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By Gabriel Gache, Science News Editor

Yet Another Invisibility Cloak... for Magnetism

Metamaterial has zero resonating frequency

Metamaterials have the unique capability of experiencing negative refractive indexes, thus literally refracting light through themselves without reflecting any to the source, therefore making any object hidden behind it invisible. This is not available only for light, acoustic waves can be also manipulated in similar ways. However, both optical and acoustical invisibility cloaks have the disadvantage that they work only on two dimensions and in certain wave frequencies, although theoretically they should work just fine in all three dimensions and frequencies. Imperial College London researchers claim to have recently created a non-resonant metamaterial, which is able to manipulate light with zero frequency. Microwave and visible light have oscillation frequencies between 0.3 and 300 GHz respectively 400 and 790 THz. However, the newly developed non-resonant metamaterials could be used to develop an invisibility cloak for magnetism. "It is already possible to protect a region of space from magnetic fields; simply surrounding it with a strongly magnetic material will do the job. However, a magnetic cloack would go further - it would keep magnetic fields out of the inner region without disturbing the fields outside the cloak," said Imperial College London researcher Ben Wood. At zero-frequency regimes, both the magnetism and electricity is being decoupled, meaning that one would be able to concentrate magnetic properties without worrying about undesired electrical ones. "When we say that ours is a zero-frequency metamaterial, we mean that it behaves as intended only at very low or zero frequency. It will interact with light at higher frequencies, but not in a useful way," says Wood. The researching team reveals that the newly created metamaterial consists of several layers of lattices, which define the properties of the structure in accordance with the spacing between each layer. The structure was constructed out of lead plates 300 nanometers thick and 167 micrometers across, with a spacing between layers of 100 micrometers. As a magnetic field is being applied, the metamaterial pushed the magnetic field between each of the lead plates. Because the metamaterial presents a weak magnetic field in concordance with the size of the plates and between them, scientists were able to tune its magnetic properties. Although it could be used as a magnetic cloaking device, its inventor believes that it could have a better application in transformation optics. "Transformation optics is a way to design devices. It allows us to mimic transforming space for light, and gives us a prescription for the electromagnetic properties we need to achieve a given effect, like cloaking. However, these properties are not usually found in natural materials, and this is where metamaterials can help. They allow us to make the devices that we design using transformation optics," added Wood.