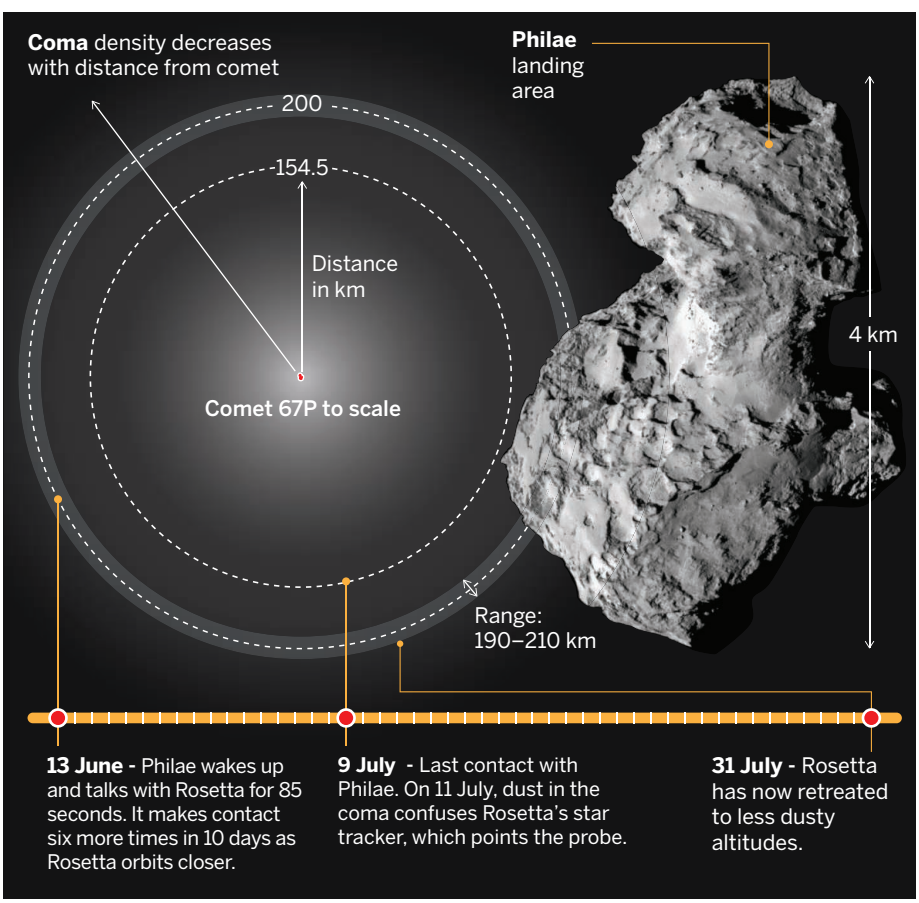
Philae even sent pictures from its 360° camera, CIVA. Jean-Pierre Bibring, who led the camera team and is one of Philae's two lead scientists, says he was surprised to see very little ice. Instead, he found grains of dust that were far bigger than expected, stuck together to form meter-sized blocks resembling conglomerate rocks on Earth. "The cement of a comet is probably not ice," says Bibring, a planetary scientist at the Institute of Space Astrophysics in Orsay, France. Instead, it may be the stickiness of the dust grains themselves—complex organic material from the presolar nebula in which the comet formed more than 4.5 billion years ago.

Sunshine isn't convinced yet. She says the surface materials may not be pristine—they may have been altered by ultraviolet light. "We're still dealing with the skin-deep problem," she says. For her, one of the surprising results came from an analysis of the lander's initial bounce. Sunshine says most scientists expected comets to be "fluffy," but Philae's trajectory showed that, underneath about 20 centimeters of soft dust, the comet has a thin, relatively strong layer, perhaps formed as ice sublimed and left behind dust that "sintered" together. The soft outer layer may consist of dust that blew off and settled back to the surface. Computer simulations work showed that larger infalling objects can splash dust across the surface, covering its features like drifting snow—but with no need to invoke any cometary "wind." "Material is moving around this thing," Sunshine says. "That's sedimentary geology."

Layers of settling dust could eventually become a problem for Philae's solar panels. For now, light levels look good, and Ulamec says that, since the 13 June contact, they have increased beyond what would be expected with the change in seasons—an indication the lander has shifted to a more favorable angle (although the tilt may have also made its radio connections worse). He is looking to September and October as the last chance to get the lander doing science again before the comet leaves the inner solar system and sunlight dims too much. "We of course keep trying," he says. "The lander surprises us again and again." ■

Gathering dust

As comet 67P/Churyumov-Gerasimenko approaches the sun, increasing dust in the coma has hindered Rosetta's ability to fly close and communicate with the Philae lander.



