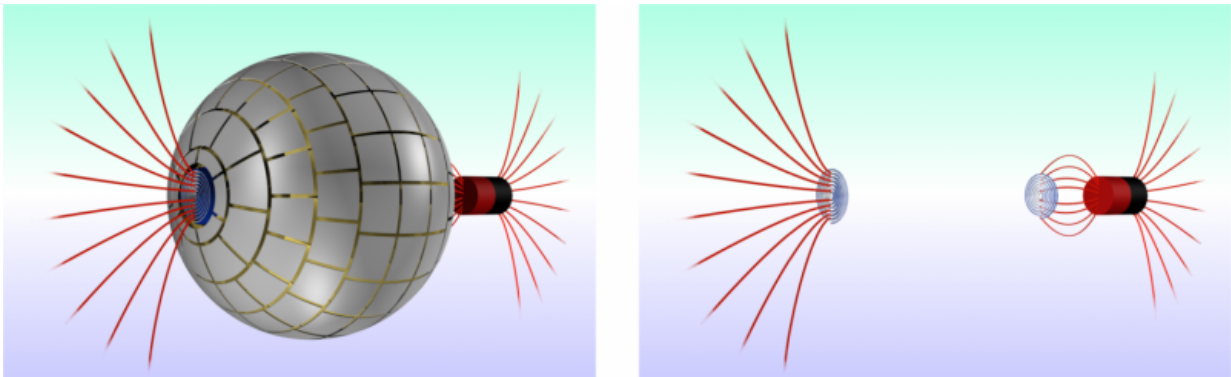


Magnetic wormhole connecting two regions of space created for the first time

September 3 2015



(Left) 3-D diagram of the magnetic wormhole shows how the magnetic field lines (in red) leaves a magnet on the right pass through the wormhole. (Right) In terms of magnetism the wormhole is undetectable, which means that the magnetic field seems to disappear on the right only to reappear on the left in the form of a magnetic monopole. Credit: Jordi Prat-Camps and Universitat Autònoma de Barcelona; the figure may be used in the media.

"Wormholes" are cosmic tunnels that can connect two distant regions of the universe, and have been popularised by the dissemination of theoretical physics and by works of science fiction like Stargate, Star Trek or, more recently, Interstellar. Using present-day technology it would be impossible to create a gravitational wormhole, as the field would have to be manipulated with huge amounts of gravitational energy, which no-one yet knows how to generate. In electromagnetism,

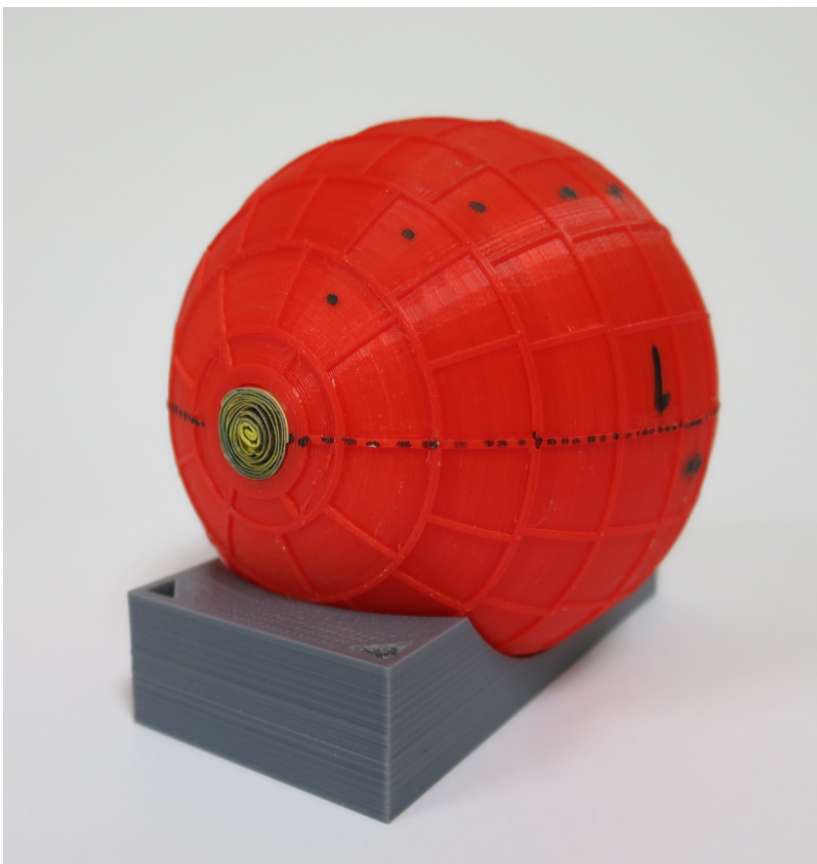
however, advances in metamaterials and invisibility have allowed researchers to put forward several designs to achieve this.

