New Scientist

Physics

LHC finds intriguing new clues about our universe's antimatter mystery

Analysing the aftermath of particle collisions has revealed two new instances of "CP violation", a process that explains why our universe contains more matter than antimatter

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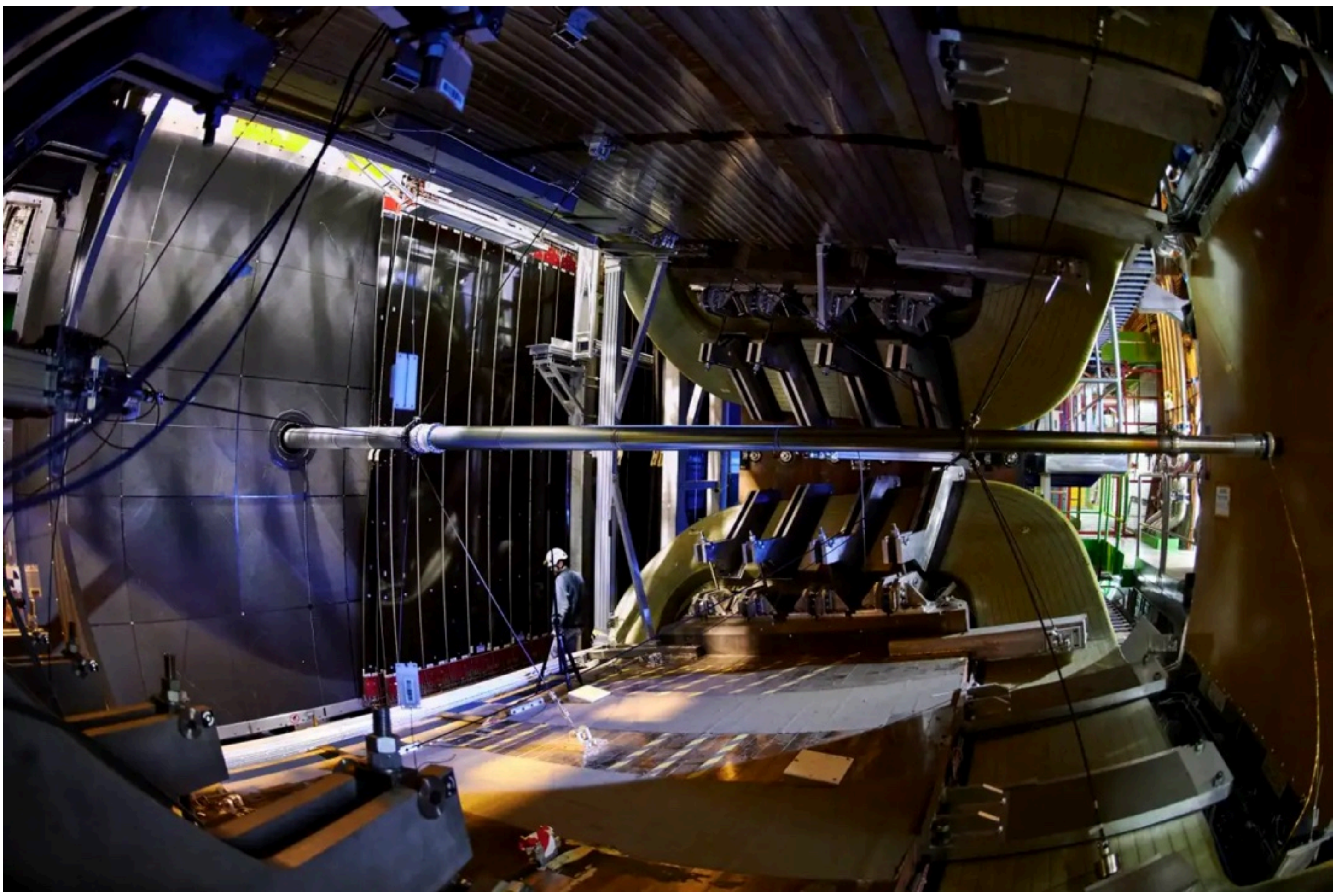


The LHCb detector at CERN
CERN

Were it not for a phenomenon called CP violation, we would probably not exist. A new analysis of particles smashing together at the Large Hadron Collider (LHC) is helping researchers better understand it.

