Superconducting levitation with YBCO and liquid nitrogen Ishaan Agarwal¹, Fernanda CerperoReina¹, Arvin Rahmatian¹, Avery Tanzil¹, Cathryn Vera¹, Rahul Nanjundan¹, Dimitri Teas¹, and Greg Kahanamoku-Meyer²

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What is a Superconductor?

- Superconductors, when very cold, conduct electricity with zero resistance, allowing perpetual current flow.
- They also push out magnetic fields, a key property with practical uses. This is known as the Meissner effect.
- This ability to conduct perfectly and repel magnets makes them useful in strong magnets and levitation technologies.

lications

Maglev trains: Maglev trains use magnetic levitation to reduce friction and propel the trains at speeds up to 311 mph.

MRI Scanners: Superconductors generate strong, uniform fields that allow for fast, high-res body scans.

Quantum Computer Chips: Contains qubits, which are different from classical bits as they can exist in the states of 0 or 1 simultaneously (AKA Superposition), enabling increased efficiency in information processing.

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https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.58.908 https://scmaglev.jr-central-global.com/about/#:~:text=When%20superconducting%20magnets%20on%20vehicl e,balanced%20against%20the%20magnetic%20force.





What is YBCO?

YBCO (Yttrium Barium Copper Oxide) is a type of ceramic, high-temperature superconductor. Unlike earlier superconductors, YBCO works at higher temperatures, making it possible to cool with liquid nitrogen instead of liquid helium.

What is liquid nitrogen? Why do we need it to make YBCO become superconducting?

Liquid nitrogen is nitrogen gas that is cooled to -196 C (77K) to result in a cryogenic liquid. When added to YBCO for cooling, YBCO becomes a superconductor because YBCO superconducts when below -181 C (92K). As a result, YBCO loses all electrical resistance and expels magnetic fields, which allows levitation.

What is electricity/magnetism

Electric Fields

- Created by positive and negative electric charges.
- Have intensity and direction depending on the particles' charge.
- particles such as electrons.

Magnetic Fields











• Move away from positively charged particles and towards negatively charged

• Created by changing electric fields, intrinsically linking the two.

• Can force moving electrically charged particles in helical or circular routes.