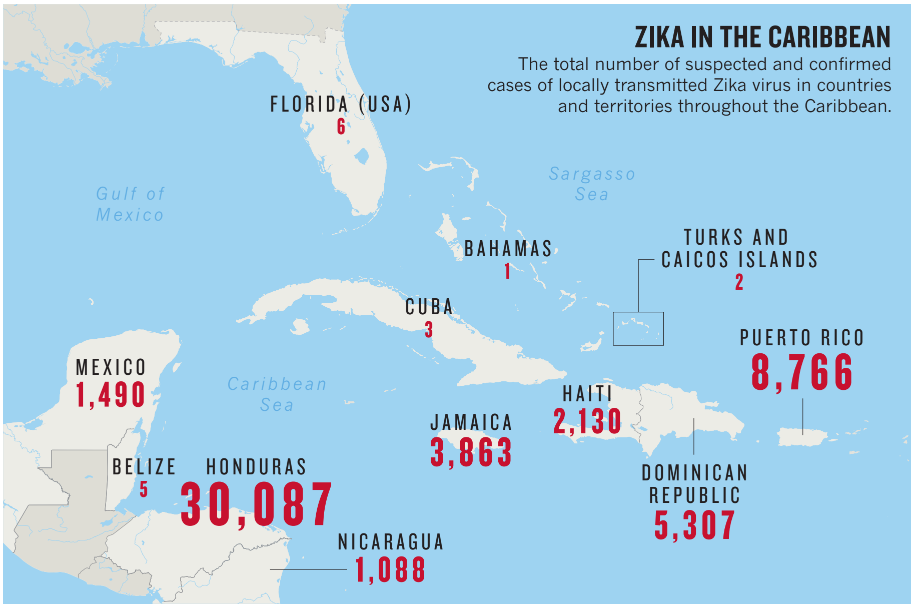

SOURCE: PAHO/WHO

with the exception of one locally acquired case in March, Cuba mostly managed to keep Zika out until this month.

ON THE BALL

That success was the result of its excellent health-care system and an extensive surveillance programme for vector-borne diseases that the government set up 35 years ago, says Ileana Morales, director of science and technology at Cuba's public-health ministry.

In 1981, Cuba saw the first outbreak of haemorrhagic dengue fever in the Americas, with more than 344,000 infections. "We turned that epidemiological event into an opportunity," says Morales. The country sent medical workers to affected areas and began intensively spraying pesticides to eradicate the *Aedes aegypti* mosquito that carries the disease.

It also created a national reporting system, as well as a framework for cooperation between government agencies and public-education campaigns to encourage spraying and self-monitoring for mosquito bites, even among children. One of the most effective measures was a heavy fine for people found to have mosquitoes breeding on their property, says Duane Gubler, an infectious-disease researcher at Duke–NUS Medical School in Singapore. With all these measures in place, Cuba eliminated the dengue outbreak in four months.

Now, when another outbreak threatens, "it's no problem for us to reinforce our system" and intensify such efforts, says Morales.

In February, before any Zika cases had been detected in Cuba, the government dispatched 9,000 soldiers to spray homes and other buildings, while workers killed mosquito larvae in habitats such as waterways. Airport officials screened visitors arriving from Zika-infected countries and medical workers went from door to door looking for people with symptoms. The health-care system already conducts extensive prenatal examinations, so it is primed to detect Zika-caused birth defects such as microcephaly.

Cristian Morales, head of the Cuba office of the Pan American Health Organization (PAHO), says that it is probably unrealistic for other countries to simply copy Cuba's mosquito-control programmes. The country's health-care network is one of the best in the developing world, and the decades-long stability of its government has ensured policy continuity and enforcement of measures such as fines. He adds that the most important aspects of a response, for any country, include collaboration between government sectors and increased surveillance.

EVERYONE'S CHALLENGE

"Cuba probably does a better job of controlling mosquitoes than any other country in the Americas, but it hasn't been totally effective," says Gubler. This is partly due to dips in funding. A resurgence of dengue in 1997 was probably exacerbated by the fall of the Soviet Union, Cuba's major trading partner, which decimated the economy and weakened health funding.

