TEXT 1

To do so, the experiment consists of two observatories in the US, each with two arms 4 kilometres long that are set perpendicular to each other.

Lasers are beamed down each arm, reflected by precise mirrors at the end and then compared using an interferometer.

The length of the arms is changed by a tiny amount as gravitational waves wash over them, and this is carefully recorded to build a picture of the origin of these signals.

The problem is that such demanding accuracy is required that even distant ocean waves or clouds passing overhead can affect measurements.

This noise can easily drown out signals, making some observations impossible.

Dozens of major adjustments need to be made to filter out the worst of this noise, tweaking the orientation of mirrors and other equipment.

Rana Adhikari at the California Institute of Technology in Pasadena, who worked with DeepMind to develop the new AI technology, says that attempting to automate these adjustments can ironically create more noise.

“That controls noise has been bedevilling us for decades and decades – everything in this field has been blocked,” says Adhikari.

“How do you hold the mirrors so still without inducing noise?

If you don’t control them, the mirrors swing all over the place, and if you control it too much, then it sort of buzzes around.”

Laura Nuttall at the University of Portsmouth in the UK was one of the scientists who used to manually make these tweaks at LIGO. “As you move one thing, something else goes, and something else goes and something else goes,” she says. “You’d spend forever tweaking.”

DeepMind’s new Deep Loop Shaping AI aims to reduce the level of noise from adjusting the mirrors at LIGO by up to 100 times.

The AI was trained in a simulation before testing in the real world, and is effectively tasked with achieving two goals: reducing noise and minimising the number of adjustments it makes.

“Over time, by repeatedly doing it – it’s like hundreds and thousands of trials that are running in simulation – the controller will sort of find what works and what doesn’t work and find a really, really good policy,” says Jonas Buchli at DeepMind.

Alberto Vecchio at the University of Birmingham, UK, who wasn’t involved in the research but works on LIGO, says the AI is exciting, although there are many hurdles yet to overcome.

Firstly, the technology has only been run for an hour in the real world on LIGO, so it needs to be shown that it can operate for weeks or even months at a time.

Secondly, the technology has so far only been applied to one aspect of control, helping to stabilise the mirrors, and there are hundreds if not thousands of aspects it could conceivably be applied to.

“It’s clearly just the first step, but I still think it’s a very intriguing one.

And clearly there is plenty of room for enormous progress,” says Vecchio.

If similar improvements could be made across the board, then he believes we could spot so-called intermediate-size black holes – for example those with masses around 1000 times that of our sun – a class of objects without any confirmed observations.

TEXT 2

Physicists in Germany say they have measured the correlated behaviour of atoms in molecules prepared in their lowest quantum energy state for the first time.

Using a technique known as Coulomb explosion imaging, they showed that the atoms do not simply vibrate individually.

Instead, they move in a coupled fashion that displays fixed patterns.

According to classical physics, molecules with no thermal energy – for example, those held at absolute zero – should not move.

However, according to quantum theory, the atoms making up these molecules are never completely “frozen”, so they should exhibit some motion even at this chilly temperature.

This motion comes from the atoms’ zero-point energy, which is the minimum energy allowed by quantum mechanics for atoms in their ground state at absolute zero.

It is therefore known as zero-point motion.

To study this motion, a team led by Till Jahnke from the Institute for Nuclear Physics at Goethe University Frankfurt and the Max Planck Institute for Nuclear Physics in Heidelberg used the European XFEL in Hamburg to bombard their sample – an iodopyridine molecule consisting of 11 atoms – with ultrashort, high-intensity X-ray pulses.

These high-intensity pulses violently eject electrons out of the iodopyridine, causing its constituent atoms to become positively charged (and thus to repel each other) so rapidly that the molecule essentially explodes.

To image the molecular fragments generated by the explosion, the researchers used a customized version of a COLTRIMS reaction microscope. This approach allowed them to reconstruct the molecule’s original structure.

From this reconstruction, the researchers were able to show that the atoms do not simply vibrate individually, but that they do so in correlated, coordinated patterns.

“This is known, of course, from quantum chemistry, but it had so far not been measured in a molecule consisting of so many atoms,” Jahnke explains.

One of the biggest challenges Jahnke and colleagues faced was interpreting what the microscope data was telling them. “The dataset we obtained is super-rich in information and we had already recorded it in 2019 when we began our project,” he says. “It took us more than two years to understand that we were seeing something as subtle (and fundamental) as ground-state fluctuations.”

