The WireWall frame measures waves sloshing over sea walls.

over the wall and, by measuring the depth of water after each slop, the scientists could take some of the only such field measurements captured so far (T. Pullen *et al. Coast. Eng.* **56**, 121–140; 2009).

But tanks are heavy and expensive to deploy, and they don't gather data on how fast water is moving. So Brown got in touch with Margaret Yelland, an oceanographer at the NOC site in Southampton, who has used capacitance wires, which sense contact with salt water, on buoys in the open ocean (R. W. Pascal *et al. J. Atmos. Ocean. Technol.* **28**, 590-605; 2011). Working with Pullen and others, they designed and tested WireWall before taking it to Crosby, where local officials plan to replace the ageing sea wall and are looking for information on how best to do that. (Part of their research involved going through photos from a Facebook group of people who walk on Crosby beach to see how often the car park flooded.)

When tides are high, winds are strong and it looks as if the sea might break over the wall at Crosby, the WireWall team sets up its rig. It's about the height of a person and has 18 wires arrayed in a grid. When seawater hits the wires, it generates an electrical contact that reveals how much of the wire is wet. By measuring how the wires get drenched as the wave passes through them, the researchers can calculate the water's speed and volume.

"We've had a good range of lovely big waves coming over," says Yelland, who has been looking through the data gathered at high tides in October, November and January. One unexpected factor is that when the waves arrive nearly parallel to the sea wall, the water splashes up in a sideways squirt that can be hard for WireWall to detect.

RISING TIDE

Eventually, the researchers aim to use the data to help improve oceanographic models and other tools, such as the European-led industry guide on overtopping known as EurOtop. Brown has already spoken to officials about taking WireWall elsewhere. One option is the Fylde peninsula in Lancashire, UK, where three new sea walls each have a slightly different design on which WireWall could compare sloshing.

"We'd like to be able to go anywhere," says Brown. In Australia, ecologists Rebecca Morris and Beth Strain of the University of Melbourne plan to use WireWall to compare flooding that breaches sea walls with flooding over natural coastal defences such as mangrove forests. In Norway, researchers might use WireWall to study how winds blowing across reservoirs can push water over the tops of dams and destabilize them, says Fjóla Guðrún Sigtryggsdóttir, a civil engineer at the Norwegian University of Science and Technology in Trondheim.

WireWall could become even more relevant as sea levels continue to rise, increasing the risk of waves breaching walls. In the United Kingdom, coastal planners are required to take the effects of sea-level rise into account when building new sea defences. At Crosby, sea level is rising by 1.6 millimetres per year. ■

AWARDS

US mathematician is first woman to win prestigious Abel Prize

Karen Keskulla Uhlenbeck built bridges between analysis, geometry and physics.

BY DAVIDE CASTELVECCHI

US mathematician Karen Keskulla Uhlenbeck has won the 2019 Abel Prize — one of mathematics' most prestigious awards — for her wide-ranging work in analysis, geometry and mathematical physics. Uhlenbeck is the first woman to win the 6-million-kroner (US$700,000) prize, which is given out by the Norwegian Academy of Science and Letters, since it was first awarded in 2003.

Uhlenbeck learnt that she had won on 17 March, after a friend called and told her that the academy was trying to contact her. "I was completely amazed," she told *Nature*. "It was totally out of the blue."

Uhlenbeck is legendary for her skill with partial differential equations, which link variable quantities and their rates of change, and are at the heart of most physical laws. But her long career has stretched across many fields, and she has used the equations to solve problems in geometry and topology.

One of her most influential results — and the one that she says she's most proud of — is the discovery of a phenomenon called bubbling, as part of seminal work she did with mathematician Jonathan Sacks. Sacks and Uhlenbeck were studying 'minimal surfaces', the mathematical theory of how soap films arrange themselves into shapes that minimize their energy. But the theory had been marred by the appearance of points at which energy seemed to become infinitely concentrated. Uhlenbeck 'zoomed in' on those points to show that this was caused by a new bubble splitting off the surface.

