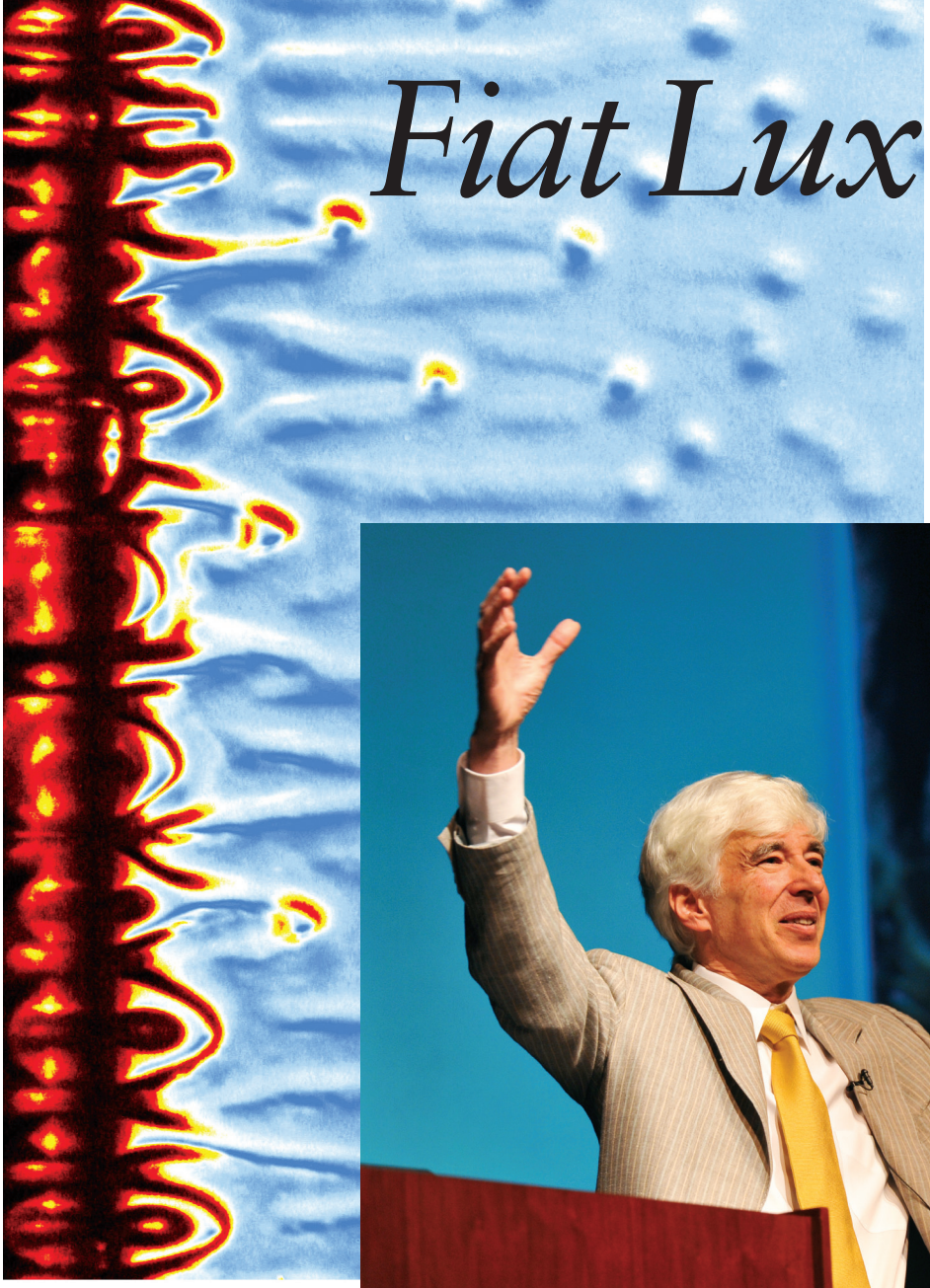

Fiat Lux in a Flask

Physicist Seth Putterman studies a wide range of extraordinary physical phenomena, such as the production of light by bursting gas bubbles, and X-rays produced by peeling adhesive tape.

Seth Putterman (right) delivering his Faculty Research Lecture. Above: a microscopie image of peeling adhesive tape, a process that can produce x-rays.

By Wendy Soderburg

When physics professor Seth Putterman delivered the 109th UCLA Faculty Research Lecture last fall, audience members knew the exact moment he got into the groove: It was when the New York native slipped back into Brooklynese.

