Superconductivity. Discovered 100 years ago, continues to fascinate and attract the interest of scientists and non-scientists all around the globe. Being the only quantum phenomena visible to the naked eye, it offers a unique window to quantum mechanics.

Now you can touch it as well. The 'Quantum Levitation' variety of kits offer a unique opportunity to witness true levitation and feel the quantum locking forces.

Designed for Science Education. Our kits were specially designed for large audience demonstrations.

⚠ WARNING!

The **"Quantum Levitation"** experiment uses extremely strong neodymium magnets. These magnets, if not handled carefully, can cause serious injury. Keep the magnets away from magnetic materials and far from sensitive electronics.

Superconductivity

Superconductivity is a quantum phenomenon of zero electrical resistance. It was discovered in 1911 by a dutch physicist named Kamerlingh Onnes. Superconductivity occurs only below a certain critical temperature(Tc). Metals such as aluminum, lead, tin become superconductors only at temperatures close to the absolute zero (-273.15C, - 459.67F).

In 1986 a new family of superconductors was discovered having a much higher Tc, close and even higher than the boiling temperature of liquid nitrogen (-196.15C,-321.07F).

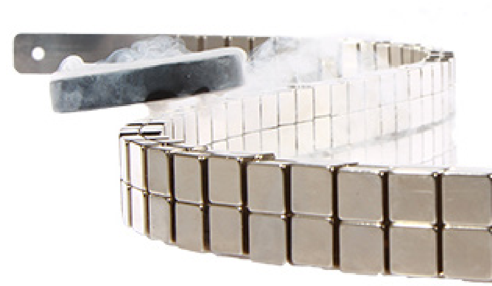
Meissner Effect

The expulsion of magnetic field from a superconductor is an intrinsic property of any superconductor. Below a certain magnetic field the superconductor expels nearly all the magnetic flux. It does that by driving currents near its surface. These currents produce a magnetic field within the bulk that cancels the external field.

Flux Pinning

In some cases the magnetic flux becomes locked or "pinned" inside a superconductor. Flux pinning is desirable in high - temperature ceramic superconductors to prevent flux movements which introduce a resistance and dissipates energy. The pinning is achieved through defects in the crystalline structure of the superconductor usually resulting from grain boundaries or impurities.

QUANTUM LEVITATION



Do It Yourself MAGLEV KIT

A truly Quantum experience

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QUANTUM LEVITATION

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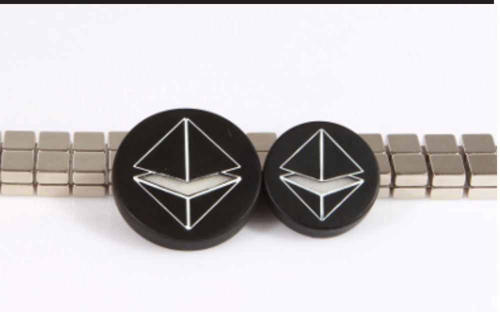


Experiments

Meissner effect

The Meissner effect describes the expulsion of magneic flux from the superconductor.

Experiment: Soak the levitator in liquid nitrogen, logo face down. Take a small magnet and gently lower it towards the levitator, ~3cm above. Let it go. See how it is repelled (falls aside). Try to force it a few more millimeters into the field and see how it levitates while still wobbling around.

Conclusions In the Meissner state the superconductor is diamagnetic, it has an opposite magnetization.

Quantum locking

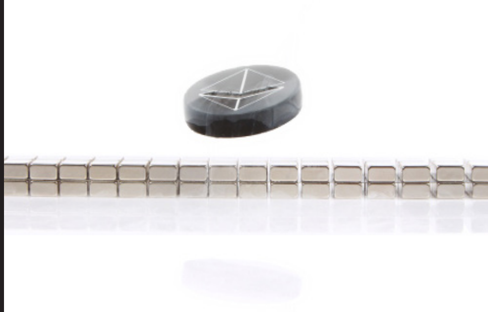
The locking is the key to understanding Quantum Levitation. Show how the superconductor is frozen in space close to the magnets.

Experiment: Construct a double layer 3x3 magnetic setup. Take the cooled superconductor and place it above the magnetic setup. The superconductor is “locked” in midair. Briefly try to move it in all directions and feel the resistance due to the pinning force. Show that the superconductor can be placed in any orientation including upside down.

Conclusions: The superconductor is ‘locked’ in space. The flux pinning force keeps the levitator stable in 3D (unlike two repelling magnets).

Frictionless motion

After seeing the locking its time to further explore its properties.



Experiment: Position the flexible track on a firm surface, either on its wide face or on its side. Soak the levitator in liquid nitrogen. Using the tweezers take the levitator and lock it on the track. See how it moves smoothly along the track. Try changing the levitation height, see how it reacts.

Conclusions: The superconductor moves without friction along the track. The fact that the magnetic flux is constant along the track allows it to move freely.

Suspension

Experiment: Soak the levitator in liquid nitrogen. Position the flexible track on a firm surface, either on its wide face or on its side. Using the tweezers take the levitator and lock it on the track. Make sure it is firmly locked and if needed, push it closer to the track. Carefully hold the track from it sides, raise it and flip it over. See how the levitator hangs and moves below the track.

Conclusions: ‘Quantum Locking’ is caused by pinning of magnetic flux lines inside the superconductor. The locking forces prevent the levitator from moving away from the track as well as going sideways. The levitator on the track is locked in 2D and thus levitation can be easily transformed into suspension.