BIOPHYSICS

Tiny built-in lasers light up living cells

Technique could revolutionize tracking of individual cells

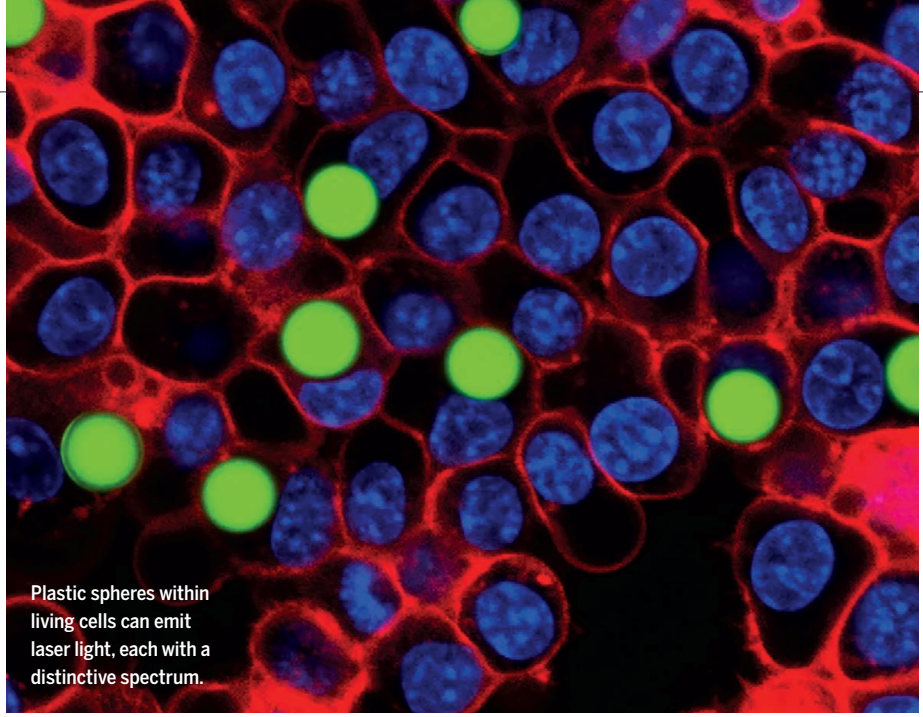
By **Adrian Cho**

Two groups of researchers have independently fashioned tiny lasers within living cells. They may sound like weapons for Ant-Man's next nemesis, but the microscopic lasers could greatly improve biologists' ability to track the movement of individual cells—a possible boon to fields ranging from developmental biology to cancer research.

"It has potential to do things you can't do with other techniques," says David McGloin, a biophysicist at the University of Dundee in the United Kingdom. For example, the lasers could potentially track more cells than fluorescent tagging can and could be easier to use than budding techniques such as radio-frequency ID. Kristian Franze, a neurobiologist at the University of Cambridge in the United Kingdom, agrees. "If they can develop this so that it's applicable in living tissue, that would be very, very interesting to many people," he says.

To make a laser, you need two things: a material or "medium" that can be excited to produce light, and a "resonant cavity" that will ring with light of specific wavelengths, just as an organ pipe rings with sound waves of specific frequencies. The medium fills the cavity with light, and when the light crosses a certain intensity threshold it stimulates the medium to radiate far more strongly. The result is a feedback loop that greatly amplifies the light, which gushes out at wavelengths set by the cavity.

Scientists have toyed with making cell-based lasers before. For example, in 2011, Seok Hyun Yun, a biomedical scientist at Harvard Medical School (HMS) in Boston, and Malte Gather, a physicist now at the University of St. Andrews in the United Kingdom, made a laser using a single cell engineered to contain a green fluorescent protein as the light-emitting medium, placing it within a resonant cavity. But no one had created a laser within a single cell. Gather and Yun have now done that inde-



Plastic spheres within living cells can emit laser light, each with a distinctive spectrum.

IMAGE: M. SCHUBERT ET AL., *NANOLETT* (2015); ACS

pendently, using much the same technique.

