ALAIN JOCARD/AFP VIA GETTY

Paris-Saclay University formed from a merger of numerous institutions.

the world stage: it was the first French university to appear on the Academic Ranking of World Universities' top 20 list, in 2020, and has done so every year since, placing 15th in 2023.

But Paris-Saclay's complex structure has led to a number of issues for its researchers. Paris-Saclay completely subsumed ten faculties and institutes of the Paris-Sud University, while four of France's *grandes écoles* – elite higher-education institutions – along with the Institute of Advanced Scientific Studies (*Institut des Hautes Études Scientifiques*) and two associate universities were brought under the same banner, but retained control over their budgets and recruitment.

The leadership has become increasingly multilayered, says Couvreur, which has increased the number of managers and the administrative burden on staff at all levels. "This is leading to burnout, and is a disincentive to young scientists, who complain they have to undertake work they weren't hired for."

Unfavourable conditions

In 2021, a study by Paris-based human-resources consultancy Degest, seen by *Nature*, concluded that working conditions for staff members had deteriorated since the merger. Despite a massive communications campaign, staff had only a hazy idea of what the Paris-Saclay project was all about, the study said. They also lacked motivation because they felt management did not listen to them, and they questioned the purpose of a number of plans, such as creating links between the various components of the institution, and creating new graduate schools and a bachelor's-degree institution. Some researchers feared a lack of resources for research, excessive time spent on coordinating operations and bidding for funding, competition between teams for the cash available and heavier administrative workloads.

The two presidential contenders had quite different visions for the future of the university, and views on how to address its problems. Bernard calls for a federated rather than centralized structure, with individual institutions working side by side. The distance of decision-making centres and central services from labs and teaching entities complicates management and procedures, Bernard says.

Iacona's expired term as president began after she took over the post from education and research minister Sylvie Retailleau, who headed Paris-Saclay until 2022. In her reelection campaign, she said she is against "massive change" and rejects the idea of returning to a federated structure.

"I am in favour of adjusting what we have already in order to build an integrated – not a centralized – structure, where we all decide on policy together, and award the same degrees at each level," she says.

The university's board of directors is divided on which is the best approach, and so far shows no signs of rallying behind a single candidate. It is possible that a future contest will include new contenders. Iacona is undecided about whether she will continue her reelection bid, but Bernard intends to stand again. "I can't identify any particular point in my programme that posed a problem," he says, adding that he needs "to think about that before deciding on any adjustments".

SCIENTISTS MOVE CLOSER TO ULTRA-PRECISE 'NUCLEAR' CLOCK

Timekeepers based on energy shifts in atomic nuclei could transform fundamental-physics research.

By Elizabeth Gibney

Physicists have taken a major leap towards making an entirely new type of clock – one based on tiny shifts in energy in an atomic nucleus. In principle, a nuclear clock would be even more precise than the world's current best timekeepers, known as optical clocks, and less sensitive to disturbances.

A nuclear timekeeper could also allow physicists to study fundamental forces of nature in new ways. "We will be able to probe scenarios of dark matter and of fundamental physics that are currently inaccessible to other methods," says Elina Fuchs, a theoretical physicist at CERN, Leibniz University Hannover, Germany.

The long-sought breakthrough – made by a collaboration between the Vienna University of Technology and Germany's national metrology institute, the PTB, in Braunschweig – involved using an ultraviolet laser to prompt a nucleus of the radioactive metal thorium-229 to switch between energy states. The frequency of light absorbed and emitted by the nucleus functions as the clock's tick. The researchers published their work on 29 April (J. Tiedau *et al. Phys. Rev. Lett.* **132**, 182501; 2024).

"This is major," says Adriana Pálffy-Buß, a theoretical physicist at the University of Würzburg in Germany. Driving the transition with a laser is "the milestone you need to say 'I'll be able to build a clock'." "It is a culmination of nearly a half a century of effort," says Olga Kocharovskaya, a physicist at Texas A&M University in College Station.

Precision timing

Optical clocks keep time so well that they waver by just 1 second every 30 billion years or so. Their ticks are governed by the frequency of the visible light needed to shift an electron orbiting an atom such as strontium between energy states.

But a nuclear clock could do even better. It would use the more energetic transition of boosting the nucleus's protons and neutrons to higher energy states. This would use slightly higher frequency radiation, meaning that time could be sliced even more finely to create a more precise clock. More importantly, such a clock would be much more stable than an optical clock, because particles in the nucleus are less sensitive than electrons to external fields or temperature.

But finding a material with a suitable nucleus has proved difficult. Energy transitions in most nuclei tend to be huge, requiring much more than the nudge of a tabletop laser. In the 1970s, physicists discovered that thorium-229 is an anomaly — its first energy state is extremely close to its lowest, ground state. And in 2003, physicists proposed using thorium-229 as the basis of a super-stable clock, but they needed to find the precise energy of the transition and its corresponding laser frequency, which would have been impossible to predict with any accuracy using theory. Since then, experimentalists have used range of methods to narrow down the figures.

