IMAGE QUALITY: A Rochester team is developing a system that displays objects in three dimensions without requiring special glasses.

'Objects' Made of Light

A type of three-dimensional display that was once only a mainstay of science fiction is now closer to reality, thanks to a device developed by a team in physics and optics.

The device is the next step in 3-D volumetric display, which enables viewers to see images in three dimensions without the use of special glasses or filters. (Think of the 3-D projection of a desperate Princess Leia, pleading, "Help me Obi-Wan Kenobi," in the classic film *Star Wars*.)

Unlike displays that rely on stereoscopy—in which one of two distinct two-dimensional images is presented to either eye, creating the perception of depth—the Rochester 3-D volumetric images are made manifest by light that illuminates every point in an image.

Three-dimensional volumetric display technology has attracted the attention of researchers around the world. But a device created by Curtis Broadbent, a research associate in the Department of Physics and Astronomy, as well as Chris Mullarkey '18 (PhD), and Rochester professor of physics and optics John Howell represents a significant improvement in the technology, creating displays that are notably brighter and larger than what most scientists have been able to achieve.

The device consists of a glass box, housing a heated glass sphere that contains cesium vapor, a silvery-gold metal good at emitting light. Two laser beams with wavelengths invisible to the eye are crossed in the sphere. Where the laser beams cross, cesium atoms are illuminated by both lasers and are excited into an especially high-energy state. When the atoms decay, they emit sky-blue light in all directions.

"Essentially, you get this tiny, point-like source of blue photons where the lasers intersect," Broadbent says. "That's really the key feature that allows us to make an intrinsically 3-D object that exists in real space."

Broadbent and his colleagues have transformed blue photons into "objects" such as dinosaurs and moving helicopters by breaking down the objects into coordinates along the three axes representing the three dimensions of length, width, and depth. The lasers, programmed to cross at the coordinates, illuminate one point at a time.

"The image never really exists at one time, even though we perceive it that way," Broadbent says. "If you want a sequence of points to look like an image, you need to draw it fast enough so the eye can't tell that the image is being drawn point by point."

Illuminating each point for a fraction of a second, the lasers are able to light up all of the points that make up the image in about 50 milliseconds (one millisecond equals one thousandth of a second).

—Lindsey Valich

ADAM FENSTER

A Collaborative Approach to Some Prison Ills

An estimated 20 percent of the US prison population consists of individuals with severe mental illnesses—people who are more than four times as likely to be arrested than other adults, and once behind bars, often wait months to receive treatment.

Now, an intervention developed at the Medical Center has been shown to reduce the population's criminal convictions, jail time, and hospitalizations by roughly 50 percent. In addition, the model—which hinges on collaborative problem-solving between the mental health and criminal justice systems—has been proven to keep individuals with mental illnesses in treatment twice as long as the study's comparison intervention. The research appeared in the journal *Psychiatric Services*.

The new intervention, called the Rochester Forensic Assertive Community Treatment model (R-FACT), relies on judges, lawyers, probation officers, and other criminal justice professionals to work with mental health professionals to guide clients with mental illnesses toward "specific interventions that target the things driving their involvement with the criminal justice system," says Steven Lamberti, lead investigator and a professor of psychiatry at the Medical Center.

—Christine Roth

Putting the Brakes on Cancer Cells

A Medical Center team has identified a new way to potentially slow the fast-growing cells that characterize all types of cancer. The findings were reported in the journal *Science*.

