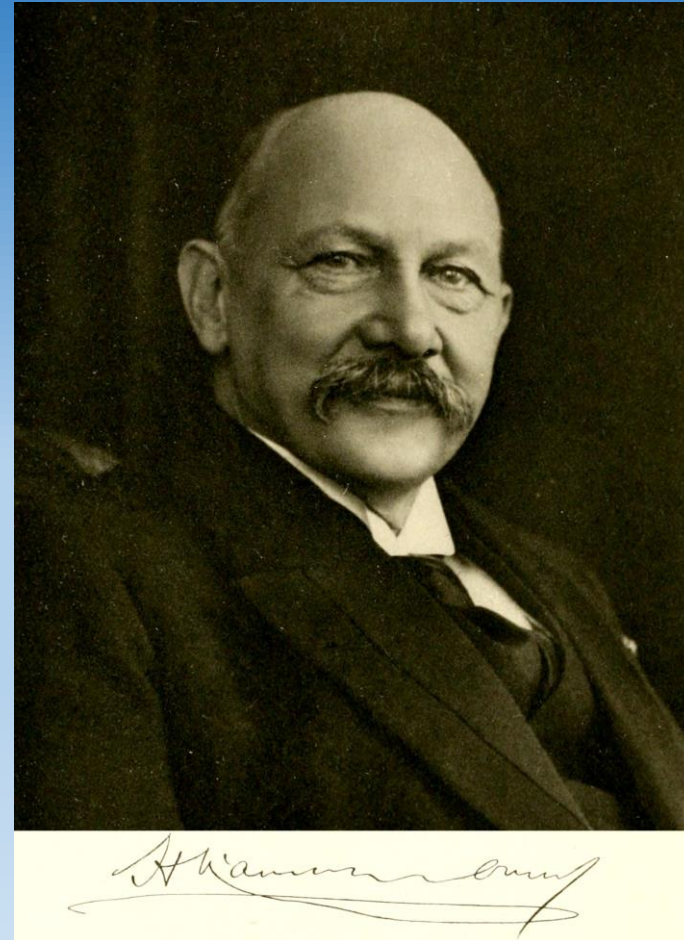


The Science and Significance of
Superconductivity

Parker Hix

Superconductivity

- What is it?
- History
- Phase Transitions
- Applications



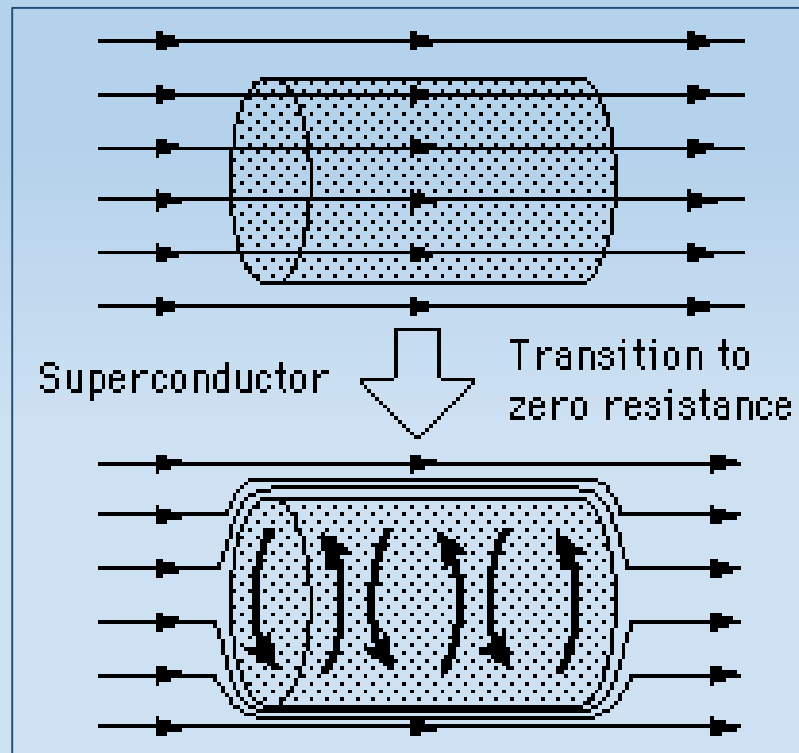
Heike Kamerlingh Onnes

What is Superconductivity?

