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First Invisibility Cloak Tested Successfully, Scientists Say

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for National Geographic News

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Researchers announced today that they've built the world's first invisibility cloak, although the fine print may disappoint science-fiction fans.

The device works only in two dimensions and only on microwaves.

Still, the experiment proves that a theoretical blueprint for building invisibility cloaks unveiled by the same team just five months ago works.

(Read "Invisibility Cloaks Possible, Study Says" [May 25, 2006].)

"The concept that you can cloak something and make something invisible can now be demonstrated by this method," said Duke University physicist David R. Smith.

"This is the first time where we show that you can actually take electromagnetic waves and wrap them around some region that you want to conceal and restore them on the other side."

An uncloaked object would cause an interruption in the waves, creating a "shadow" behind the object. But the cloak succeeded in making the waves reconnect on the other side.

The team describes its experiment in tomorrow's issue of *Science Express,* the online early edition of the journal *Science.*

Metamaterial "Magic"

The electromagnetic sleight-of-hand is enabled by novel, human-made substances called metamaterials.

Developed just seven years ago, the materials use a matrix of exceptionally tiny, sometimes nanoscale, metal wires and loops to control electromagnetic radiation in ways natural substances can't.

(See a *National Geographic* magazine feature about nanotechnology.)

"Using these materials, you can create a field-region in space where no electromagnetic phenomena penetrate," said team member Sir John Pendry, a physicist at England's Imperial College London.

Researchers say the new technology could aid antenna and radar designs—not to mention obvious military applications, like hiding spy planes or even buildings.

But scientists have a long way to go. The new, cylindrical experimental cloak measures just 5 inches (13 centimeters) wide and 0.4 inch (1 centimeter) tall.

To make it work, researchers painstakingly tuned the design of the cloak's metamaterial parts so that incoming microwaves slipped around its inner surface.

"You can restore them as they exit the device in such a way that the waves [look like they] travel through free space, rather than being guided around an object," said team member David Schurig, another Duke University physicist.

"You can think of it visually as like water flowing around a rock smoothly," he added.

"If you look downstream from the rock, the stream has been restored to its original flow pattern, and you can't tell that the water flowed around a rock by looking at the water."

Schurig and his colleagues say their cloak created a space nearly, but not completely, invisible to

microwaves. The device still generates a minute reflection and shadow.

Experts say the breakthrough will certainly conjure excitement.

"Cloaking has been a long-time dream for many scientists," said Xiang Zhang, a metamaterials engineer and physicist at the University of California, Berkeley, who was not involved in the research.

"If we look at these experiments, of course, it doesn't give you three-dimensional, arbitrary shape cloaking," but the new cloaking device is significant nonetheless, he said.

"Even though it is simpler in form, in [a] two-dimensional circular shape, it clearly demonstrates the general theory works."

Visible Light

The team says their next goal is to build a spherical invisibility cloak that shields microwaves in three dimensions, a task they describe as vastly more difficult.

But they are confident it can be done.

As for Harry Potter-like cloaks that block visible light? "Don't count on it in the next few decades," Schurig said.

While the general design theory has been worked out, metamaterial fabrication technology has yet to catch up.

Researchers are still puzzling over, among other things, how to make metamaterials that work for light in the visible spectrum, which has smaller wavelengths than microwaves.

Indeed, it may be impossible to build a cloak that can block all the colors found in the visible spectrum, the team says.

"All technologies have problems, except when they're magic," Duke University's Smith said.

"So OK, maybe we can't get the Harry Potter cloak," he adds. "But maybe we can do something more … like the Romulan cloaking devices in *Star Trek."*

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