Critical Temperature Measurement Setup

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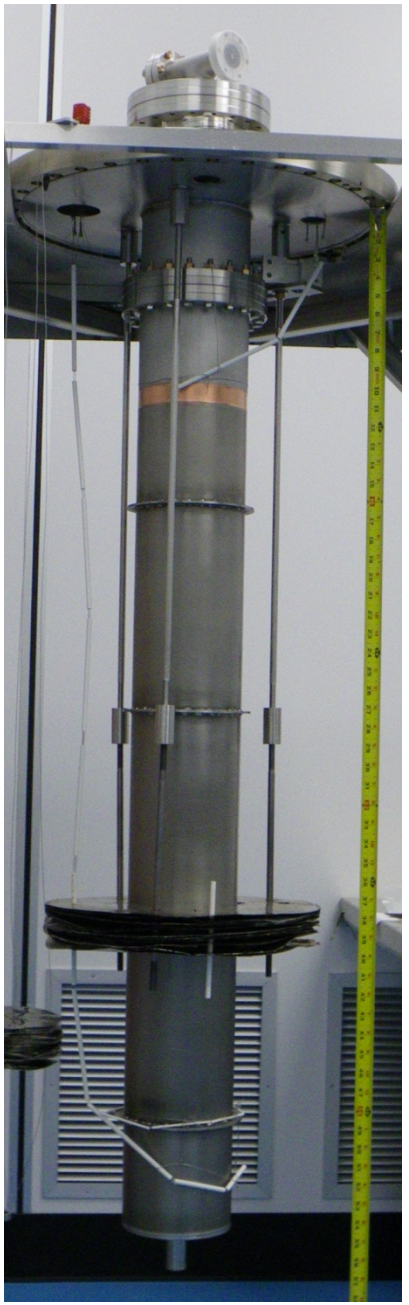
Superconducting Radio Frequency (SRF)

- Electromagnetic cavities resonating at RF can accelerate charged particles
- Quality Factor: The ratio of energy stored in the cavity to the energy lost
- Superconducting cavities have high quality factors and high accelerating electric fields
- Currently, superconductors are most commonly made out of Nb
- Quenching: Superconducting material reverting to normal conducting
- B_c=.23T for Nb
- Problem: The accelerating field is proportional to the magnetic field

Nb_3Sn

- Can withstand stronger magnetic fields w/o quenching than Nb
- Can be made using shown machine
- Problem: possibility of other Nb-Sn compounds
- Only Nb_3Sn is useful for SRF