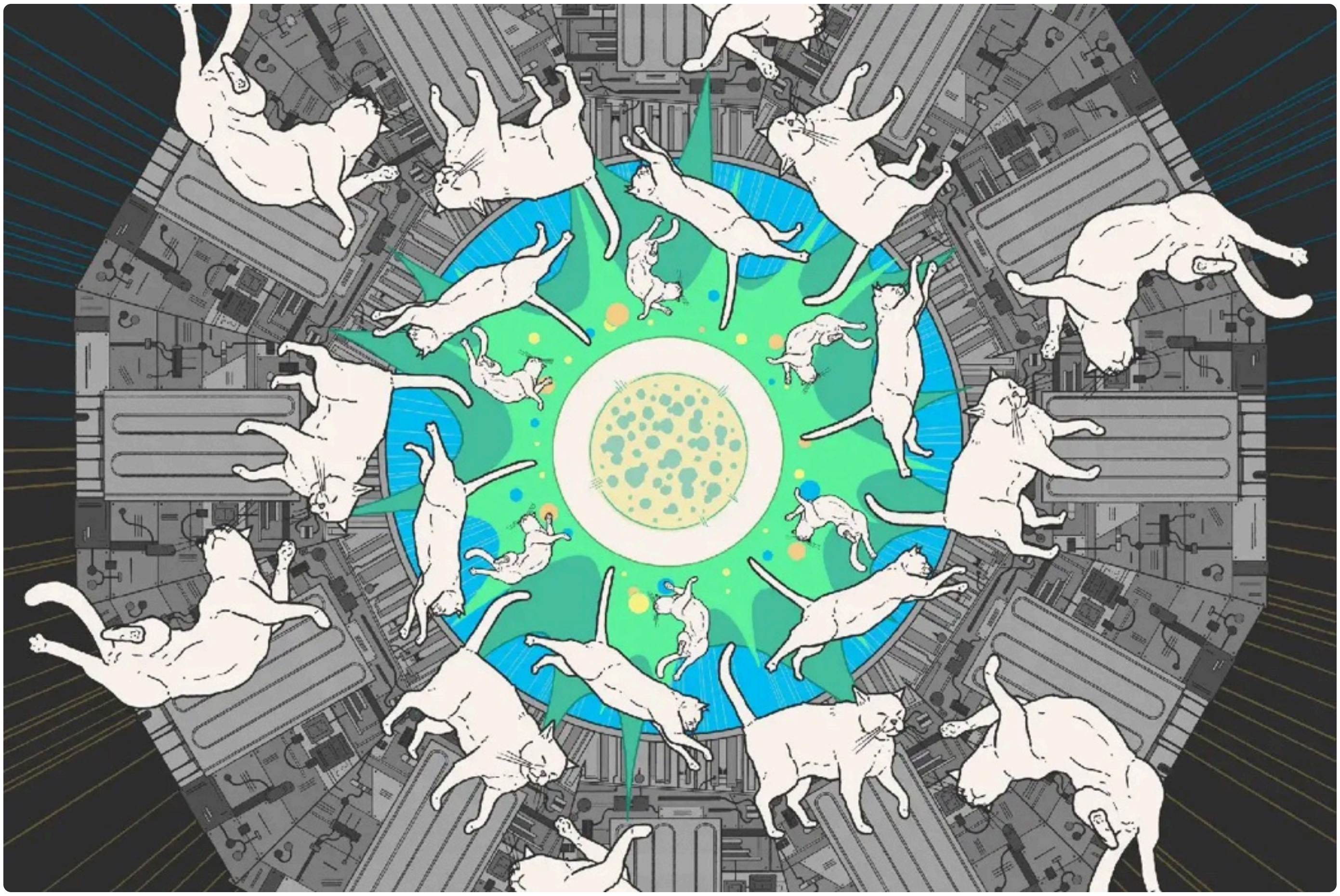
“In cosmological models, we think that there was the same amount of matter and antimatter at the beginning of the universe, and then it evolved into a matter-dominated universe. But how?” says Ozlem Ozcelik 🔗 https://www.linkedin.com/in/ozlem-ozcelik-57ba7841/?originalSubdomain=ch at CERN, the particle physics laboratory near Geneva, Switzerland, home of the LHC.

