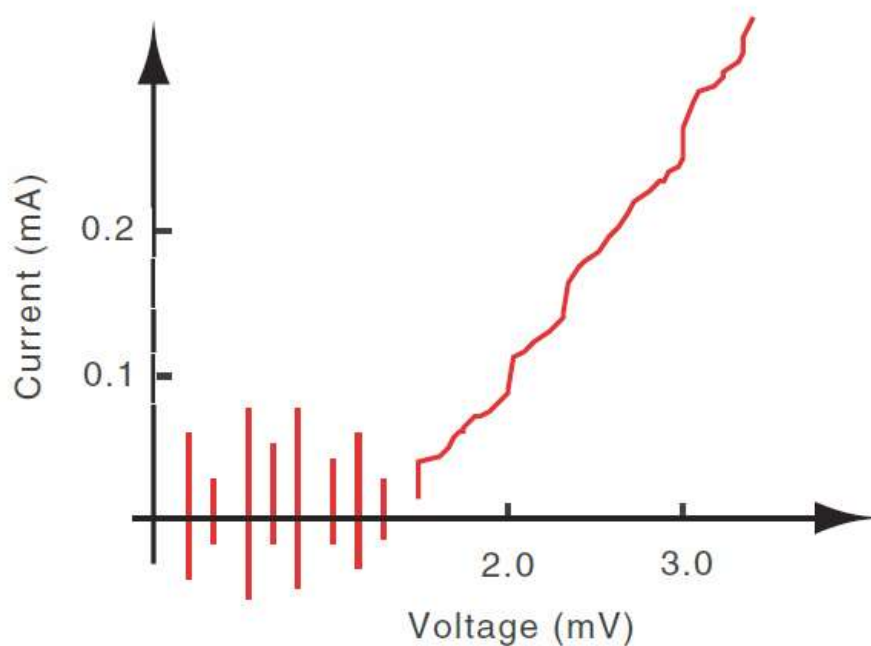
ac - Josephson effect



Brian Josephson



$$V = -\frac{d\Phi}{dt} = n\Phi_0 f = \frac{nhf}{2e}$$

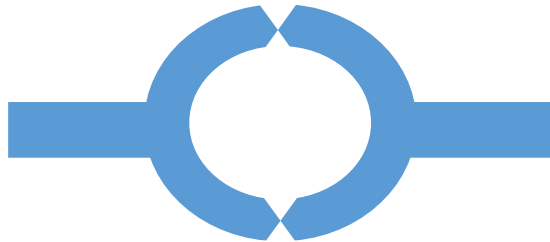


10 V standard

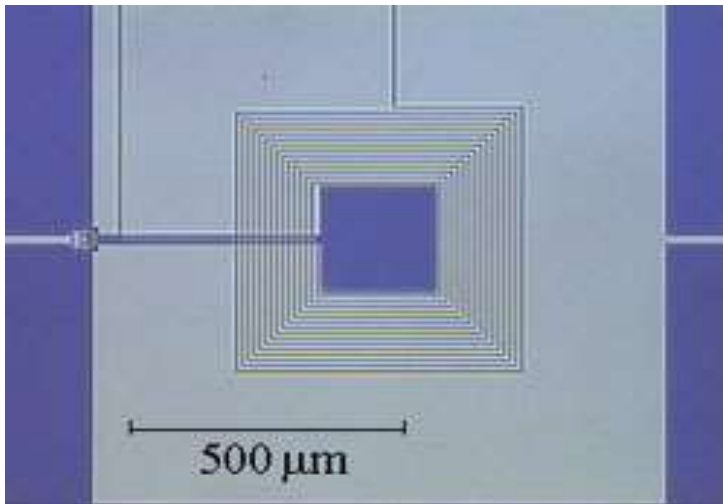
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SQUID

Superconducting quantum interference device



$$10^{-6} \Phi_0 / (\text{Hz})^{1/2}$$



Sensitive detectors

$$10^{-20} \text{ m} / (\text{Hz})^{1/2}$$



Gravity wave detector