Photons that aren’t actually there influence superconductivity

Despite the headline, this isn’t really a story about superconductivity—at least not the superconductivity that people care about, the stuff that doesn’t require exotic refrigeration to work. Instead, it’s a story about how superconductivity can be used as a test of some of the weirder consequences of quantum mechanics, one that involves non-existent particles of light that still act as if they exist.

Researchers have found a way to get these virtual photons to influence the behavior of a superconductor, ultimately making it worse. That may, in the end, tell us something useful about superconductivity, but it’ll probably take a little while.

Virtual reality

The story starts with quantum field theory, which is incredibly complex, but the simplified version is that even empty space is filled with fields that could govern the interactions of any quantum objects in or near that space. You can think of different particles as energetic excitements of these fields—so a photon is simply an energetic state of the quantum field.

Some of these particles have real existences we can track, like a photon emitted by a laser and absorbed by a detector some distance away. But the quantum field also allows for virtual photons, which simply act to transmit the electromagnetic force between particles. We can’t really

directly detect these, but we can definitely track their effects.

One of the stranger consequences of this is that locations that have a strong electromagnetic field can be filled with virtual photons even when no real ones are present.

Which brings us to one of the materials central to the new work: boron nitride. Like the more famous graphene, boron nitride forms a series of interlinked hexagonal rings, extending out into macroscopic sheets. The bulk material is made of sheets layered onto sheets layered onto yet more sheets. This has an effect on light transiting through the material. In one direction, the light will simply slam into the material, getting absorbed or scattered. But if it’s oriented along the plane of the sheets, it’s possible for the light to travel in the space between the boron and nitrogen atoms.

https://arstechnica.com/science/2026/02/photons-that-arent-actually-there-influence-superconductivity/