Team to develop materials to bend lightwaves backwards

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A University of Michigan research team will receive a combined total of $5 million over the next five years to support an interdisciplinary research project on negative refraction—or bending lightwaves downward.

The group of physicists, electrical engineers, materials scientists, chemists and biologists from five universities will explore methods to produce new synthetic materials that can refract, or bend, light waves "backwards." The U-M team, led by physics professor Roberto Merlin, includes: Stephen Forrest, vice president for research, who has appointments in the Physics Department, and in the College of Engineering; Rachel Goldman, materials science and engineering professor; and Jinsang Kim, materials science and engineering professor.

The phrase "negative refraction" describes the property of a material that refracts light in the opposite direction of substances found in nature. Refraction is a well-known phenomenon of light and other electromagnetic radiation. In essence, it is observed as light bending as it passes from one medium to another. Stick your finger into an aquarium and you will see that the finger in the water does not appear to line up with the rest of your hand because light waves bend as they leave the water and go through the glass side and air before reaching your eye.

Since this negative refraction was first predicted in the 1960s, scientists have debated whether it exists, and have struggled to definitively demonstrate this property. In recent years, some of these obstacles have

been overcome and scientists, including those at the UM, are developing new methods for creating "smart, self-assembling" polymers, organic thin films, and semiconductor materials with the desired negative refraction characteristics.

One goal of this research is to create materials that can perform as a lens without needing the curved surfaces found in traditional lenses. It has been predicted that materials with negative refraction can image objects that are significantly smaller than the wavelength of light. Although this is an impossible task for common materials, this may be achieved by the development of negative refraction media. Over the course of this project, the interdisciplinary team of researchers intends to improve upon existing materials exhibiting negative refraction at microwave frequencies and show the way toward the creation of a new class of devices with a broader range of applications.

The negative refraction project is one of 30 in the nation to be funded by the Department of Defense in fiscal year 2006 under the Multidisciplinary University Research Initiative (MURI) program. In all, $150 million will be spent by the 30 research projects over five years. The MURI program is designed to address large multidisciplinary topic areas representing exceptional opportunities for future Department of Defense applications and technology options. The awards will provide long-term support for research, graduate students and laboratory instrumentation development that supports specific science and engineering research themes vital to national defense.

Source: University of Michigan