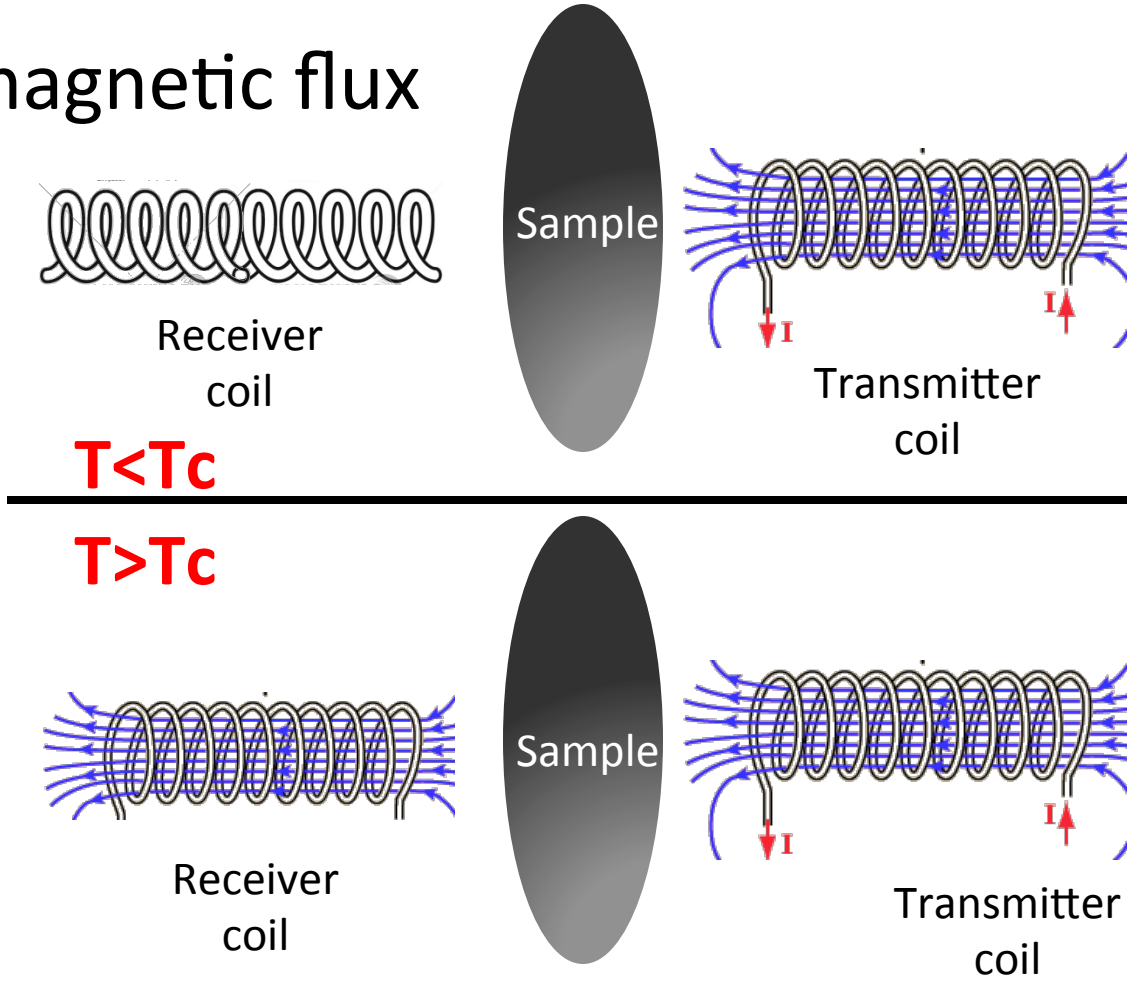


Purpose

- Create a device that can be used to measure the critical temperature of a substance
- Used for identifying compounds (in this case, Nb_3Sn) by their characteristic critical temperature

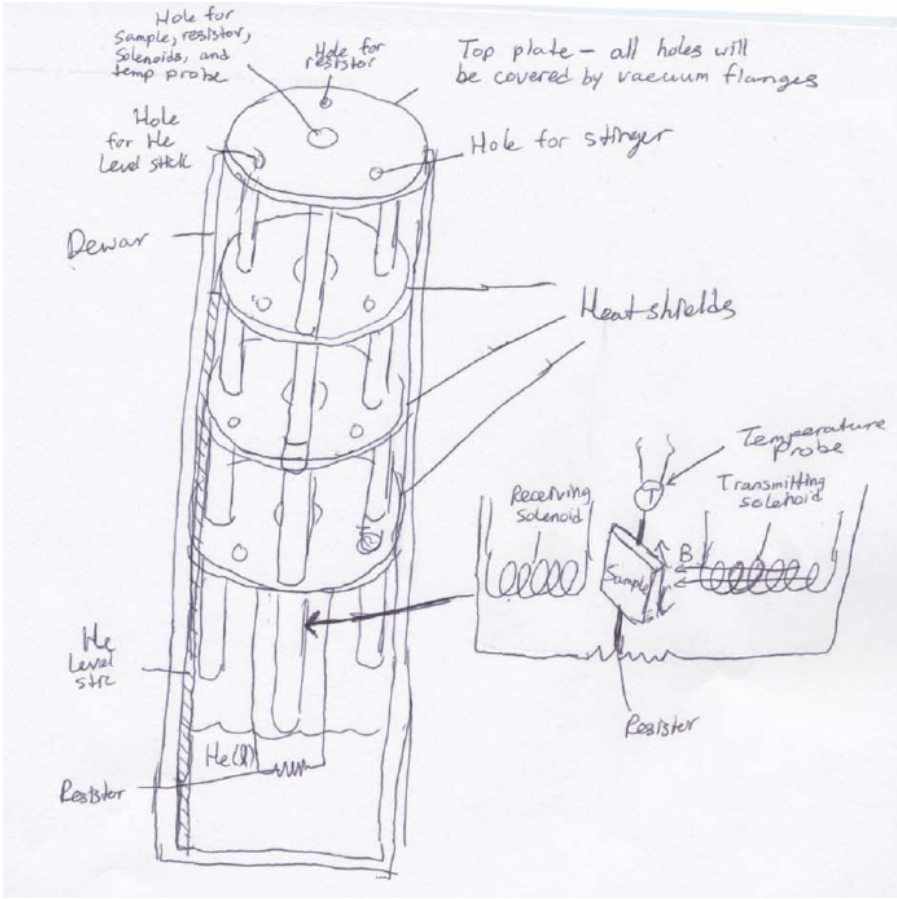
Characteristics of Superconducting Materials

