Physicists demonstrate rotated light images

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(PhysOrg.com) -- In what might at first seem obvious, but isn't after further thinking, a group of physicists from the United States and Canada have demonstrated, for the first time, that images generated by light, can be rotated via a rotating medium. In a paper published in *Science*, physicists Sonja Franke-Arnold, Graham Gibson, Robert W. Boyd and Miles J. Padgett describe how they were able to replicate the effects of light shifting via a moving medium, in a spinning medium, opening the door to a possible new way of encoding transmitted images.

Scientists have long known that when a light is shone through certain moving material, that the light itself can be shifted along with it, due to the photons being absorbed and then released by the atoms in the medium. The effect has been demonstrated over the years and can be seen in the simplest of venues, such as light shining through a waterfall. Until now however, no one has shown that a similar effect might apply to a rotating medium.

The idea is that if a beam of light, projected in a certain shape, such as a square for example, were to be shone through a spinning medium, such as a round block of glass, the image would emerge on the other side, but not exactly opposite; it would be off, just a little bit, in the direction of the spin. The amount of shifting would of course depend on both the speed of revolution of the cylinder and on the medium used, as some, such as rubies are able to cause more of a drag, per se, on the light as it moves through, than others.

To test this theory, the team created a square beam of green light, which

they then directed at a spinning cylinder made entirely of ruby. The light was sufficiently strong enough to shine all the way through the cylinder, creating a square image on the other side. To see if the image was being rotated as the cylinder spun, the exact location of the projected image was noted, then the cylinder was spun in the opposite direction, to see if it would then be in a different position; which of course, it was. With the cylinder spinning at 30 revolutions per second, they found that the projected image was rotated about a third of a degree. They also found that increasing the amount of light tended to increase the amount of rotation of the projected image, in some cases, by as much as ten degrees.

The research team note in their paper that they believe one application of this phenomenon could be its use in image encoding, just as current methods now include an image's intensity.

More information: Rotary Photon Drag Enhanced by a Slow-Light Medium, *Science* 1 July 2011: Vol. 333 no. 6038 pp. 65-67 DOI: 10.1126/science.1203984

ABSTRACT
Transmission through a spinning window slightly rotates the polarization of the light, typically by a microradian. It has been predicted that the same mechanism should also rotate an image. Because this rotary photon drag has a contribution that is inversely proportional to the group velocity, the image rotation is expected to increase in a slow-light medium. Using a ruby window under conditions for coherent population oscillations, we induced an effective group index of about 1 million. The resulting rotation angle was large enough to be observed by the eye. This result shows that rotary photon drag applies to images as well as polarization. The possibility of switching between different rotation states may offer new opportunities for controlled image coding.

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