- Zero electrical resistance (diamagnetism) and cancelation of magnetic field
- Only certain materials can be Superconductive
- Important for many different modern uses:
 - SQUIDS
 - MagLev Train
 - Hoverboard
 - MRI's

History of Superconductivity

- Heike Kamerlingh Onnes – April 8, 1911
- Walther Meissner and Robert Ochsenfeld – Meissner Effect
- London Theory

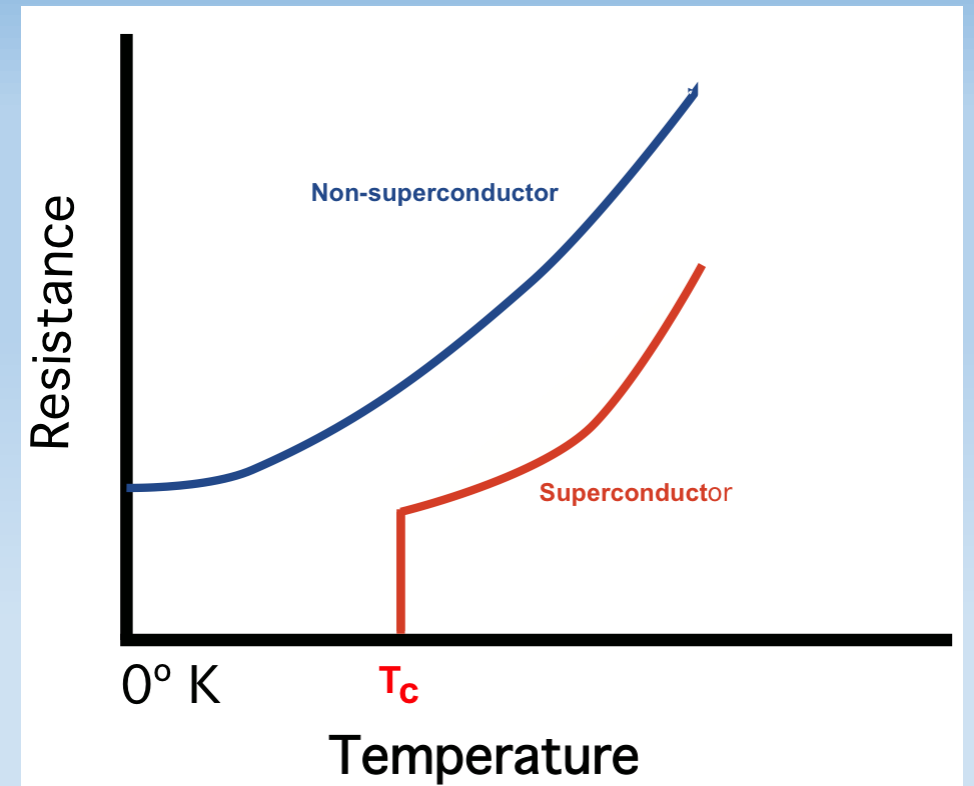


History of Superconductivity

- Material Discoveries
- Electromagnet Advancements
- 1972 Nobel Prize (BCS Theory-1957)