CP violation is the agreed upon answer to this question. It refers to processes, such as the decay of particles, that result in more matter than antimatter 🔗 /article/2240543-neutrinos-may-explain-why-we-dont-live-in-an-antimatter-universe/. This ensures matter dominates the universe, including that in our bodies, rather than having all been annihilated 🔗 /article/mg23931961-100-10-mysteries-of-the-universe-why-does-anything-exist-at-all/ in a scenario with exactly equal amounts of antimatter. But the details of such processes are unclear – which is where Ozcelik’s research comes in. With colleagues, she has uncovered two new examples of CP violation in the aftermath of energetic particle collisions.

The researchers analysed data on proton collisions collected by the LHCb detector 🔗 https://home.cern/science/experiments/lhcb – an experiment at CERN that focuses on CP violation. Each collision creates a variety of particles, including both matter and antimatter forms, some of which are so unstable that they instantly begin to decay. Ozcelik and her colleagues discovered that one unstable matter particle known as the “bottom lambda baryon” decayed at a different rate to its antimatter counterpart, revealing a CP violation.

In a second study, the team looked to LHC data to analyse the decay of a different particle called the “beauty meson” and its antimatter counterpart 🔗 /definition/antimatter/ – and identified another CP violation. Neither violation has been detected before.

Ozcelik says that the standard model of particle physics – our best description of the fundamental building blocks of nature – predicts many CP violations, including the newly detected ones, but they don’t add up to a large enough effect to explain just how much more matter than antimatter 🔗 /article/2444715-this-antimatter-version-of-an-atomic-nucleus-is-the-heaviest-yet/ our cosmos contains. That is why looking for new CP violations and precisely quantifying them is crucial for gathering hints of what may be missing from the standard model 🔗 /article/2441744-particle-physicists-may-have-solved-a-strange-mystery-about-the-muon/, she says.



A new kind of experiment at the LHC could unravel quantum reality

The Large Hadron Collider is testing entanglement in a whole new energy range, probing the meaning of quantum theory – and the possibility that an even stranger reality lies beneath

🔗 /article/mg26234881-800-a-new-kind-of-experiment-at-the-lhc-could-unravel-quantum-reality/

Robert Fleischer 🔗 https://theory.web.nikhef.nl/people/ at the Dutch National Institute for Subatomic Physics says that the decay processes the team focused on are important for refining theories of particle physics, especially in cases where making mathematical predictions is exceedingly difficult. "It's also experimentally really incredible that the team managed to reach this level of [precision] making measurements," he says. This makes him optimistic that not only will more instances of CP violation be discovered soon, but that some will be surprising and point towards new laws of physics 🔗 /article/2448286-hopes-for-new-physics-dashed-by-ordinary-looking-w-bosons-at-cern/.

In 2030, the LHC is scheduled to conduct another slew of experiments that will capture data on even more particles and Ozcelik and her team will use them to look for new CP violations.

Reference: *Physical Review Letters*, DOI: 10.1103/PhysRevLett.134.101801 🔗 https://doi.org/10.1103/PhysRevLett.134.101801 and DOI: 10.1103/PhysRevLett.134.101802 🔗 https://doi.org/10.1103/PhysRevLett.134.101802