Scientists in the Department of Physics at the Universitat Autònoma de Barcelona have designed and created in the laboratory the first experimental wormhole that can connect two regions of space magnetically. This consists of a tunnel that transfers the magnetic field from one point to the other while keeping it undetectable - invisible - all the way.

The researchers used metamaterials and metasurfaces to build the tunnel experimentally, so that the magnetic field from a source, such as a magnet or an electromagnet, appears at the other end of the wormhole as an isolated magnetic monopole. This result is strange enough in itself, as [magnetic monopoles](#) - magnets with only one pole, whether north or south - do not exist in nature. The overall effect is that of a magnetic field that appears to travel from one point to another through a dimension that lies outside the conventional three dimensions.

The wormhole in this experiment is a sphere made of different layers: an external layer with a ferromagnetic surface, a second inner layer, made of superconducting material, and a ferromagnetic sheet rolled into a cylinder that crosses the sphere from one end to the other. The sphere is made in such a way as to be magnetically undetectable - invisible, in magnetic field terms - from the exterior.

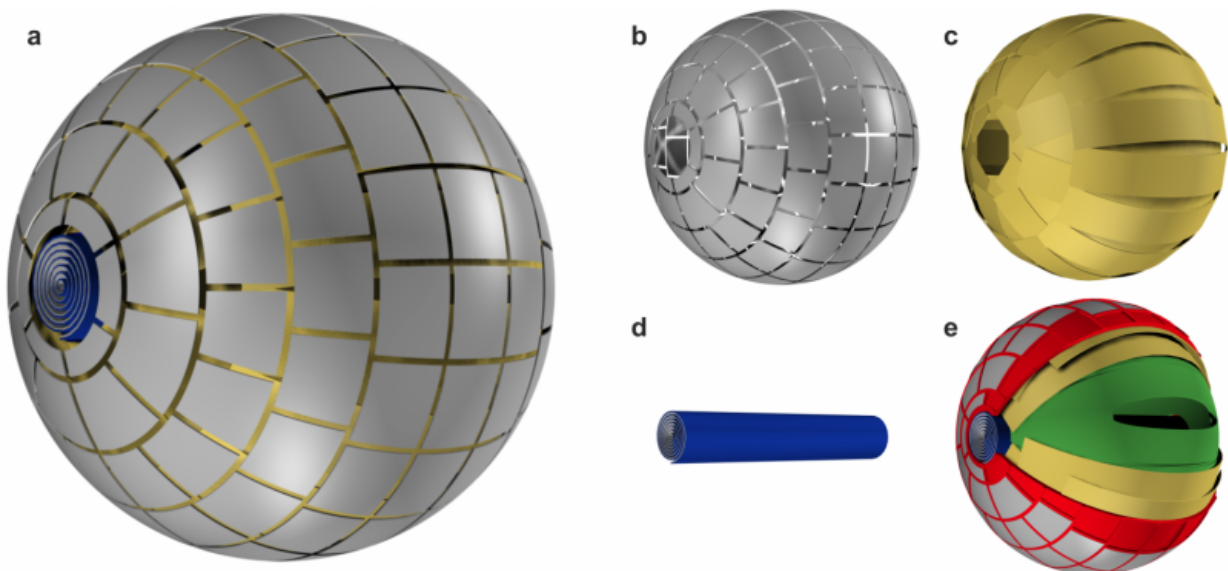
The magnetic wormhole is an analogy of gravitational ones, as it "changes the topology of space, as if the inner region has been magnetically erased from space", explains Àlvar Sánchez, the lead researcher.