To observe the transition, researchers placed radioactive thorium atoms into crystals of calcium fluoride that were a few millimetres wide. Scanning across the expected region with a purpose-built laser, they eventually hit on the right frequency — around 2 petahertz (10^{15} oscillations per second) — which they detected by spotting the photons emitted as the nuclei returned to the lower energy state. Co-author Thorsten Schumm, an atomic physicist at the Vienna University of Technology, recalls scrawling "found it" in large red letters across his lab book at a meeting convened the next day to discuss the promising-looking signal. "It was crystal clear," he says.

The team pinpointed the frequency with a resolution 800 times better that of the next best attempt. A team at the University of California, Los Angeles, has since reproduced the result using a different crystal, but the same frequency, says co-author Ekkehard Peik, a physicist at PTB. It's "a very nice confirmation", he says.

Fundamental physics boost

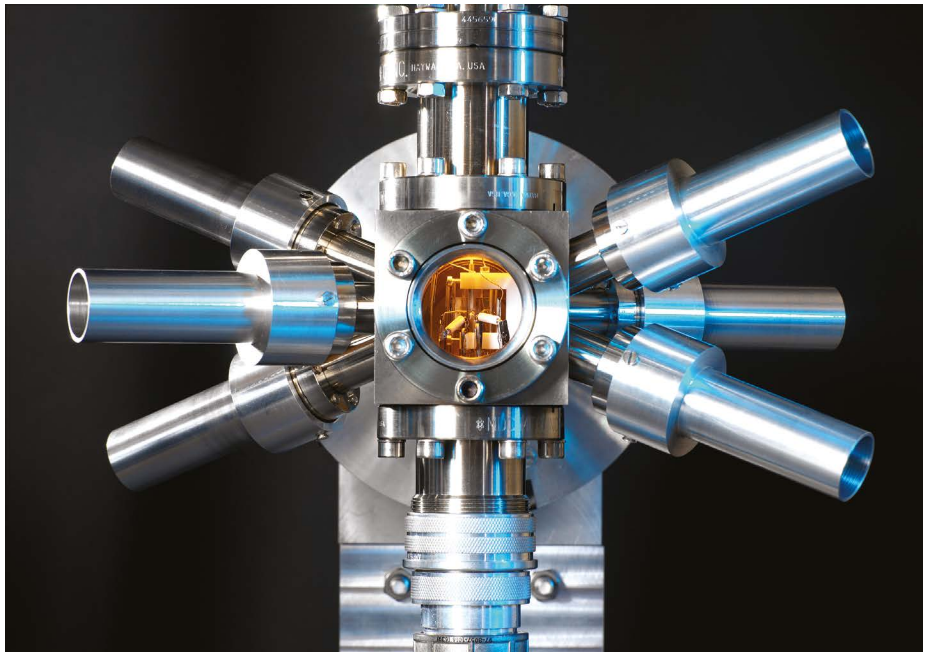
To turn the system into an actual clock, physicists will need to markedly reduce the resolution of the laser, so that it stimulates the nucleus at almost exactly the right frequency to be read off reliably, says Peik. Building such a laser "remains a big challenge, but there are little doubts that it will be achievable in the near future", adds Kocharovskaya.

If all goes well, the team says that a thorium-based nuclear clock could end up being around ten times more accurate than the best optical clocks. Hosting the nuclei in a solid crystal could also help to make the clock more compact and portable than optical systems.

Scientific methods that were made possible by super-precise optical clocks, such as probing Earth's gravitational field by measuring differences in clock speed, "could get a major boost", says Kocharovskaya.

Physics could also benefit at a deeper level. A nuclear clock would be around 10,000 times more sensitive to changes in fundamental constants — such as the strength of the electromagnetic and strong nuclear forces — than an optical clock is, says Fuchs. This means that they could detect proposed forms of dark matter, an invisible substance that physicists think accounts for 85% of material in the Universe, and which are predicted to make minuscule changes in the strength of these forces.

"It could be that there's very 'light' dark matter that wiggles around and that could make these fundamental constants wiggle," says Fuchs. Nuclear clocks might be able to detect that wiggle, she says, because the energy of their transition is governed by these forces, and any change in their strength would alter the clock's tick. Nuclear clocks could also detect whether some particle masses change over time, she adds. Fuchs and her collaborators are already working on their first paper, about the frequency measurement. "This is exciting us quite a lot," she says.



ANDREW BROOKES, NATL PHYSICAL LAB./SPL

Optical clocks (pictured) are currently physicists' most precise timekeepers.

BIRD FLU IN US COWS: WHERE WILL IT END?

Scientists worry that the H5N1 strain of avian influenza will become endemic in cattle.

By Sara Reardon

Concerns that pasteurized milk in the United States is teeming with H5N1 avian influenza virus are over. But there's no sign that the outbreak in cows is over, and scientists are increasingly concerned that cattle will become a permanent reservoir for this adaptable virus — giving it more chances to mutate and jump to humans.

New data show that the virus can hop back and forth between cows and birds, a trait that could allow it to spread across wide geographical regions (see go.nature.com/3qajc9p). Although the virus kills many types of mammal, most infected cows don't develop severe symptoms or die[1], meaning that no one knows