

Invisibility undone: Chinese scientists demonstrate how to uncloak an invisible object

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Harry Potter beware! A team of Chinese scientists has developed a way to unmask your invisibility cloak. According to a new paper in the latest issue of *Optics Express*, the Optical Society's (OSA) open-access journal, certain materials underneath an invisibility cloak would allow invisible objects be seen again.

"Cloaking is an important problem since invisibility can help survival in hostile environment," says Huanyang Chen of Shanghai Jiao Tong University in China. He and his colleagues have proposed a theoretical "anti-cloak" that would partially cancel the effect of the invisibility cloak, which is another important problem as it turns out.

If this sounds like more movie magic, it's no accident. From the 1933 classic *The Invisible Man* to the more recent installment in the *Harry Potter* series, devices that achieve invisibility have long been the stuff of film fantasy. In recent years, however, scientists using special types of "meta" materials have shown that these Hollywood fantasies could one day become reality after all.

These materials are effectively invisible because of the way they interact with light. All materials scatter, bounce, absorb, reflect and otherwise alter light rays that strike them. We perceive color, for instance, because different materials and coatings interact with light differently. Transformation media cloaks are special materials that can bend light so

much that it actually passes around the object completely. In 2006, scientists at Duke University demonstrated in the laboratory that an object made of metamaterial is partially invisible when viewed using microwaves.

Sounds cool? Not so fast. Invisibility as it has been achieved so far in the laboratory is very limited. It works, but only for a narrow band of light wavelengths. Nobody has found a way yet to make an object invisible to the broad range of wavelengths our eyes are attuned to seeing, says Chen, and doing so would be a challenge.

An even greater problem for anyone who has aspirations to be concealed in public one day is that invisibility achieved through transformation media is a two-way street. With no light penetrating a perfect invisibility cloak, there would be no way for an invisible person to see outside. In other words, invisible people would also be blind—not exactly what Harry Potter had in mind.

But now, Chen and his colleagues have developed way to partially cancel the invisibility cloak's cloaking effect. Their "anti-cloak" would be a material with optical properties perfectly matched to those of an invisibility cloak. (In technical jargon, an anti-cloak would be anisotropic negative refractive index material that is impedance matched to the positive refractive index of the invisibility cloak).

While an invisibility cloak would bend light around an object, any region that came into contact with the anti-cloak would guide some light back so that it became visible. This would allow an invisible observer to see the outside by pressing a layer of anti-cloak material in contact with an invisibility cloak.

"With the anti-cloak, Potter can see outside if he wants to," says Chen, who conducted the research together with his colleagues at Shanghai Jiao

Tong University and The Hong Kong University of Science and Technology.

Paper: "The Anti-Cloak," Huanyang Chen et al, *Optics Express*, Vol. 16, Issue 19, September 15, 2008, pp. 14577 – 14582.

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