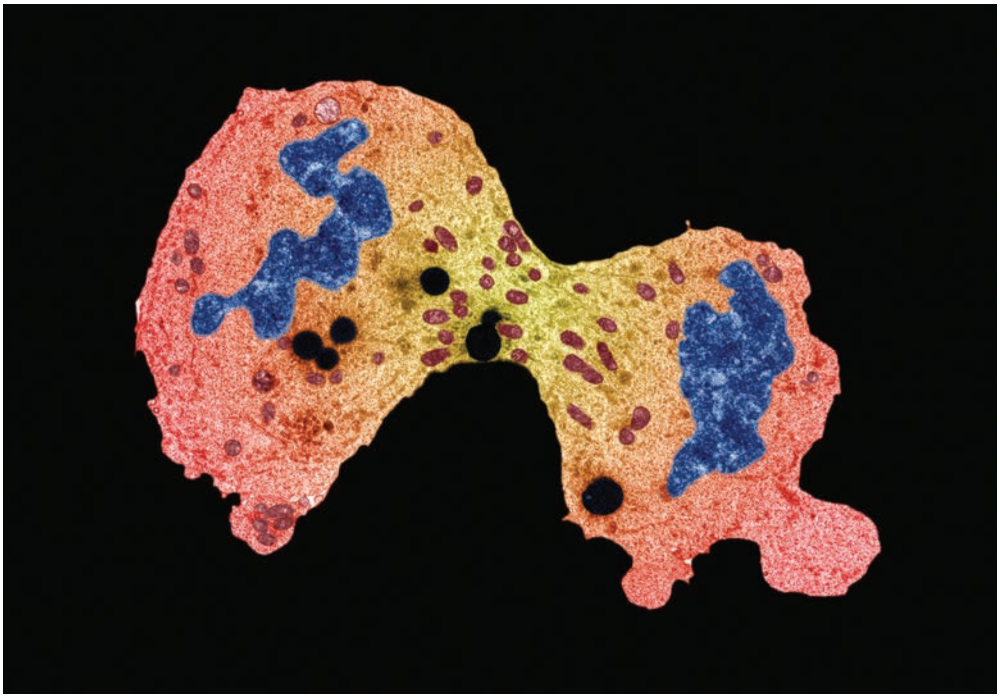
All cells go through the cell cycle, a series of events that, in healthy cells, culminates in orderly cell growth and division. The researchers discovered that when a protein called Tudor-SN is eliminated from cells, the cells take longer to gear up for division, slowing the cell cycle.

"We know that Tudor-SN is more abundant in cancer cells than healthy cells, and our study suggests that targeting this protein could inhibit fast-growing cancer cells," says Reyad Elbarbary, research assistant professor in the Center for RNA Biology and the Department of Biochemistry and Biophysics at the Medical Center.

The Tudor-SN protein controls microRNAs, molecules that fine-tune the expression of thousands of human genes. When Tudor-SN is removed from human cells, the levels of dozens of microRNAs go up. Boosting the presence of microRNAs puts the brakes on genes that encourage cell growth.

"Because cancer cells have a faulty cell cycle, pursuing factors involved in the cell cycle is a promising avenue for cancer treatment," says Lynne Maquat, director of the Center for RNA Biology and the J. Lowell Orbison Distinguished Service Alumni Professor of Biochemistry and Biophysics. Maquat also holds an appointment in the Wilmot Cancer Institute.

Researchers aim next to understand how Tudor-SN works in concert with other molecules and proteins, with the ultimate goal of identifying drugs to target Tudor-SN. —Emily Boynton



SLOWING CELL DIVISION: Targeting a key protein may play an important role in slowing the rapid cell division (above) that characterizes all forms of cancer, say Rochester researchers.

New Materials from Quantum Dots

Photoredox catalysis—the use of light to mediate chemical reactions—has become an essential way to synthesize novel organic compounds. It may soon be used even more widely—and less expensively—thanks to work by Rochester chemists.

A team led by Todd Krauss, a professor of chemistry and chair of the department, and Daniel Weix, an associate professor of chemistry, demonstrated for the first time how light-emitting quantum dots can be used as catalysts to create carbon-carbon bonds, the basic building blocks for numerous molecular forms, many of them essential to biological functions.

In the study, which appeared in the *Journal of the American Chemical Society*, the researchers showed that quantum dots create the bonds just as effectively as rare-metal catalysts, such as ruthenium and iridium.

Quantum dots are tiny semiconductor crystals. They "have properties of both the molecular and the macroscopic world," says Krauss, and can be "manipulated just as you would manipulate small molecules in solution. You can spray them, you can coat them on surfaces, you can mix them, and do all different chemistries with them."

Quantum dots have potential applications in the synthesis of pharmaceuticals, fine chemicals, and agro-chemicals. Noting that the research is still in its early stages, Weix says,"The next step is to look at what these things do that nothing else can do. That's the promise of the future."

—Bob Marcotte

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