She applied similar techniques to do foundational work in the mathematical theory of gauge fields, a generalization of the theory of classical electromagnetic fields that underlies the standard model of particle physics.

DISPARATE FIELDS

Much of Uhlenbeck's work was done in the early 1980s, when research communities that had grown apart were starting to connect again, she recalls. "There was a real flowering of this relationship between mathematics and physics," she says. Mathematicians proved that they had information useful to physicists, who "had great ideas of objects to study that mathematicians couldn't come up with by themselves".

The work of other prizewinning mathematicians has been rooted in techniques introduced by Uhlenbeck, says Mark Haskins, a mathematician at the University of Bath, UK, who was one of her doctoral students. These include Fields Medal winner Simon Donaldson — who ▶

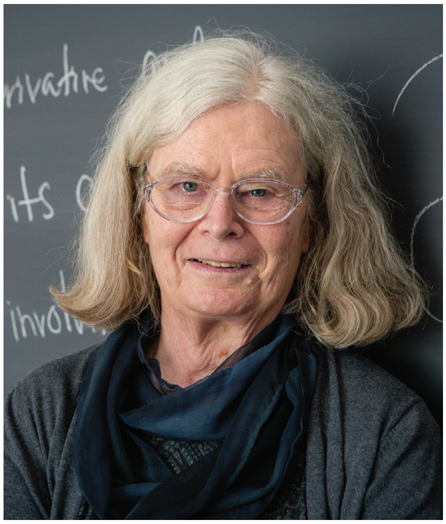
applied gauge theory to the topology of four-dimensional spaces — and 2009 Abel laureate Mikhail Gromov, who studied a mathematical analogue of the 'strings' of string theory, in which the bubbling idea was crucial.

Haskins says Uhlenbeck has "an innate sense of what should be true". As a student, he recalls sometimes being baffled by her answers to his questions. "Your immediate reaction was that Karen had misheard you, because she had answered a different question," Haskins says. But "maybe weeks later, you would realize that you had not asked the correct question".

'LEGITIMATE REBELLION'

Karen Keskulla was born in Cleveland, Ohio, in 1942, and grew up in part in New Jersey, intensely interested in learning. "I read all of the books on science in the library and was frustrated when there was nothing left to read," she wrote in a 1996 autobiographical essay.

After an initial interest in physics, she earned her PhD in mathematics in 1968 from Brandeis University in Waltham, Massachusetts. She was one of the few women in her department; some academics recognized her talent and encouraged her, but others did not. "We were told that we couldn't do math because we were women," she wrote in the 1996 essay. "I liked doing what I wasn't supposed to do, it was a sort of legitimate rebellion."



Karen Keskulla Uhlenbeck.

ANDREA KANE/IAS

Uhlenbeck held positions at several universities before settling at the University of Texas at Austin in 1987, where she stayed until she retired in 2014.

Uhlenbeck has been a relentless advocate for women in mathematics, and was the founder of the Women and Mathematics programme at the Institute for Advanced Study in Princeton, New Jersey. "She has been an enormous role model and mentor for many generations of women," says Caroline Series, a mathematician at the University of Warwick in Coventry, UK, and president of the London Mathematical Society. In 1990, she gave a plenary speech at the International Congress of Mathematicians — the only woman to have done so apart from algebra pioneer Emmy Noether, who spoke at the 1932 meeting.

Uhlenbeck became a role model reluctantly at first, but she says that, after a few successes by female mathematicians in her generation, she realized that the path towards fair representation would be harder than expected. "We all thought that once the legal barriers were down, women and minorities would walk through the doors of academia and take their rightful place." But fixing universities was easier than fixing the culture in which people grow up, says Uhlenbeck. She hopes that her prize can inspire girls to go into maths, just as Noether and others inspired her. ■

CLARIFICATION

The News Feature 'What's next for CRISPR babies?' (*Nature* **566**, 440–442; 2019) now includes a comment from Michael Deem's lawyer, in which he says that Deem was not a senior author on the human-gene-editing paper describing He's experiments.