Another disadvantage stems from the 56-year-old US trade embargo, which prevents Cuba from acquiring drugs and medical supplies that include components made in the United States. It must instead buy them from other countries, such as China, often at higher cost.

Yet success has come despite these issues. According to PAHO, health workers have intensified efforts to spray pesticides and eradicate standing water — where mosquitoes can breed — within 150 metres of the homes of each of the two most recent people to get Zika, in the southeastern province of Holguin. Workers are also searching houses for infected people and collecting mosquitoes for study. Guzmán adds that Cuban researchers have begun to plan work on a Zika vaccine.

She says that international cooperation will be important in helping Cuba and others to address Zika. "It's a problem of everybody. It's a new challenge for the world." ■

PHYSICS

Black-hole mimic triumphs

Result could be closest thing yet to observation of Hawking radiation.

BY DAVIDE CASTELVECCHI

Black holes are not actually black. Instead, these gravitational sinks are thought to emit radiation that causes them to shrink and eventually disappear. This phenomenon, one of the weirdest things about black holes, was predicted by Stephen Hawking more than 40 years ago, creating problems for theoretical physics that still convulse the field.

Now, after seven years of often solitary study, Jeff Steinhauer, an experimental physicist at the Technion-Israel Institute of Technology in Haifa, has created an artificial black hole that seems to emit such 'Hawking radiation' on its own, from quantum fluctuations that emerge from its experimental set-up.

It is nearly impossible to observe Hawking radiation in a real black hole, and previous artificial-black-hole experiments did not trace their radiation to spontaneous fluctuations. So the result, published on 15 August[1], could be the closest thing yet to an observation of Hawking radiation.

Steinhauer says that black-hole analogues might help to solve some of the dilemmas that the phenomenon poses for other theories, including one called the black-hole information paradox, and perhaps point the way to uniting quantum mechanics with a theory of gravity.

Other physicists are impressed, but they caution that the results are not clear-cut. And some doubt whether laboratory analogues can reveal much about real black holes. "This experiment, if all statements hold, is really amazing," says Silke Weinfurtner, a theoretical and experimental physicist at the University of Nottingham, UK. "It doesn't prove that Hawking radiation exists around astrophysical black holes."

It was in the mid-1970s that Hawking, a theoretical physicist at the University of Cambridge, UK, discovered that the event horizon of a black hole — the surface from which nothing, including light, can escape — should have peculiar consequences for physics.

His starting point was that the randomness of quantum theory ruled out the existence of true nothingness. Even the emptiest region of space teems with fluctuations in energy fields, causing photon pairs to appear continuously, only to immediately destroy each other. But, just as Pinocchio turned from a puppet into a boy, these 'virtual' photons could become real particles if the event horizon separated them before they could annihilate each other. One photon would fall inside the event horizon and the other would escape into outer space.

This, Hawking showed, causes black holes both to radiate — albeit extremely feebly — and to ultimately shrink and vanish, because the particle that falls inside always has a 'negative energy' that depletes the black hole. Most controversially, Hawking also suggested that a black hole's disappearance destroys all information about objects that have fallen into it, contradicting the accepted wisdom that the total amount of information in the Universe stays constant.

In the early 1980s, physicist Bill Unruh of the University of British Columbia in Vancouver, Canada, proposed a way to test some of Hawking's predictions[2]. He imagined a medium that experienced accelerated motion, such as water approaching a waterfall. Like a swimmer reaching a point where he cannot swim away fast enough to escape the waterfall, sound waves that are past the point in the medium that surpasses the speed of sound would become unable to move against the flow. Unruh predicted that this point is equivalent to an event horizon — and that it should display a sonic form of Hawking radiation.

"For sure, this is a pioneering paper."

Steinhauer implemented Unruh's idea in a cloud of rubidium atoms that he cooled to a fraction of a degree above absolute zero. Contained in a cigar-shaped trap a few millimetres long, the atoms entered a quantum state called a Bose–Einstein condensate (BEC), in which the speed of sound was just half a millimetre per second. Steinhauer created an event horizon by accelerating the atoms until some were travelling at more than 1 mm s^{-1} — a supersonic speed for the condensate (see 'Building a black hole').

