Physics

Mysterious rotation trick makes magnets float in the air

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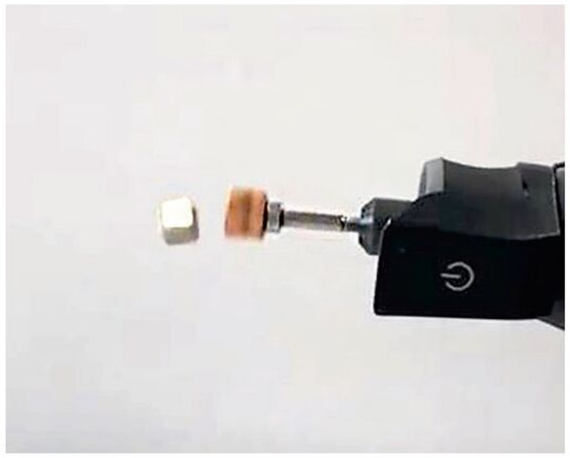
THERE is a simple way to levitate magnets – and physicists are now beginning to understand how it works. The technique could have applications for robotics in the future.

In 2021, Hamdi Ucar – then at Göksal Aeronautics in Turkey – posted a YouTube video showing two magnetic spheres levitating on either side of a rapidly spinning bar magnet that was positioned with its north-south poles oriented vertically.

Ucar also published a paper on the phenomenon, which attracted the attention of Rasmus Bjørk at the Technical University of Denmark.

With a colleague, Bjørk decided to replicate Ucar's levitation technique. "We sat down for half an hour and tried. I was like, it's completely out of the question, it simply shouldn't work. And then it just worked. We were completely baffled by this," he says.



J. M. HERMANSEN ET AL.

A demonstration of a spinning magnet being used to keep another one afloat

Now, Bjørk and several other colleagues, all at the Technical University of Denmark, think they have figured out what is going on to make the magnet levitate.

They started with Ucar's set-up, where a "floater" magnet levitates when placed on top of another magnet that is spinning hundreds of times every second.

Then, Bjørk and his colleagues tested a range of spinning frequencies and floater sizes while filming the magnets and measuring their magnetic fields. The researchers also developed a computer simulation of the experiment (*Physical Review Applied*, doi.org/k2pq).

Team member Frederik Durhuus says the rotation is key to the process.

Many people are familiar with the way two magnets repel one another when their respective north poles or south poles are close together. But one of the magnets will usually flip over, meaning that a north and south pole are close together – at which point they stick to each other.

Durhuus says the rotation counters this magnetic "flipping" and keeps the floating magnet levitating. He compares it to the way that a spinning top counters the downward pull of gravity and spins for longer than we might expect it to.

Ucar's experiments show that the effect can persist even when the rotating magnet is oriented horizontally, rather than vertically like a spinning top. He disagrees with some details of the team's numerical and theoretical models, but says that their independent validation of this surprising effect is important.

"I don't think we will be able to make any [magnetically levitating] trains with this any time soon, but it will be interesting to see where it can be useful because it does not require very fancy equipment," says team member Joachim Hermansen.

Marcel Shuck at No-Touch Robotics in Switzerland says magnets are already used to suspend and transport objects in some industries. Using rotation to levitate magnets could be a simpler alternative to systems that require their magnets to be constantly readjusted, he says.