Since the technique provides detailed information that is hidden to other imaging approaches, such as crystallography, the researchers are now using it to perform further time-resolved studies – for example, of photochemical reactions.

Indeed, they performed and published the first measurements of this type at the beginning of 2025, while the current study (which is published in Science) was undergoing peer review.

“We have pushed the boundaries of the current state-of-the-art of this measurement approach,” Jahnke tells Physics World, “and it is nice to have seen a fundamental process directly at work.”

For theoretical condensed matter physicist Asaad Sakhel at Balqa Applied University, Jordan, who was not involved in this study, the new work is “an outstanding achievement”.

“Being able to actually ‘see’ zero-point motion allows us to delve deeper into the mysteries of

quantum mechanics in our quest to a further understanding of its foundations," he says.
Micron-sized dust particles in the atmosphere could trigger the formation of ice in certain types of clouds in the Northern Hemisphere.
This is the finding of researchers in Switzerland and Germany, who used 35 years of satellite data to show that nanoscale defects on the surface of these aerosol particles are responsible for the effect.

TEXT 3
Physicists at the Chinese Academy of Sciences (CAS) have used diamond-based quantum sensors to uncover what they say is the first unambiguous experimental evidence for the Meissner effect – a hallmark of superconductivity – in bilayer nickelate materials at high pressures.
The discovery could spur the development of highly sensitive quantum detectors that can be operated under high-pressure conditions.
Superconductors are materials that conduct electricity without resistance when cooled to below a certain critical transition temperature Tc.
Apart from a sharp drop in electrical resistance, another important sign that a material has crossed this threshold is the appearance of the Meissner effect, in which the material expels a magnetic field from its interior (diamagnetism).
This expulsion creates such a strong repulsive force that a magnet placed atop the superconducting material will levitate above it.
In "conventional" superconductors such as solid mercury, the Tc is so low that the materials must be cooled with liquid helium to keep them in the superconducting state.
In the late 1980s, however, physicists discovered a new class of superconductors that have a Tc above the boiling point of liquid nitrogen (77 K).
These "unconventional" or high-temperature superconductors are derived not from metals but from insulators containing copper oxides (cuprates).
Since then, the search has been on for materials that superconduct at still higher temperatures, and perhaps even at room temperature.
Discovering such materials would have massive implications for technologies ranging from magnetic resonance imaging machines to electricity transmission lines.
In 2019 researchers at Stanford University in the US identified nickel oxides (nickelates) as additional high-temperature superconductors.
This created a flurry of interest in the superconductivity community because these materials appear to superconduct in a way that differs from their copper-oxide cousins.
Among the nickelates studied, La3Ni2O7-δ (where δ can range from 0 to 0.04) is considered particularly promising because in 2023, researchers led by Meng Wang of China's Sun Yat-Sen University spotted certain signatures of superconductivity at a temperature of around 80 K.
However, these signatures only appeared when crystals of the material were placed in a device called a diamond anvil cell (DAC).
This device subjects samples of material to extreme pressures of more than 400 GPa (or 4 × 106 atmospheres) as it squeezes them between the flattened tips of two tiny, gem-grade

diamond crystals.
The problem, explains Xiaohui Yu of the CAS' Institute of Physics, is that it is not easy to spot the Meissner effect under such high pressures.
This is because the structure of the DAC limits the available sample volume and hinders the use of highly sensitive magnetic measurement techniques such as SQUID.
Another problem is that the sample used in the 2023 study contains several competing phases that could mix and degrade the signal of the $La_3Ni_2O_{7-\delta}$.
Nitrogen-vacancy centres embedded as in-situ quantum sensors
In the new work, Yu and colleagues used nitrogen-vacancy (NV) centres embedded in the DAC as in-situ quantum sensors to track and image the Meissner effect in pressurized bilayer $La_3Ni_2O_{7-\delta}$.

