OSA Past President Brings Lasers to Summer Camp

Patricia Daukantas

Anthony M. Johnson explains laser safety to middle school students in the ESTEEM program.

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On one of the hottest afternoons of July, 25 middle school students witnessed some cool applications of laser technology. OSA 2002 president Anthony M. Johnson hosted the students for a couple of hours at his laser laboratory at the University of Maryland, Baltimore County (UMBC).

The middle schoolers, who live in Anne Arundel and Baltimore counties in Maryland, spent four weeks in a UMBC summer camp that is part of a program called ESTEEM (Enhancing Science and Technology Education and Exploration Mentoring). The camp, under the auspices of UMBC's Center for Women and Information Technology and Shriver Center, aims to stimulate girls' interest in technology careers; however, boys are welcome to attend as well, and several of this year's campers were boys.

The campers began their day learning about a fundamental aspect of the science of light: solar energy. In their morning session, they built small plastic toy carts powered by solar panels.

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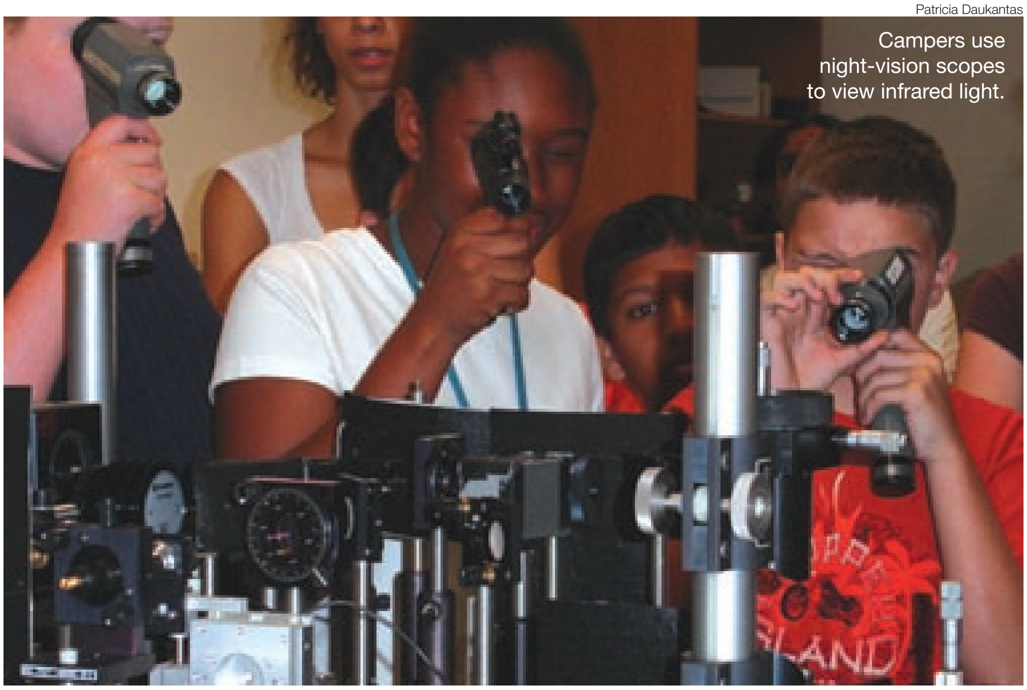

Campers use night-vision scopes to view infrared light.

In the afternoon, Johnson, who serves as director of UMBC's Center for Advanced Studies in Photonics Research (CASPR), told the youngsters that he became interested in lasers many years ago, thanks to a summer internship he did at Bell Laboratories—the site of many early innovations in the field.

He played for the campers an introductory OSA video, "Lasers as a Tool," which explains how the devices work and showcases numerous applications in the home, laboratory, factory and hospital. Apart from a few "ewwwws" when the camera zoomed in on surgical procedures, the students watched the video without squirming.

Johnson discussed how lasers are used in dentistry and ophthalmology as well as CD-ROM drives. He also explained that his own interests lie in the field of ultra-high-speed photonics, a topic that fits into UMBC's physics and electrical engineering departments, where he holds joint appointments.

The lasers in his lab, he said, give off pulses that are a million times shorter than a billionth of a second, and some that are even a thousand times shorter than that. "You can only do measurements that fast with light, because no electronics can do that," he told the students. His explanation of the lasers' intense speed increased the impact of his exhibition of his picosecond and femtosecond lasers.

Those lasers are included in a laboratory that Johnson calls the "million dollar room," because it contains the expensive and sensitive equipment used by CASPR researchers. There, he also showed the students an optical table insulated from vibrations from the floor via a compressed-air system.

Johnson then took the youths into a smaller "training" lab, where "everyone gets their feet wet"—that is, undergraduates and first-year graduate students learn how to use the equipment and even make a mistake or two. He had already set up an infrared laser; to prove that it was working, he slipped a sheet of paper into the path of the beam and pulled it back out when it started to smoke. Johnson's grad-student assistants passed around several night-vision scopes so that the campers could see the laser's glow. (Dust and smoke particles in the air were, of course, scattering some of the coherent laser light.)

Just as on the stage and screen, visual effects always capture the audience's attention in the classroom. So, in a demonstration of nonlinear optics, Johnson re-aimed the laser beam through a crystal of potassium titanyl phosphate. The exiting beam, with a wavelength half as long as the original laser emission, looked greener and more brilliant than a "Star Wars" light saber.

The conversion process requires highly intense light, Johnson explained. A 100-W light bulb doesn't look intense to the eye because its power radiates outward in nearly all directions. However, 100 W of laser light, focused into a tiny area, can cut steel. Fortunately, the campers heeded the look-but-don't-touch warning.

For a lesson on fiber optics, Johnson coupled the laser setup to about 100 m of fiber, much of it coiled into a circle. The green light was funneled into the fiber via a microscope. By changing the voltage on a piezoelectric device, he could move the microscope's objective a tiny bit and change the amount of light entering the optical fiber. Johnson reminded the students that the human eye is most sensitive to green wavelengths, which made the bending loss in the fiber easy to see. Johnson also conducted simple experiments for the campers to demonstrate polarization and interference of light waves.

ESTEEM uses the TechBridge curriculum from the Chabot Space & Science Center in Oakland, Calif., and supplements it with visits to nearby laboratories and science museums. Alicia Sparks, the UMBC center's director of K-12 programs, is assisted by UMBC technology majors who serve as additional role models for the middle schoolers. One of this year's camp counselors was Angelique Johnson, a recent UMBC graduate who was about to enroll in the University of Michigan's doctoral program in electrical engineering.

Besides solar energy and optics, the summer campers got a chance to sample Web page design, kite aerodynamics, reverse engineering and networking. During the previous academic year, they also participated in after-school sessions on photography, electronics and other topics.

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For more information on ESTEEM, please visit www.umbc.edu/cwit/esteem.html.