SNS COLLEGE OF TECHNOLOGY

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APPLICATIONS OF SUPERCONDUCTOR

A **Superconducting Quantum Interference Device (SQUID)** is a highly sensitive magnetometer used to measure extremely subtle magnetic fields. SQUIDs are based on superconducting loops containing Josephson junctions, which take advantage of quantum mechanical effects. Here's a breakdown of key concepts related to SQUIDs and their relationship with magnetic levitation:

How SQUIDs Work:

1. **Superconductivity**: SQUIDs rely on the properties of superconductors, which can carry electrical current without resistance when cooled below a critical temperature.
2. **Josephson Junction**: This is a fundamental component of a SQUID, consisting of two superconductors separated by a thin insulating barrier. Quantum tunneling allows for current to pass between the superconductors without voltage, creating a supercurrent. The Josephson junction plays a crucial role in detecting changes in magnetic flux.
3. **Magnetic Flux Quantization**: In a superconducting loop, the magnetic flux passing through it is quantized, meaning it can only take on discrete values. The SQUID detects changes in this quantized flux by measuring the interference of supercurrents through the Josephson junctions.
4. **Sensitivity**: SQUIDs are extremely sensitive, capable of detecting magnetic fields as small as a few femtoteslas (10^-15 tesla). This makes them ideal for applications in physics, medicine (e.g., magnetoencephalography for brain activity), and material science.

Magnetic Levitation:

Magnetic levitation (maglev) involves the suspension of an object in the air without any support other than magnetic fields. This phenomenon can occur through several principles, including diamagnetism, ferromagnetism, and the Meissner effect in superconductors.

Relationship between SQUIDs and Magnetic Levitation:

- **Meissner Effect**: Superconductors exhibit the Meissner effect, where they expel magnetic fields from their interior when cooled below the critical temperature, resulting in perfect diamagnetism. This property allows for stable magnetic levitation. If a superconductor is placed near a magnet, the repulsion from the expelled magnetic field can cause the magnet to levitate.
- **Levitation Applications**: Magnetic levitation is used in maglev trains, contactless bearings, and even in experimental setups where SQUIDs are utilized to measure subtle magnetic fields near levitated objects.