Levitation and Its Practical Applications

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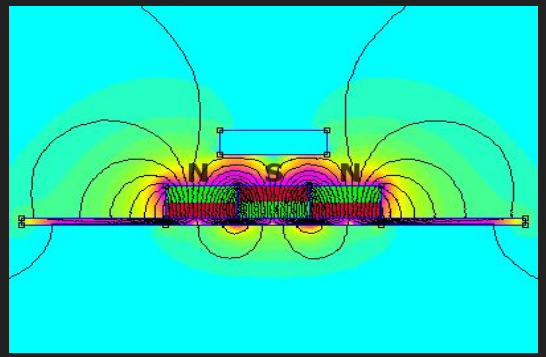
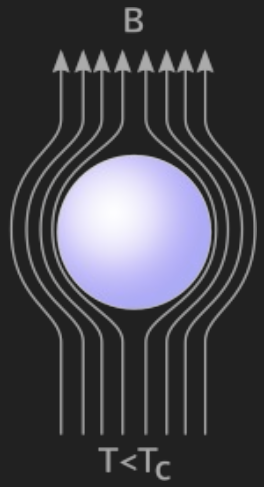
What is Levitation?

Levitation is the process by which an object is held aloft, without mechanical support, in a stable position

From the Latin word: **levitas**
"lightness"





Super diamagnetism:
A phenomenon that occurs in materials at low temperatures where there is an absence of magnetic permeability and the exclusion of the interior magnetic field

Levitation outside the movies is caused by opposing forces in a vortex pinning direction

Meissner Effect and Quantum Mechanics

The Meissner Effect: *MAGNETIC FLUX BEING EXPELLED FROM A SUPERCONDUCTING MATERIAL, CREATING A REPULSIVE EFFECT IN TYPE I AND TYPE II CONDUCTORS*

Q.M research has shown that **electrons are both particles and waves** - giving it different properties like energy and its magnetization ability

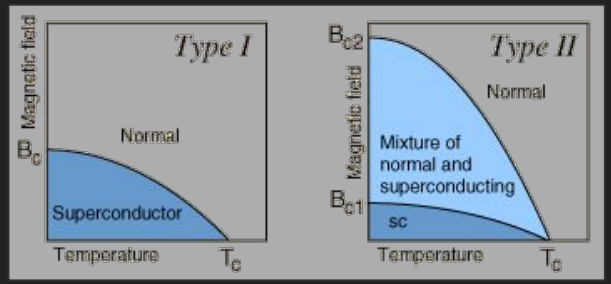
At normal temperatures: electrons can collide freely within the material, resistance generates heat

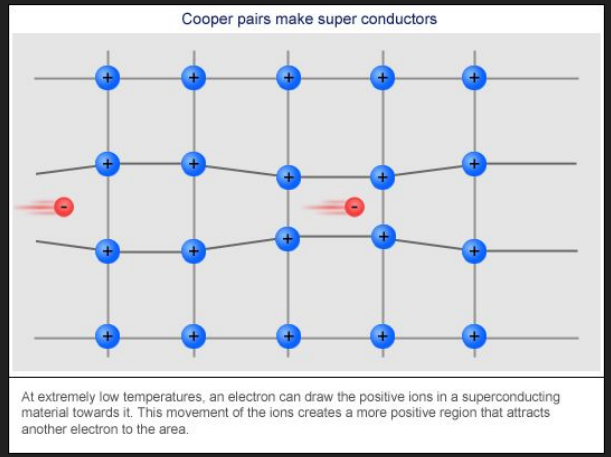
At high temperatures: magnetic fields can easily penetrate material

At cold temperatures: the material does not allow magnetic fields to penetrate it, which forces the superconductors to the expel magnetic field

Meissner Effect in action: When a superconducting material is cooled to its critical temperature, magnetic fields are expelled inducing a magnetic force

Meissner Effect and Superconductors





Superconductor materials: Metals, ceramics, organic materials, or heavily doped semiconductors that conduct electricity without resistance

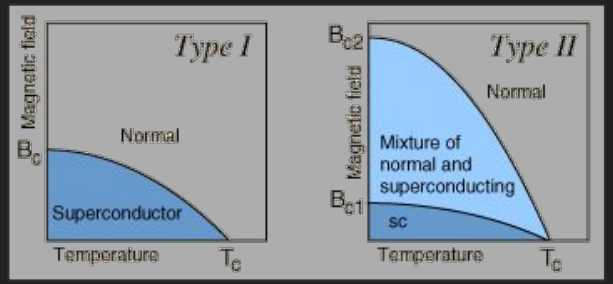
Type I: Perfect conductors that will act as a superconductor under a specific strength of magnet field, and will not show Meissner effect as readily