At the Faculty Research Lecture—the highest honor that UCLA faculty can award to one of their own—that auspicious moment occurred early in Putterman's talk, titled "Fiat Lux: Light from Gas Bubbles, X-Rays from Peeling Tape, and Fusion from Crystals." Putterman, whose research explores "spontaneous energy," carried out an experiment on stage that demonstrated a phenomenon called sonoluminescence, in which a flash of light accompanies the bursting of a bubble in a liquid when sound waves are passed through it.

To demonstrate sonoluminescence, Putterman took a flask filled with phosphoric acid and shook it until the temperature inside reached roughly 18,000 degrees Fahrenheit. Bubbles inside the liquid expanded and collapsed, releasing tiny flashes of light as they did so.

Putterman received a grant from the U.S. Department of Defense to study these bubbles of liquid, with the goal of increasing their energy density. Should his lab reach its goal, however, he will be careful about what he says—lofty claims in science are always challenged, as Putterman well knows. In fact, in 2005, Putterman was asked by the BBC to appear in a documentary while trying to reproduce results that scientists at another university claimed they had achieved.

"The documentary was called *An Experiment to Save the World*," Putterman said.

Putterman's lab heated a crystal, causing an electric charge to build up on its surface and develop 100,000 volts. Appreciating the enormous potential of their invention, Putterman and his staff were actually able to use it to generate nuclear fusion.

"The other researchers claimed that by making bubbles using deuterated acetone, when the bubble collapsed, they got deuterated acetone nuclear fusion. And that would be very interesting, because they were saying that instead of 10,000 degrees, they got to a temperature of millions of degrees. And at temperatures of millions of degrees, they reached thermonuclear fusion."

In a form of "reality physics television," a BBC camera crew filmed Putterman and his staff as they tried to reproduce the experiment in real time. They set up the experiment with deuterated acetone and used a neutron detector that was built at UCLA. After two weeks of filming and interviewing, however, Putterman's lab was unable to reproduce the results.

"This is a very important point: No one has proven that it's impossible to do this," Putterman said. "The payoff is so great that although it's risky, it's worth doing if you have an idea. So this is what we could call 'high-risk, high-gain' research."

Putterman created news himself back in 1990 when he and his graduate student, Brad Barber, published a paper in *Nature* magazine showing that in some situations, the flash of light in the sonoluminescence phenomenon was about 50 picoseconds—or 50 trillionths of a second—long. That was a much shorter period than scientists had thought, and it generated a lot of interest in the field.

More recently, Putterman's lab was credited with inventing crystallic fusion. They took a crystal—just an inch in size—and heated it by about 40 degrees Celsius, causing an electric charge to build up on its surface and develop a voltage of 100,000 volts. Appreciating the enormous potential of their invention, Putterman and his staff were actually able to use it to generate nuclear fusion.

"And *here*, we succeeded," Putterman said with a smile. "This has been reproduced. That's essential. Other laboratories have reproduced this; they need neutron generators for various applications."

In October 2008, Putterman and three colleagues in the UCLA Department of Physics and Astronomy—Carlos Camara, Juan Escobar and Jonathan Hird—published research that showed that peeling everyday adhesive tape can, incredibly, produce X-rays.

The cover of the journal *Nature*, in fact, showed an X-ray picture of Putterman's finger that was produced by peeling regular Scotch tape.

In a May 2011 issue of *Nature,* Putterman and his colleagues again were the subject of an article about using adhesive tape to produce X-rays. This time, however, the focus was on their development of a simple prototype that could serve as a low-cost X-ray source for commercial engineering.

The middle son of a U.S. Customs Service employee and a housewife-turned-interior-designer, Putterman attended the engineering school at Manhattan's Cooper Union for the Advancement of Science and Art for two years before transferring to Caltech. At Rockefeller University in New York City, where he received his Ph.D., Putterman's thesis adviser was famed physicist George Uhlenbeck, with whom he worked on various research papers in the field of quantum fluids.

Putterman recalled that it was the chance to work with physicist Isadore Rudnick that drew him to UCLA in 1970 as an assistant professor.

"I was a theorist, and Izzy Rudnick was an experimentalist. It looked as though there was room to combine and do interesting things," Putterman said.

One of those 'interesting things' was the study of sonoluminescence. Putterman recalled how a friend teased him about his interest in fluid mechanics.

"He said if I knew so much about fluids, explain how they make light when vibrated," the physicist said. "I thought it was impossible, but he said to study the old German literature."

Putterman had UCLA graduate student Brad Barber set up an apparatus to create sonoluminescence based on the published papers; in the meantime, he visited other labs that had studied it. When he got to Lawrence Crum's laboratory at the University of Mississippi, he was astonished to find that one of Crum's graduate students, Felipe Gaitan, was exploring an unusual phenomenon: the creation of light from sound from just one bubble. Putterman was intrigued, and a lifetime fascination with sonoluminescence was born.