

BC Physicist Helps Augment Use of Metamaterials

Work with terahertz radiation could boost screening, imaging tech improvements

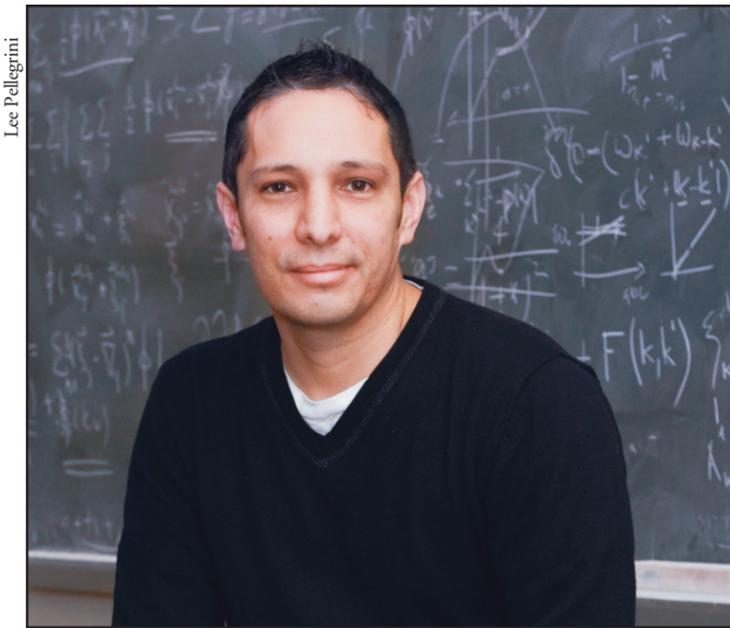
BY ED HAYWARD
STAFF WRITER

An engineered metamaterial proved it can function as a state-of-the-art device in the complex terahertz range of the electromagnetic spectrum, setting a standard of performance for modulating tiny waves of radiation, according to a team of researchers that includes Asst. Prof. Willie J. Padilla (Physics).

This finding could have implications for terahertz devices like cameras and scanners, according to researchers.

An electrical current applied to the metamaterial – a hybrid structure of metallic split-ring resonators – controlled the phase of a terahertz beam with 30 times more speed and far greater precision than a conventional optical device, the co-authors report in the journal *Nature Photonics*.

The discovery marks a milestone in the use of metamaterials and terahertz radiation, a safe, non-ionizing frequency that is the subject of a growing body of research and viewed as a promising component in applications that include advanced security screening systems and imag-



Lee Pellegrini

Asst. Prof. Willie J. Padilla (Physics)

ing technologies.

“This is a true metamaterial device,” said Padilla. “This highlights the fact that you can make solid state devices at terahertz frequencies with metamaterials.”

Constructed on the micron-scale, metamaterials are composites that use unique metallic contours to produce responses to light waves, giving each metamaterial its own unique properties beyond the elements of the actual materials in use. Within the past decade, researchers have sought ways to significantly expand the range of material responses to waves of electromagnetic radiation –

classified by increasing frequency as radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays. These metamaterials have demonstrated numerous novel effects that defy accepted electromagnetic principles.

Previously, in systems known as THz time domain spectrometers, the flow of terahertz radiation has been modulated indirectly by optical choppers, mechanical devices that either blocked a laser or allowed it to pass through. This “all or nothing” approach – similar to opening and closing the shutter of a camera

– limits the speed with which one can manipulate terahertz waves since the chopper’s mechanical components move relatively slowly, according to Padilla.

The metamaterial devised by the research team electronically controlled the flow of terahertz radiation over roughly 70 percent of the frequency band – not simply at the points of maximum or minimum frequency.

“We can apply an electronic signal to this device, thus making it opaque to stop terahertz, or transparent to allow terahertz through,” Padilla said. “Eventually, you can turn it on and off very quickly – and that allows you to modulate the beam at a very specific frequency.”

Because the metamaterial device is solid-state, eliminating moving parts, it is 30 times faster than the optical chopper, according to the report, co-authored by Padilla, Hou-Tong Chen, Abul K. Azad and Antoinette J. Taylor of Los Alamos National Laboratory, Michael J. Cich of Sandia National Laboratories and Richard D. Averitt of Boston University.

“The advantage of the metamaterial is you are doing it electronically,” Padilla said. “If you want to build a device, the advantage of this is that it is all solid-state and voltage controlled. You have no moving parts. Therefore, you can modulate at very high speeds.”

These kinds of controls have been developed for microwave and optical frequencies and led to a number of key breakthroughs, the researchers note. But the technologies have not extended to the terahertz frequency.

Padilla said a solid-state metamaterial device is a critical step toward improved terahertz devices, such as cameras or scanners.

“What we’ve shown with this metamaterial is that it is now improved to the point where it could be used as a device,” Padilla said. “It could be the device you could use to build a terahertz system.”