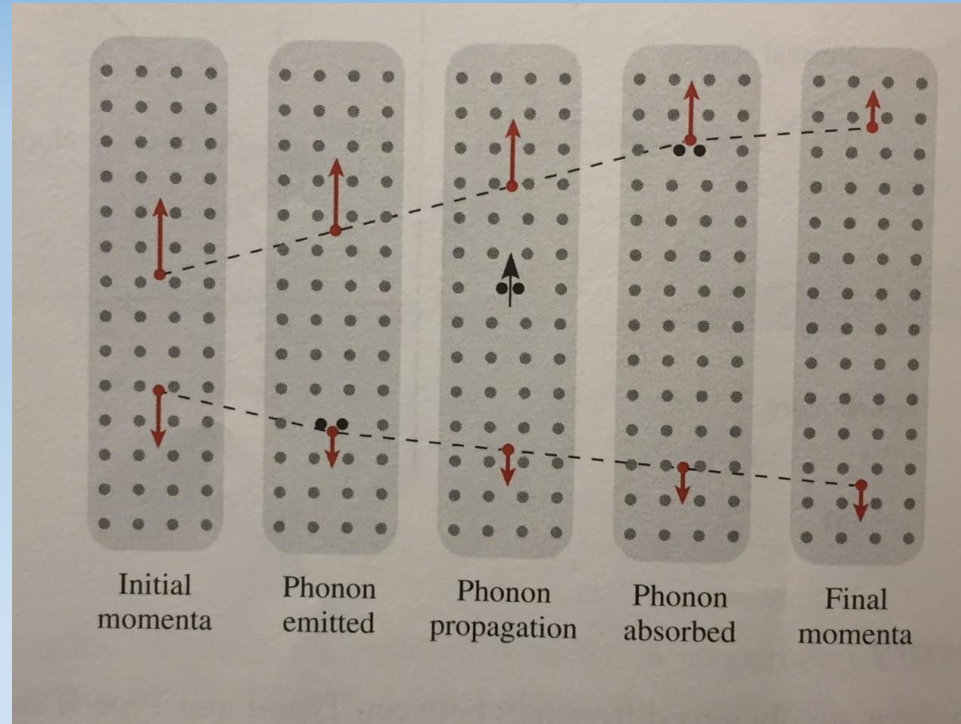
Phase Transitions

- Critical Temperature
- Resistivity

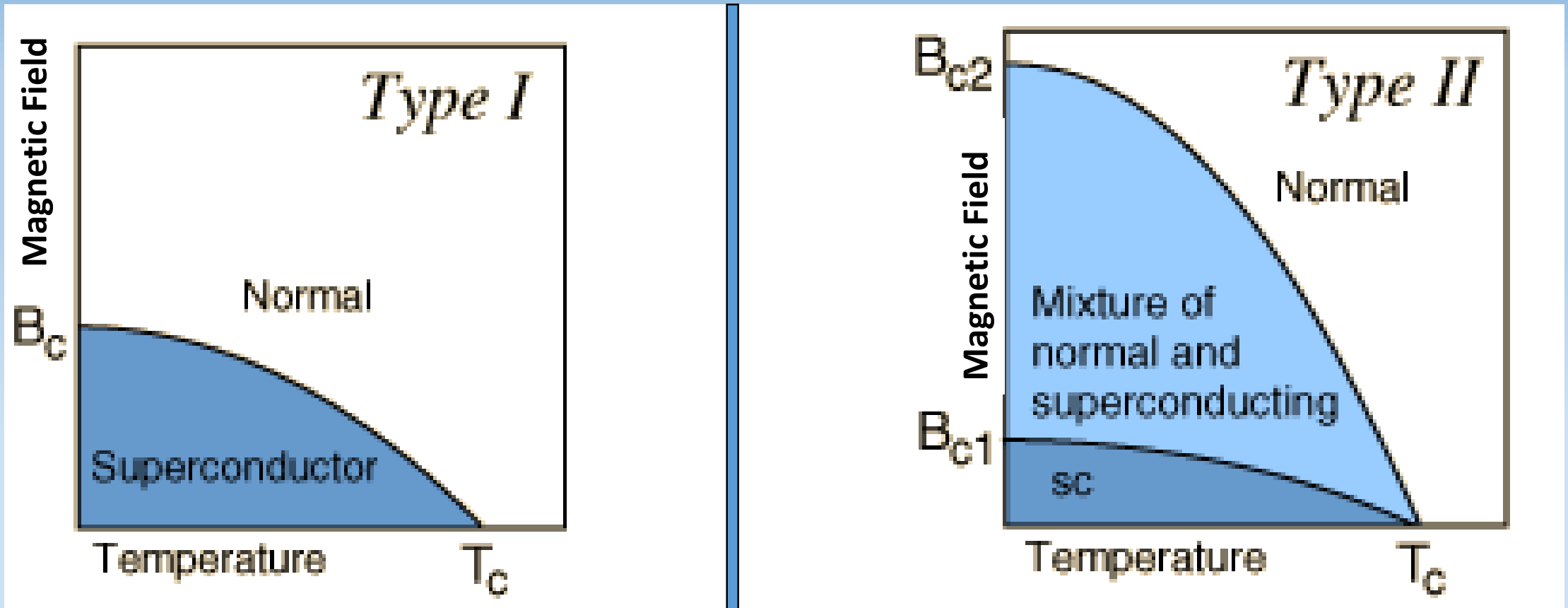


Bardeen, Cooper, Schrieffer (BCS Theory)

