

# Magnetic Levitation Basics

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## **Abstract**

This document provides a short overview of how diamagnetism enables stable levitation and what fundamental limits exist.

## **Summary**

Diamagnetism is a property of materials that causes them to create an opposing magnetic field when exposed to an external one. Unlike ferromagnetic or paramagnetic effects, diamagnetism is weak but universal: all materials exhibit it to some degree. However, in strongly diamagnetic materials such as bismuth or pyrolytic graphite, the effect is strong enough to counteract gravity when placed above a set of permanent magnets.

The stability of diamagnetic levitation arises because the repulsive force acts directly against displacements, preventing the object from sliding off the field. This is in contrast with purely magnetic attraction, where Earnshaw's theorem forbids stable static levitation.

Limitations come from the weakness of diamagnetism: only very light objects, or those with exceptional diamagnetic response, can be stably levitated with permanent magnets. For larger or heavier systems, active feedback or superconducting levitation is required.