(Above) Superconducting layer surrounded by the plastic support for the ferromagnetic pieces. (Below) Final appearance of the experimental wormhole, showing the protective plastic in yellow. Credit: Jordi Prat-Camps and Universitat Autònoma de Barcelona

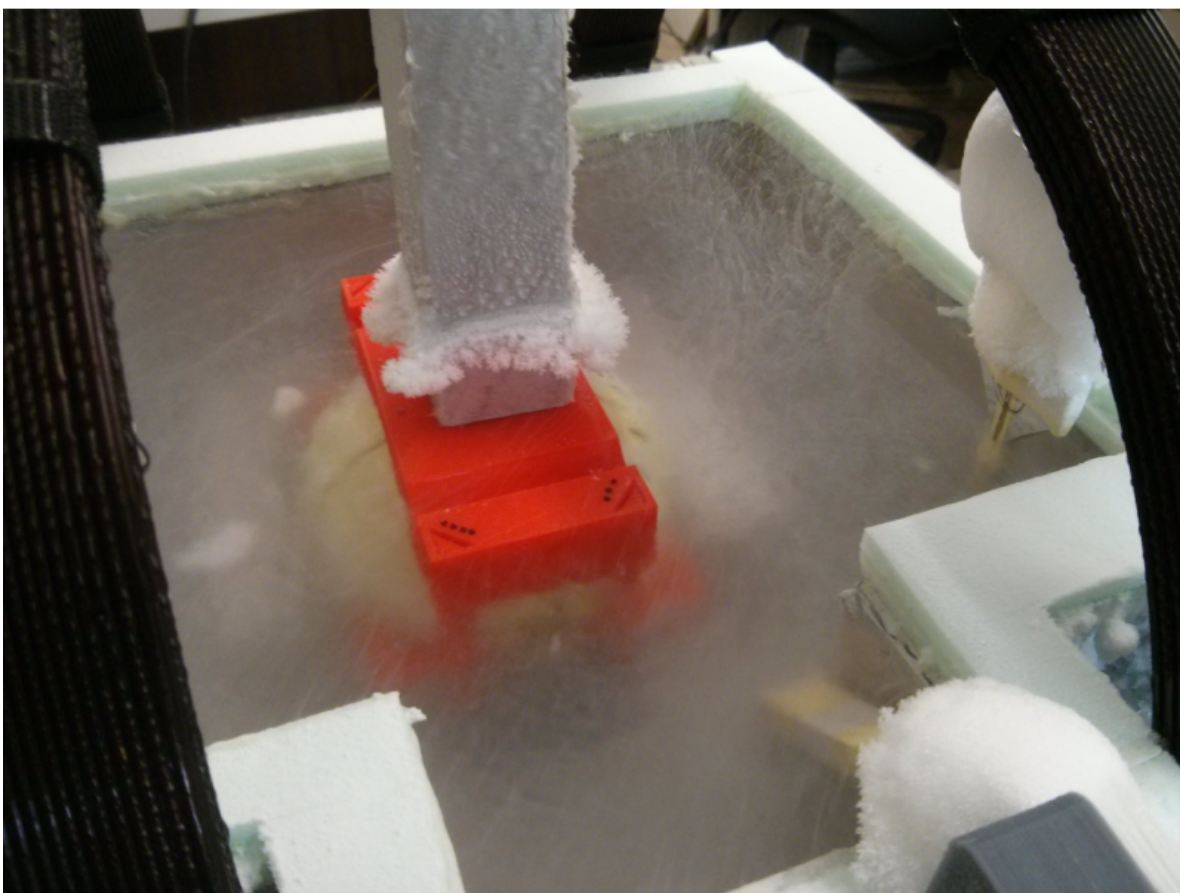
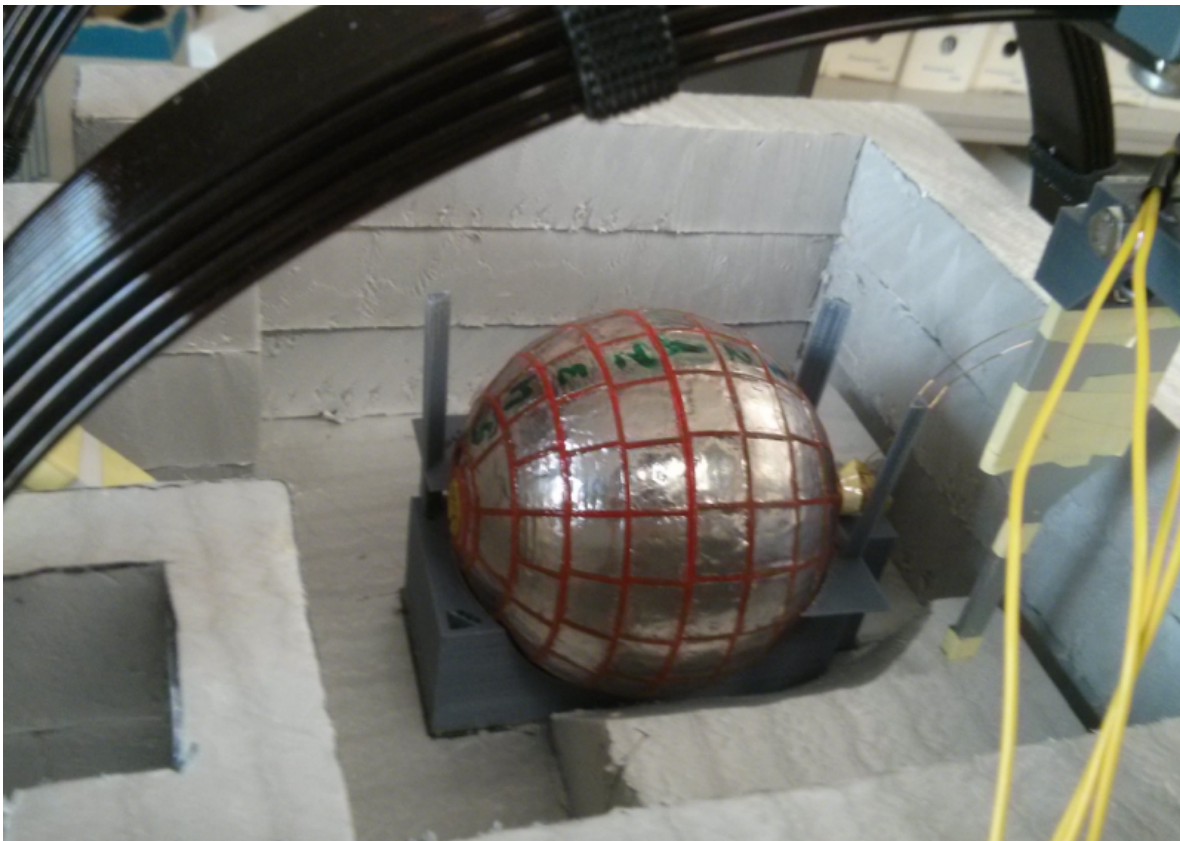
These same researchers had already built a magnetic fibre in 2014: a device capable of transporting the magnetic field from one end to the other. This fibre was, however, detectable magnetically. The [wormhole](#) developed now, though, is a completely three-dimensional device that is undetectable by any [magnetic field](#).

This means a step forward towards possible applications in which magnetic fields are used: in medicine for example. This technology could, for example, increase patients' comfort by distancing them from the detectors when having MRI scans in hospital, or allow MRI images of different parts of the body to be obtained simultaneously.



(a.) 3D image of the wormhole, made up of concentric layers: from outside to inside, (b) an external metasurface made of ferromagnetic pieces, (c) an internal superconducting layer and, (d) a magnetic fibre made of folded ferromagnetic foil. (e.) Cross-section of the wormhole, including the plastic supports (in green and red) for the different pieces. Credit: Jordi Prat-Camps and Universitat Autònoma de Barcelona

The study is published in *Scientific Reports*.



Experiments to confirm the magnetic properties of the wormhole before (above) and after (below) adding the liquid nitrogen needed to cool the superconducting parts. Credit: Jordi Prat-Camps and Universitat Autònoma de Barcelona

Provided by Universitat Autònoma de Barcelona

Citation: Magnetic wormhole connecting two regions of space created for the first time (2015, September 3) retrieved 2 May 2024 from <https://phys.org/news/2015-09-magnetic-wormhole-regions-space.html>

| |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|