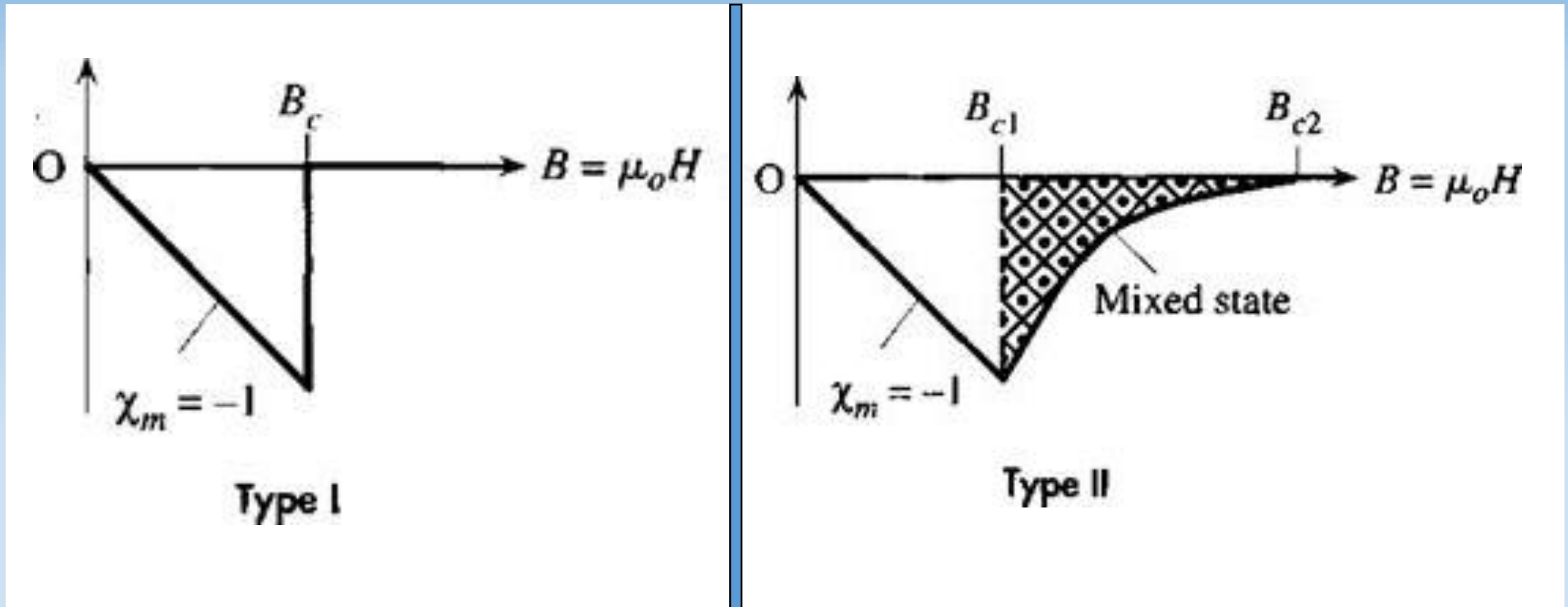
- Cooper Pairs
- Isotope Effect
- Mean Free Path
- Flux Quantization