The hard part is putting a cavity in a cell. Gather and colleagues got cells to do that for themselves. In culture, they mixed cells with tiny plastic spheres 5 to 10 micrometers in diameter that had been "doped" with a fluorescent dye. The beads served as the cavities, the dye as the medium. The cells absorbed the spheres through endocytosis, the same process by which immune cells gobble up pathogens, the team reported online on 17 July in *Nano Letters*. The trick worked with four types of cells, including human macrophages, a type of white blood cell.

The researchers then applied a 5-nanosecond pulse of light to excite the dye. It emitted light that raced around the sphere's equator, held in by a process called total internal reflection. Specific wavelengths—those for which a whole number of light waves wrapped exactly around a bead's circumference—resonated and grew more intense, until the bead "lased" at a couple of those wavelengths.

Yun and his HMS colleague Matjaž Humar also managed to get cells to take up plastic beads, and they created two other kinds of resonating spheres as well, they reported online on 27 July in *Nature Photonics*. They injected cells with droplets of dyed oil and also showed that the natural lipid globules in fat cells could be made to serve as resonating spheres.

The most obvious application of the lasers would be to track the movements of individual cells, Yun and Gather say. Each plastic bead has a slightly different diameter and optical properties, so it shines at distinctive wavelengths, which serve as a barcode to identify a cell. Gather and colleagues tracked a handful of macrophages in culture for 19 hours, and Yun and Humar did a similar demonstration.

The lasers' ability to shine at narrowly defined wavelengths should give them an edge over rival cell-tracking techniques such as fluorescent tags. Because a fluorescent molecule gives off a spectrum of wavelengths, researchers cannot tag many cells before the tags' spectra overlap. But the lasers' spike-like spectra should make it possible to track thousands of the tiny beacons simultaneously. Researchers might even be able to expand the number to millions or billions by loading each cell with multiple spheres. Every cell would then lase at a distinctive combination of wavelengths.

But that prospect is a way off. First, the teams need to show that various types of cells will take up the spheres, especially in living tissue. Gather predicts that won't be a problem. "I'm confident that this [technique] is generalizable," he says. Developers must also reduce the size of the plastic beads. Now, the beads stuff the cells full, Yun acknowledges. "You feel a bit of pity for them," he says. However, both he and Gather have shown that they can use smaller glass beads instead of the plastic ones.

The tiny lasers might be put to use in research right away to track cultured immune cells as they migrate in response to chemical stimuli, Franze says. A bigger payoff would come if they can be used in vivo, he says, for example, to track cells in developing embryos, the immune system, or cancerous tumors. To do that, researchers would need to get light into and out of living tissue. Zebrafish, which can be made transparent, would be an ideal organism to start experimenting with, Franze says.

Ultimately, laser cells might find uses nobody has imagined. "Regardless of anything else," McGloin says, "it's very cool." ■

INFECTIOUS DISEASES

Risk of 'leaky' vaccines debated

Controversial finding suggests they can speed the spread of deadly pathogens

By **Kai Kupferschmidt**

When people talk about the impact of vaccines, they usually mean the millions of humans saved from disease and death. But Andrew Read, an evolutionary biologist at Pennsylvania State University, University Park, likes to think about what vaccination does to pathogens. In 2001, he published a theory in *Nature* suggesting that some vaccines may cause viruses and bacteria to become more deadly.

Now, Read has some evidence to back that up—at least in animals. A paper published in *PLOS Biology* this week suggests that widespread vaccination against Marek's disease, a viral infection in chickens, explains why it has evolved to become more lethal the past few decades. Something similar might happen with certain human vaccines, Read cautions.

But other researchers say the study has little relevance for public health. Read "should stop scaremongering," says vaccine researcher Adrian Hill of the University of Oxford in the United Kingdom. He and others worry that the paper—and news stories like this one—will only play into the hands of the antivaccine movement.

Read's ideas are built on the widely accepted idea that pathogens often evolve to become less lethal over time. After all, killing their host quickly reduces their chances of being passed on, whereas causing mild symptoms, or none at all, should aid their spread. So-called leaky or imperfect vaccines, which don't prevent infection but merely reduce symptoms, upend that notion, Read argues. They allow the spread of deadlier pathogens that would normally burn out quickly.

Leaky vaccines are common for animal infections, including Marek's disease. Most human vaccines, on the other hand, actually prevent infection, but that may soon change. With diseases like malaria or HIV, for which protection is very hard