Researchers create metamaterial that looks similar to 3D Minkowski spacetimes

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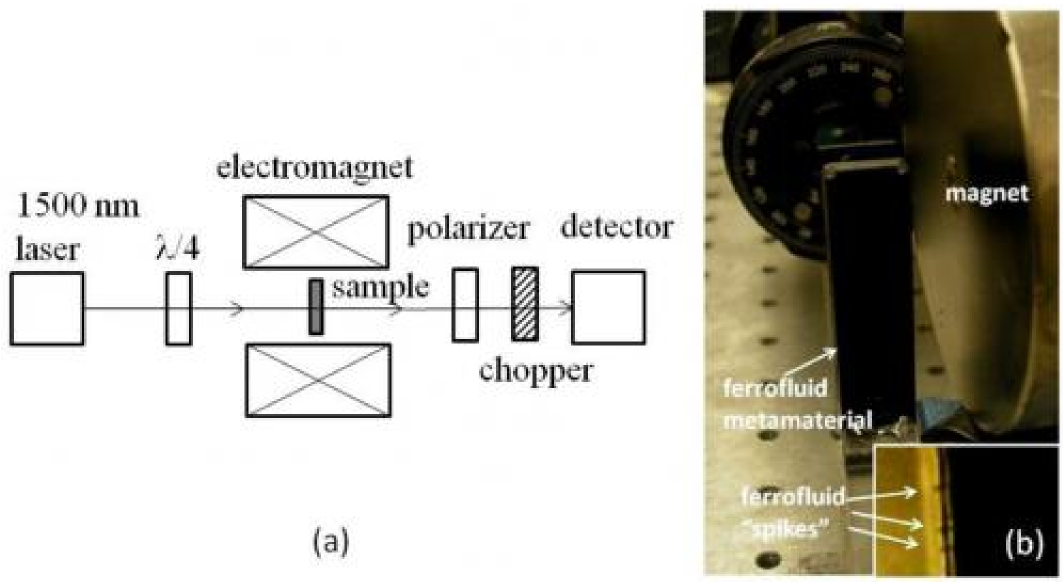

(a) Schematic view of the experimental setup. (b) Photo of the ferrofluid metamaterial sample next to a permanent magnet. The inset shows excessive ferrofluid on the side of the cuvette, which forms "spikes" along the applied magnetic field. Credit: arXiv:1301.6055 [physics.optics]

(Phys.org)—Researchers from the University of Maryland and Towson University have created a new type of metamaterial that they describe as looking similar to 3D Minkowski spacetimes. In their paper, which they've uploaded to the preprint server *arXiv*, the researchers explain how the metamaterial can be adjusted to create a demonstration of a multiverse.

Because the exact definition of a universe is difficult to pin down, it's difficult to say whether the creation of a metamaterial that acts the same as a theoretical universe, is an actual universe if it follows the same rules. And if that metamaterial is capable of demonstrating different types of universes, with unique properties and rules that govern how things behave in them, is it a true multiverse, or simply a simulation of one?

In the case of the metamaterial made by the researchers in Maryland, the answer might lie in the eye of the beholder. They created a solution that had cobalt suspended in kerosene, than applied a magnetic field. Because cobalt is ferromagnetic, the applied field caused the cobalt to line up in columns. But not just ordinary columns, they were mathematically equivalent to a 2+1 Minkowski spacetime. Light passing through the columns has one dimension of time, while light aligned perpendicular to the columns has two dimensions of space. In this configuration, light behaves according to Einstein's theory of relativity, which means, it might be construed to be its own unique universe, albeit, analogous to the one we perceive around us. But the researchers didn't stop there, they found that by varying the amount of cobalt in the fluid, they were able to cause different types of columns to form, collapse, and reform, which don't necessarily conform mathematically to the laws governing our own universe, but do for others, at least in theory. This meant they had created a metamaterial that was able to look like different universes at different moments over time. And if it looked like them, and acted like them, who's to say that each wasn't a unique existence of a true universe?

The researcher's aren't arguing about whether they've created universes in their lab, however, instead, they are demonstrating a new kind of metamaterial that might prove useful in studying how the laws of physics might look in other universes – something that most anyone in the field would have to concede is a very useful thing.

More information: Experimental demonstration of metamaterial multiverse in a ferrofluid, arXiv:1301.6055 [physics.optics] arxiv.org/abs/1301.6055

Abstract
Extraordinary light rays propagating inside a hyperbolic metamaterial look similar to particle world lines in a 2+1 dimensional Minkowski spacetime [1]. Magnetic nanoparticles in a ferrofluid are known to form nanocolumns aligned along the magnetic field, so that a hyperbolic metamaterial may be formed at large enough nanoparticle concentration nH. Here we investigate optical properties of such a metamaterial just below nH. While on average such a metamaterial is elliptical, thermal fluctuations of nanoparticle concentration lead to transient formation of hyperbolic regions (3D Minkowski spacetimes) inside this metamaterial. Thus, thermal fluctuations in a ferrofluid look similar to creation and disappearance of individual Minkowski spacetimes (universes) in the cosmological multiverse. This theoretical picture is supported by experimental measurements of polarization-dependent optical transmission of a cobalt based ferrofluid at 1500 nm.

via Arxiv Blog