Type-I vs Type-II Superconductors



Type-I vs Type-II Superconductors



London Equation

$$\mathbf{j}_s = -\frac{n_s e^2}{m} \mathbf{A}$$

\mathbf{j}_s = superconducting current density

n_s = constant

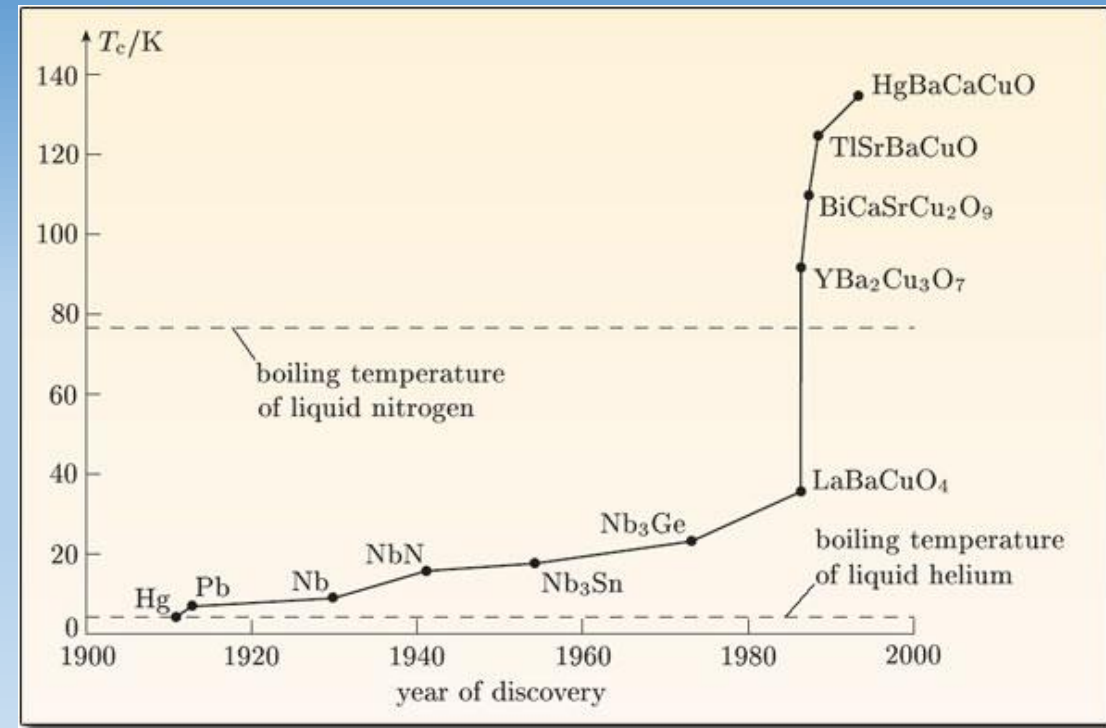
e = elementary charge

m = mass of electron

\mathbf{A} = magnetic vector potential

Applicability

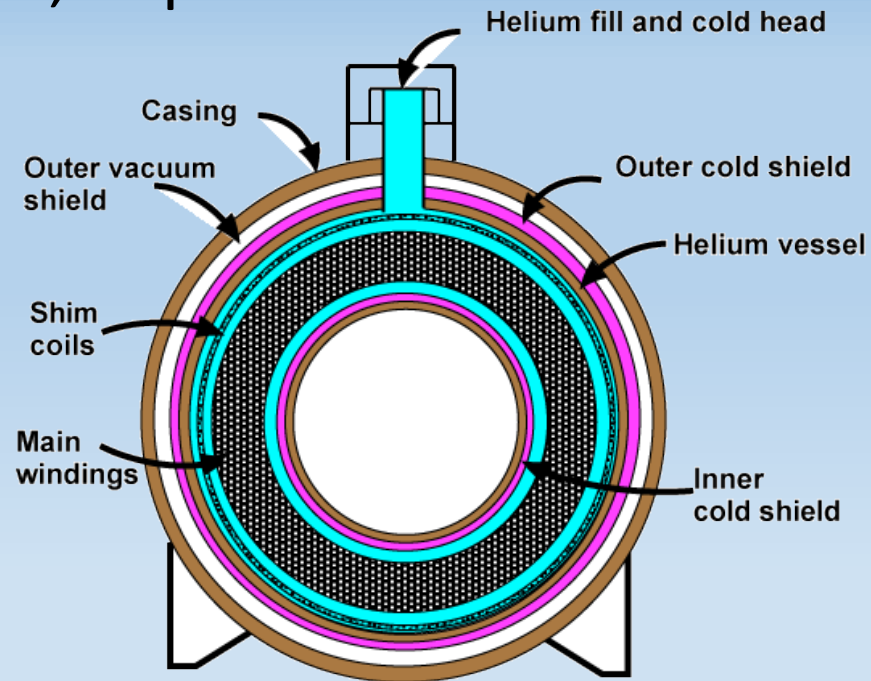
- Which Materials are Superconductive?
- Why are these superconductive and not others?



- Cost Efficiency and Other Practical Properties

MRI Superconductors

- Functionality, diagram, importance of MRI's



Niobium-titanium or niobium-tin alloy is cooled by liquid helium to 4 K to produce the magnetic field.

Future Uses and Applications

- Military Weapons
- High Temp Superconductors
- Ongoing Research

Superconductivity

- Q&A time



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