- Very low resistance
- Expel all magnetic flux



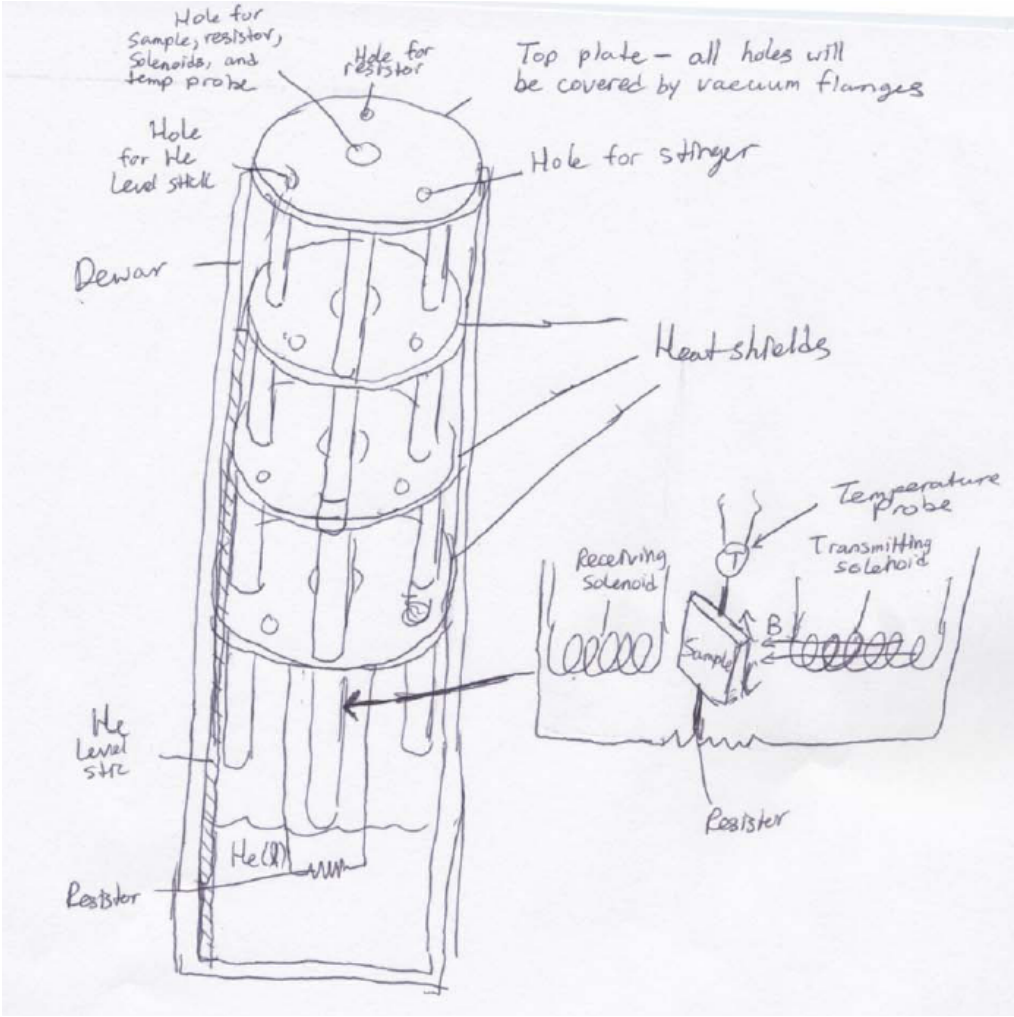
How it Works

- $B=\mu_0 nI$ (in a solenoid); μ_0 and n are constant
- While the sample is normal conducting, the receiving solenoid will act as an inductor
- While the sample is superconducting, it will not be able to induce current
- T_c can be found by keeping track of the voltage across the solenoid and the temperature of the sample



How it Works

- Resistors act as heaters
- Heating process is sped up and made reversible
- Level stick: measures He level
- Heat Shields: Prevent heat transfer from above
- Dewar and top plate: Container
- Vacuum flanges: Allow Liquid He to be recovered



Future and Current Progress

- Finish design in Autodesk Inventor
- Build device based on Inventor design
- Perform a test to make sure that it functions properly