TEXT 4
Android phone network makes an effective early warning system for earthquakes
The global network of Android smartphones makes a useful earthquake early warning system, giving many users precious seconds to act before the shaking starts.
These findings, which come from researchers at Android's parent organization Google, are based on a three-year-long study involving millions of phones in 98 countries.
According to the researchers, the network's capabilities could be especially useful in areas that lack established early warning systems.
"By using Android smartphones, which make up 70% of smartphones worldwide, the Android Earthquake Alert (AEA) system can help provide life-saving warnings in many places around the globe," says study co-leader Richard Allen, a visiting faculty researcher at Google who directs the Berkeley Seismological Laboratory at the University of California, Berkeley, US.
Traditional earthquake early warning systems use networks of seismic sensors expressly designed for this purpose.
First implemented in Mexico and Japan, and now also deployed in Taiwan, South Korea, the US, Israel, Costa Rica and Canada, they rapidly detect earthquakes in areas close to the epicentre and issue warnings across the affected region.
Even a few seconds of warning can be useful, Allen explains, because it enables people to take protective actions such as the "drop, cover and hold on" (DCHO) sequence recommended in most countries.
Building such seismic networks is expensive, and many earthquake-prone regions do not have them.
What they do have, however, is smartphones.
Most such devices contain built-in accelerometers, and as their popularity soared in the 2010s, seismic scientists began exploring ways of using them to detect earthquakes.
"Although the accelerometers in these phones are less sensitive than the permanent instruments used in traditional seismic networks, they can still detect tremors during strong earthquakes," Allen tells Physics World.
A smartphone-based warning system
By the late 2010s, several teams had developed smartphone apps that could sense

earthquakes when they happen, with early examples including Mexico’s SkyAlert and Berkeley’s ShakeAlert.
The latest study takes this work a step further.
“By using the accelerometers in a network of smartphones like a seismic array, we are now able to provide warnings in some parts of the world where they didn’t exist before and are most needed,” Allen explains.
Working with study co-leader Marc Stogaitis, a principal software engineer at Android, Allen and colleagues tested the AEA system between 2021 and 2024.
During this period, the app detected an average of 312 earthquakes a month, with magnitudes ranging from 1.9 to 7.8 (corresponding to events in Japan and Türkiye, respectively).
For earthquakes of magnitude 4.5 or higher, the system sent “TakeAction” alerts to users.
These alerts are designed to draw users’ attention immediately and prompt them to take protective actions such as DCHO.

TEXT 5
In his debut book, Einstein’s Tutor: the Story of Emmy Noether and the Invention of Modern Physics, Lee Phillips champions the life and work of German mathematician Emmy Noether (1882–1935).
Despite living a life filled with obstacles, injustices and discrimination as a Jewish mathematician, Noether revolutionized the field and discovered “the single most profound result in all of physics”.
Phillips’ book weaves the story of her extraordinary life around the central subject of “Noether’s theorem”, which itself sits at the heart of a fascinating era in the development of modern theoretical physics.
Noether grew up at a time when women had few rights.
Unable to officially register as a student, she was instead able to audit courses at the University of Erlangen in Bavaria, with the support of her father who was a mathematics professor there.
At the time, young Noether was one of only two female auditors in the university of 986 students.
Just two years previously, the university faculty had declared that mixed-sex education would “overthrow academic order”.
Despite going against this formidable status quo, she was able to graduate in 1903.
Noether continued her pursuit of advanced mathematics, travelling to the “[world’s] centre of mathematics” – the University of Göttingen.
Here, she was able to sit in the lectures of some of the brightest mathematical minds of the time – Karl Schwarzschild, Hermann Minkowski, Otto Blumenthal, Felix Klein and David Hilbert.
While there, the law finally changed: women were, at last, allowed to enrol as students at university.
In 1904 Noether returned to the University of Erlangen to complete her postgraduate dissertation under the supervision of Paul Gordan.
At the time, she was the only woman to matriculate alongside 46 men.
Despite being more than qualified, Noether was unable to secure a university position after graduating from her PhD in 1907.

Instead, she worked unpaid for almost a decade – teaching her father's courses and supervising his PhD students.
As of 1915, Noether was the only woman in the whole of Europe with a PhD in mathematics. She had worked hard to be recognized as an expert on symmetry and invariant theory, and eventually accepted an invitation from Klein and Hilbert to work alongside them in Göttingen. Here, the three of them would meet Albert Einstein to discuss his latest project – a general theory of relativity.
In Einstein's Tutor, Phillips paints an especially vivid picture of Noether's life at Göttingen, among colleagues including Klein, Hilbert and Einstein, who loom large and bring a richness to the story.
Indeed, much of the first three chapters are dedicated to these men, setting the scene for Noether's arrival in Göttingen.