



news release

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For release immediate

SHEDDING LIGHT ON METAMATERIALS

University of Toronto engineer captures prestigious Canadian research prize

(Ottawa, Ontario) – Dr. George Eleftheriades' Web site contains a quote from the Greek philosopher Plato, which, roughly paraphrased, says that great ideas come from hard work and are born "as light that is kindled by a leaping spark." Put that in a Canadian context more than two millennia later, and Dr. Eleftheriades indeed had a Platonic moment—in a way that amazingly extends the laws of physics and could potentially revolutionize fields from nanotechnology to medical imaging. The spark? He was flipping steak on the BBQ.

"I remember it was a Sunday in August 2001, and I was outside in the backyard at the BBQ. In that moment, I just knew something was true. I saw the light," says Dr. Eleftheriades, an associate professor in the Department of Electrical and Computer Engineering at the University of Toronto.

But what a weird light it was. Dr. Eleftheriades envisioned a new way to create artificial materials, called metamaterials, that do what until now is the seemingly impossible: they bend electromagnetic waves—such as microwaves, radio waves and visible light—the "wrong" way.

Eleftheriades' internationally acclaimed work today captured him an NSERC Steacie Fellowship, one of Canada's top science and engineering honours.

The award was among six announced today by Lucienne Robillard, Minister of Industry and Minister responsible for the Economic Development Agency of Canada for the Regions of Quebec, and Dr. Tom Brzustowski, President of NSERC. University of Toronto colleague Dr. Lisa Jeffrey also receives one of the prestigious awards (see separate release).

"NSERC Steacie Fellows are quickly rising to the top of their fields while providing role models for younger scientists and engineers," said Minister Robillard. "Through their creativity and excellent research, they are helping Canada build the knowledge base needed for a 21st century economy."

"These awards are public recognition for outstanding scientific achievement," said Dr. Brzustowski. "The researchers honoured today have already started their careers in an incredible way and I know that they will do great things for science in Canada."

Shine a flashlight through a conventional window on any angle other than straight-on, and inside the glass, the beam of light (called the incident beam) refracts, or bends, away from the source. Known

as Snell's Law, it's a standard of high-school physics textbooks, and a law of physics that's been considered inviolate from its articulation in 1621.

But shine a beam of light, or in this case a radio wave, through one of Dr. Eleftheriades' flat metamaterials and the beam bends in the opposite direction, towards the source. Welcome to the world of left-handed or negative-refractive-index metamaterials.

“You can't say it's the correct or the wrong way for light to bend,” says Dr. Eleftheriades. “It's the right way for left-handed materials. These phenomena were predicted by the Russian physicist Victor Veselago in the 1960s, based on Maxwell's equations created in the 1870s. But it's only recently that people managed to make materials that would behave like this.”

Left-handed materials open-up a range of new practical possibilities. Their ability to focus waves on sub-wavelength details means that they can be used to miniaturize antennas, making for significantly smaller wireless devices with ultrawide bandwidth. He's currently working with a major multinational telecommunications company to do just this.

As part of his NSERC Steacie research, and in collaboration with the Department of National Defence, he's also working to make metamaterials to enhance radar resolution, as well as to avoid radar detection through stealth technology. If super-resolving metamaterials are extended to optical frequencies, they could enable new photolithography techniques, whose sharper beams could burn more information onto CDs or allow the fabrication of nanodevices.

For Dr. Eleftheriades one of the most inspiring applications is medical. He's determined to see his left-handed metamaterials applied to medical imaging devices, such as MRI. This would increase their resolution, providing the ability to see much smaller details, including, potentially, tiny cancerous tumours.

NSERC, now also known as Science and Engineering Research Canada, is a key federal agency investing in people, discovery, and innovation. It supports both basic university research through research grants, and project research through partnerships among postsecondary institutions, government and the private sector, as well as the advanced training of highly qualified people.

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The Prize

NSERC Steacie Fellowships are awarded to outstanding Canadian university scientists or engineers, who have earned their doctorate within the last twelve years, and whose research has already earned them an international reputation. Nominations are received by NSERC from universities across Canada and judged by a distinguished panel of independent experts. The awards include increased research funding from NSERC and payments to the universities to allow the Steacie Fellows to pursue their research full-time. They are also eligible to compete for a special Canada Foundation for Innovation Career Award. The announcement of these awards will be made later.

The six winners this year are:

Dr. Mosto Bousmina (Université Laval); **Dr. Thomas Brabec** (University of Ottawa); **Dr. George Eleftheriades** (University of Toronto); **Dr. Lisa Jeffrey** (University of Toronto); **Dr. Eric Hessels** (York University); and **Dr. Patrick Keeling** (University of British Columbia).

Dr. Edgar William Richard Steacie, for whom the awards are named, was a physical chemist and President of the National Research Council from 1952 to 1962. He strongly believed that:

- fundamental research is essential to the development of science;
- the individual is key to research, and individual ideas are ultimately responsible for important advances in science;
- there are no national boundaries in science; and
- complete freedom is required for creative work.

Dr. Steacie felt that promising young scientists are our greatest asset and should be given every opportunity to develop their own ideas. Through the NSERC Steacie Fellowships, his philosophy lives on.