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Read more about the physicist who models black holes in sound:
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At its ultracold temperature, the BEC undergoes only weak quantum fluctuations that are similar to those in the vacuum of space. And these should produce packets of sound called phonons, just as the vacuum produces photons, Steinhauer says. The partners should separate from each other, with one partner on the supersonic side of the horizon and the other forming Hawking radiation.

On one side of his acoustical event horizon, where the atoms move at supersonic speeds, phonons became trapped. And when Steinhauer took pictures of the BEC, he found correlations between the densities of atoms that were an equal distance from the event horizon but on opposite sides. This demonstrates that pairs of phonons were entangled — a sign that they originated spontaneously from the same quantum fluctuation, he says, and that the BEC was producing Hawking radiation.

By contrast, radiation that he observed in an earlier version of the set-up had to be triggered, rather than arising from the BEC itself[3], whereas a previous experiment in water waves led by Unruh and Weinfurtner did not attempt to show quantum effects[4].

Just as real black holes are not black, Steinhauer's acoustical black holes are not completely quiet. Their sound, if it were audible, might resemble static noise.

"For sure, this is a pioneering paper," says Ulf Leonhardt, a physicist at the Weizmann Institute of Science in Rehovot, Israel, who leads a different attempt to demonstrate the effect, using laser waves in an optical fibre. But he says that the evidence of entanglement seems incomplete, because Steinhauer demonstrated correlations only for phonons of relatively high energies, with lower-energy phonon pairs seemingly not correlated. He also says he's not confident that the medium is a true BEC, which, he says, means that there could be other types of fluctuation that could mimic Hawking radiation.

Also unclear is what analogues can say about the mysteries surrounding true black holes. "I don't believe it will illuminate the so-called information paradox," says Leonard Susskind, a theoretical physicist at Stanford University in California. In contrast to the case of astrophysical black holes, there is no information loss in Steinhauer's sonic black hole because the BEC does not evaporate.

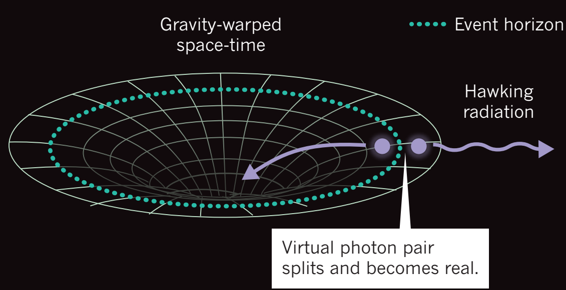
Still, if Steinhauer's results were confirmed, it would be "a triumph for Hawking, perhaps in the same sense that the expected detection of the Higgs boson was a triumph for Higgs and company", says Susskind. Few doubted that the particle existed, but its discovery in 2012 still earned Peter Higgs and another theorist, François Englert, who predicted it, a Nobel prize. ■

BUILDING A BLACK HOLE

A black hole's event horizon — the point beyond which the gravitational pull is too strong even for light to escape — has been mimicked in the lab using a cloud of ultracold atoms. The artificial black hole seems to emit a form of Hawking radiation.

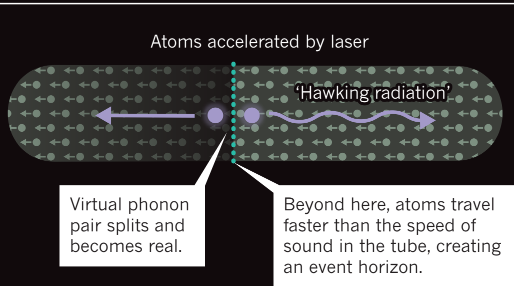
REAL BLACK HOLE

Quantum fluctuations in the vacuum of space produce virtual photons. Sometimes, one of a pair gets trapped behind the event horizon before the two destroy each other, forcing both to become real particles. The photon that escapes is emitted as Hawking radiation.



ARTIFICIAL BLACK HOLE

Ultracold atoms in a tube undergo quantum fluctuations that produce pairs of virtual particles — in this case, packets of sound called phonons. If one phonon falls in the supersonic region, it is trapped, leading to a sonic form of Hawking radiation.



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3. Steinhauer, J. *Nature Phys.* **10,** 864–869 (2014).
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