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Cloaking magnetic fields: The first 'antimagnet' device developed

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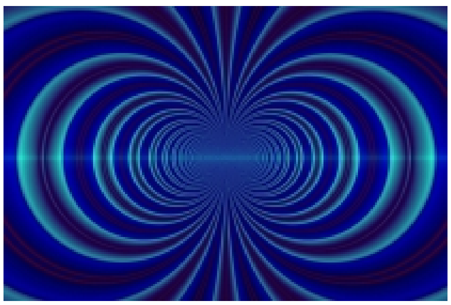

Spanish researchers have designed what they believe to be a new type of magnetic cloak, which shields objects from external magnetic fields, while at the same time preventing any magnetic internal fields from leaking outside, making the cloak undetectable.

The development of such a device, described as an 'antimagnet', could offer many beneficial applications, such as protecting a ship's hull from mines designed to detonate when a magnetic field is detected, or allowing patients with pacemakers or cochlear implants to use medical equipment.

In their study, published today, Friday 23 September, in the Institute of Physics and German Physical Society's New Journal of Physics, researchers have proved that such a cloak could be built using practical and available materials and technologies, and used to develop an array of applications.

Take, for example, a patient with a pacemaker undergoing an MRI scan. If an MRI's large magnetic field interacts with the pacemaker, it can cause serious damage to both the device and the patient. The metal in the pacemaker could also interact with and distort the MRI's large magnetic field, affecting the machine's detection capabilities.

The researchers, from Universitat Autònoma de Barcelona, are aware that the technology could also be used by criminals to dodge security systems, for example in airports and shops, but they are confident that the new research could benefit society in a positive way, while the risks could be minimized by informing security officials about potential devices, enabling them to anticipate and neutralize problems.

Lead author, Professor Alvar Sanchez, said, "The ideas of this device and their potential applications are far-reaching; however it is conceivable that they could be used for reducing the magnetic signature of forbidden objects, with the consequent threat to security. For these reasons, this research could be taken into account by security officials in order to design safer detection systems and protocols."

The antimagnet has been designed to consist of several layers. The inner layer would consist of a superconducting material that would function to stop a magnetic field from leaking outside of the cloak, which would be very useful to cloak certain metals.

A downside to using this material, however, is that it would distort an external magnetic field placed over the cloak, making it detectable, so the device would need to be combined with several outer layers of metamaterials, which have varying levels of magnetic field permeability, to correct this distortion and leave the magnetic field undisturbed.

The researchers demonstrated the feasibility of the cloak using computer simulations of a ten-layered cylindrical device cloaking a single small magnet.

Impressively, the researchers also showed that the cloak could take on other shapes and function when the cylinder was not fully enclosed, meaning that applications for pacemakers and cochlear implants are even more feasible, given that they require wires to connect to other parts of the body.

"We indeed believe, and hope, that some laboratories could start constructing an antimagnet soon. Of the two components, superconductors are readily available, for example in cylindrical shape, and the key point would be to make the magnetic layers with the desired properties. This may take a bit of work but in principle the ingredients are there," continued Professor Sanchez.

An Institute of Physics spokesperson said, "The research group have put forward a novel and, most importantly, conceivable plan for a magnetic cloak. The obvious next step will be to translate design into fabrication so some of the wide-ranging applications can be realised."

More information: "Antimagnets: controlling magnetic fields with superconductor–metamaterial hybrids" Sanchez et al 2011 *New J. Phys.* 13 093034 Paper online: iopscience.iop.org/1367-2630/13/9/093034/fulltext

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