The research is supported by the Laboratory Directed Research and Development program at Los Alamos National Laboratory.

To learn more about Padilla’s lab, see www2.bc.edu/~padillaw/

Choice of Archbishop Dolan for NYC Post Lauded

BY REID OSLIN
STAFF WRITER

The recent appointment of Milwaukee Archbishop Most Rev. Timothy M. Dolan as Archbishop of New York elicited nods of approval among members of the Boston College community who recalled the positive message – and some “hometown outreach” – he brought to campus last year.

Archbishop Dolan, who will be installed on April 15 as head of one of the nation’s largest Catholic archdioceses, came to Chestnut Hill in January of 2008 as a participant in the University’s Church in the 21st Century’s “Vatican Visitors” program that sponsors visits of prominent Church leaders.

As Acting C21 Director John McGinley recalls, Archbishop Dolan carried a clear and uplifting message for Catholic universities. “He spoke with a sense of some urgency about the whole reality of handing on the faith in our culture of religious education.

“He said that sometimes the Catholic Church is seen as an organization that is usually and rather constantly saying ‘no’ to this, that and the other thing. But Archbishop Dolan told us that the Gospel is all about saying ‘yes’ – saying ‘yes’ to life and ‘yes’ to God and ‘yes’ to one another. He called upon all of us to work and to turn a corner so that the Church may be seen more as a power for life, for energy for moving forward.”



Timothy M. Dolan, Archbishop of New York

After meeting with various University leaders, faculty and staff, Archbishop Dolan sat down with a group of Boston College students – many of them from the Milwaukee area – assembled with the help of Vice President and Special Assistant to the President William B. Neenan, SJ.

“That, I think, was one of the best parts of the day for the archbishop,” says McGinley. “He interacted with them with such ease and obvious affection, asking them what schools they had attended back home, what parishes they were from, what they were studying here and what they thought of BC. There were good responses all around.”

At the end, Archbishop Dolan

asked students to write down their home phone numbers and parents’ names, so that he could call and tell their parents he had seen and spoken with their children in Boston.

“I heard later,” adds McGinley, “that one of the parents was out when he called and he left a message on the answering machine. The student’s mother called her and said ‘I am never going to delete that message!’ He was very, very gracious.

“He showed a lot of warmth when he was here,” notes McGinley. “I think he will be a real breath of fresh air for them in New York.”

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—John McGinley

Photo by Chris Sheridan, courtesy Archdiocese of New York City

STM’s Fr. Shea Plays Major Role in World Congress on Children

BY KATHLEEN SULLIVAN
STAFF WRITER

A Boston College priest was among the 140 social workers, counselors, educators and other professionals from across four continents and six religious traditions who gathered last month in New Delhi, India, for a world congress that sought to draw attention to children’s plight as globalization, rapid urbanization and economic development affect families and societies.

Adj. Prof. John Shea, OSA (STM), participated as a presenter, moderator and facilitator at “Giving Children A Voice: The Transforming Role of the Family in a Global Society.” The group met under the auspices of SERFAC (Service and Research Foundation of Asia on Family and Culture), a non-governmental organization with consultative status with the United Nations. As a member of SERFAC’s international advisory board, Fr. Shea helped to plan the congress.

The congress concluded with the creation of two declarations, one penned by the practitioners and the other authored by children aged 14-17 from Iraq, Libya, Yemen, Sudan, Palestine, the US, Nepal, Syria, India and Rwanda.

“In many ways they were typical teens, but they had so much wisdom,” recalled Fr. Shea, whose expertise is in pastoral care and counseling. “The children’s declaration is exceptional. Some of the children stayed up until 3 in the morning to finish it,” he continued.

In the declaration, the children wrote that: “To grow physically, emotionally and intellectually, a child must essentially be happy. Every child has the right to a happy childhood.”

The declaration went on to describe some resolutions the children felt necessary to meet this goal, such as devising global laws against agents of child trafficking, and prohibiting children from working in hazardous industries like mining, fireworks and heavy-duty agriculture. Children who must work to support family income should be above the age of 10 and able to freely pursue their education, the declaration stated, and functional trauma centers must be established to assist victims of child trafficking, child prostitution, sexual abuse, drug abuse and exploitation.

The practitioners’ declaration expressed a similar concern for the fate of families: “We are painfully aware that the unequal distribution of power and the world’s resources, ominous forces of war, terrorism, violence, globalization, migration, rapid urbanization, pollution of the environment and mind, corruption and weak government are negatively impacting the lives of children and families.”

Practitioners recommended such measures as training children in resiliency skills to strengthen them in the face of diversity, and giving them their own public voice through activities such as children’s parliaments. They also called for integrating peace and justice in school curriculums, developing holistic health care and promoting responsible use of technology.

“It is our hope that through this congress and these declarations, we can educate others about the situation of children in the world and encourage policymakers, governments and other agencies to focus on and support families and children,” said Fr. Shea.

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