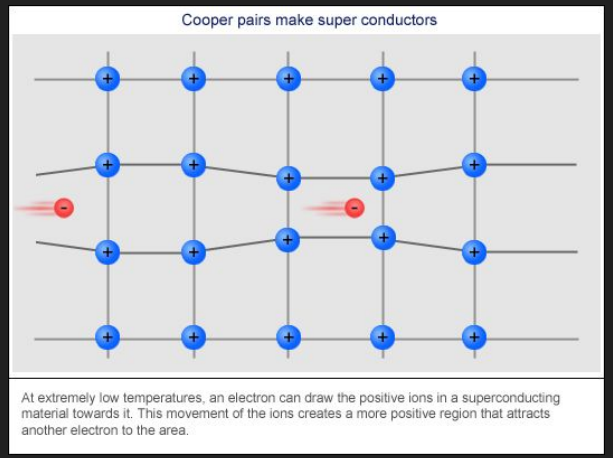
Type II: Not perfect conductors, but are able to enter into a mixed state where vortexes appear in motion and more readily show the Meissner effect

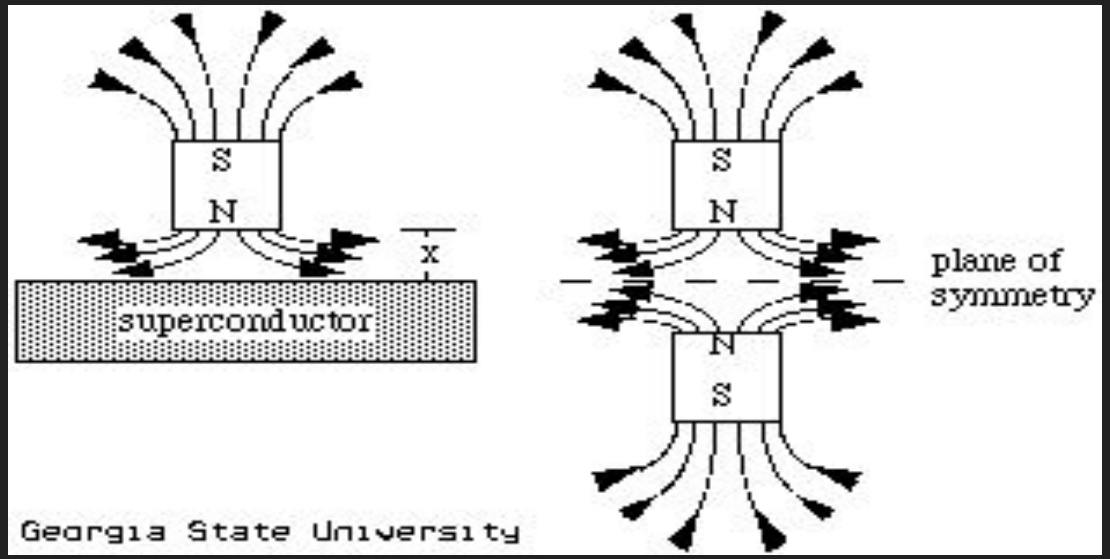
The magnets induce a magnetic fields and causes the current within the superconductor to move in vortex formation

Cooper Pairs: *At extremely low temperatures, an electron can draw the positive ions in a superconducting material towards it. This movement of the ions create a more positive region that attracts another electron to the area*

Meissner Effect and Superconductors







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Real life applications

FIrst thought - Trains/transportation

Space Launch System

Efficient Wind Power - boost wind energy generation by 20%

Opens a whole new world of technologies and opportunity

Current Research

Mikhail Eremets, physicist at Max Planck Institute for Chemistry

Previous Record (2014) - 203 Kelvin (-70℃)

New Record (2019) - 250 Kelvin (-23℃/-9.4℉)

Need high pressure - lanthanum hydride at 170 gigapascals

“This leap, by 50 Kelvin,... indicates the real possibility of achieving room-temperature superconductivity (that is at 273 Kelvin) in the near future at high pressures.”

Eremets 2019

Next steps 1: Parts assembly, familiarization, and initial testing

- Learn to use liquid nitrogen safely, learn to use Neodymium magnets safely
- Construct insulation casing for superconductor
- Use few Neodymium magnets and test the cooled superconductor
- Attempt to get the superconductor stable above the magnets, achieve levitation

Next steps 2: Further testing and Track assembly

- Following successful first trial more elaborate set ups would be created to test the capabilities of the levitation
- The goal is to try to see how far and how fast the superconductor can go along a track
- After capabilities are found a design for a presentation track would be made
- Prototype will be constructed using our materials.

Next steps 3: Working model and beyond

- The track must be tested and fixed until it can functionally run the superconductor over it
- Once a working track is assembled, Creatively design the track and entire presentation set up to possibly match some future applications mentioned
- The track was originally going to be the main attraction of URC presentation
- After this specific project the materials can be used to do more rigorous in depth research on just how far superconductors can go.