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Trio create artificial magnetic wormhole

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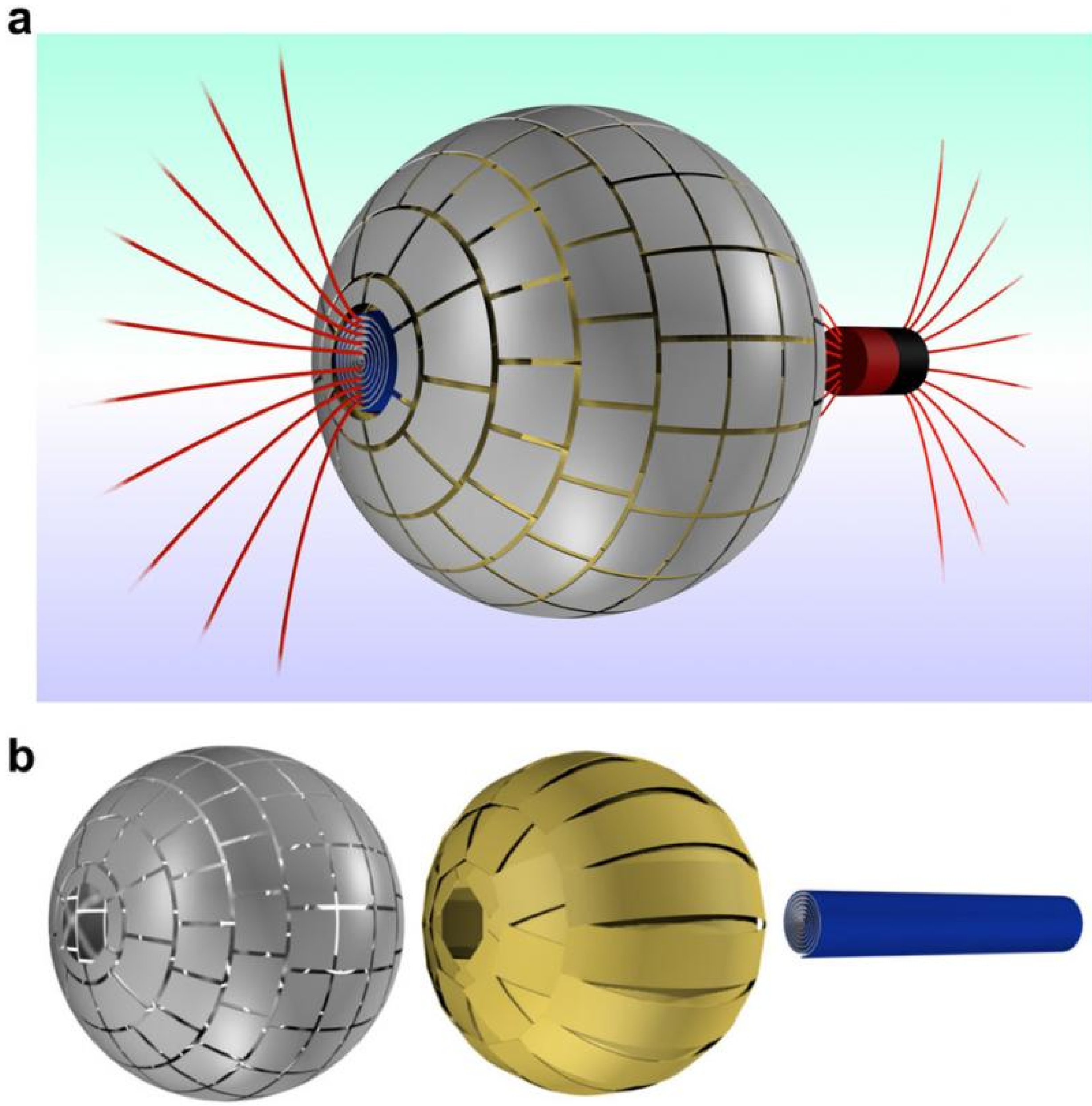

(a) The field of a magnetic source (right) is appearing as an isolated magnetic monopole when passing through the magnetostatic wormhole; the whole spherical device is magnetically undetectable. (b) The wormhole is composed of (from left to right) an outer spherical ferromagnetic metasurface, a spherical superconducting layer, and an inner spirally wound ferromagnetic sheet. Credit: *Scientific Reports* 5, Article number: 12488 (2015) doi:10.1038/srep12488

(Phys.org)—A trio of physicists with the Autonomous University of Barcelona has built what they claim is the first artificial magnetic wormhole. In their paper published in the journal *Scientific Reports*, Jordi Prat-Camps, Carles Navau and Alvaro Sanchez describe how they built the device and why they believe it might prove useful in building a more user-friendly MRI machine.

People have grown familiar with the term wormhole as it applies to physics and science-fiction. It has been described as a portal in space-time, where an object, or perhaps a person, could be transported from one region of space to another, nearly instantaneously. And while the theory has stood the test of time, no one has ever been able to prove that they actually exist. In this new effort, the researchers built a much simpler version, one that applies only to a magnetic field. Their device essentially allows for a magnetic field to be conveyed from one point to another, while remaining magnetically invisible.

The device is a three layered sphere—at its center they placed a magnetized metal tube. The tube was then surrounded by a sphere made of strips of a superconducting material (yttrium barium copper oxide)—it served to deflect incoming fields. Another sphere was then placed over the whole works to make the deflection of the inner sphere undetectable. To make the device work as intended it was put into a liquid nitrogen bath to bring the temperature inside the sphere down to the point where the yttrium barium copper oxide behaved as a superconductor. The end result was a device that made it appear that a magnetic field suddenly disappeared, then reappeared at another place.

The team tested their device by placing it in an external magnetic field that that they created and then placed magnetic probes at either end of the sphere. The first probe indicated the presence of a monopole-like field. The second probe was moved back and forth across the length of the sphere and indicated no magnetic field was present—temporarily removing either shell revealed that there was indeed a field inside the sphere.

Beyond its research value, the team believes that their device could serve as the basis for a new type of MRI machine, one that could relieve patients from having to sit inside of a big loud shell while their insides are examined.

More information: A Magnetic Wormhole, *Scientific Reports* 5, Article number: 12488 (2015) DOI: 10.1038/srep12488

Abstract
Wormholes are fascinating cosmological objects that can connect two distant regions of the universe. Because of their intriguing nature, constructing a wormhole in a lab seems a formidable task. A theoretical proposal by Greenleaf et al. presented a strategy to build a wormhole for electromagnetic waves. Based on metamaterials, it could allow electromagnetic wave propagation between two points in space through an invisible tunnel. However, an actual realization has not been possible until now. Here we construct and experimentally demonstrate a magnetostatic wormhole. Using magnetic metamaterials and metasurfaces, our wormhole transfers the magnetic field from one point in space to another through a path that is magnetically undetectable. We experimentally show that the magnetic field from a source at one end of the wormhole appears at the other end as an isolated magnetic

monopolar field, creating the illusion of a magnetic field propagating through a tunnel outside the 3D space. Practical applications of the results can be envisaged, including medical techniques based on magnetism.