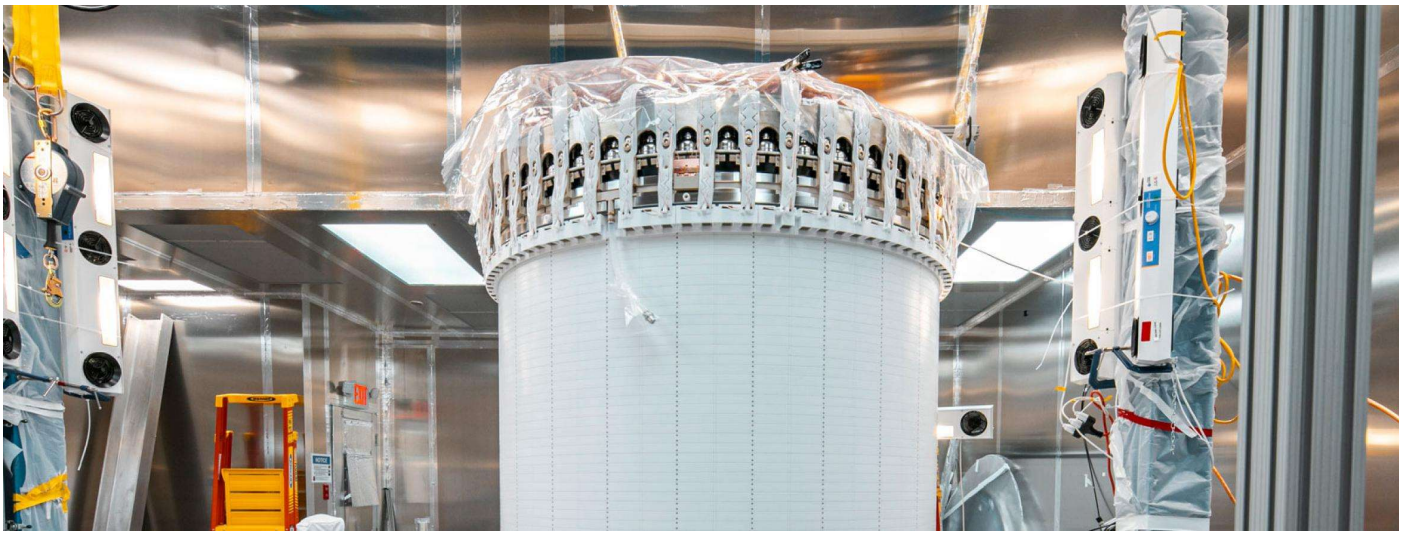


News

# Experiment sees surprising result in search for dark matter



## The LUX-ZEPLIN experiment observed a particle interaction that could be interpreted as a signal from WIMPs, a dark matter candidate — but researchers will need more data to confirm

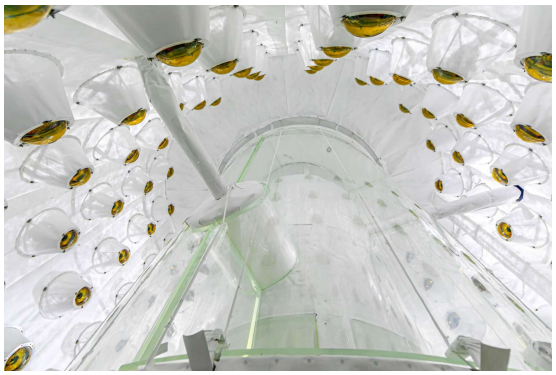
**9 September 2026**

For the better part of a century, researchers have been trying to understand dark matter. This invisible substance makes up roughly 85% of the mass in the universe but has never been directly detected.

Now, a new analysis from the **LUX-ZEPLIN** (LZ) dark matter experiment has recorded a single particle interaction that researchers have great difficulty explaining with known background signals from normal matter. The result does not yet meet the statistical threshold required to claim a discovery, but it is the most compelling hint of dark matter reported by the experiment to date.

"We expect dark matter interactions to be extremely rare, so it wouldn't take many to represent the first real detection of dark matter," said **Carmen Carmona,** associate professor of physics and leader of the LZ experiment group at Penn State. "That's why even a single event stands out to us. In fact, this particular signal came from a region of the dataset we hadn't previously examined, and it took our team months of additional work on understanding possible causes of backgrounds to rule out conventional explanations for it."

The results were recently presented in a scientific talk at the **2026 TeV Particle Astrophysics conference** in Japan.



*Looking up into the LZ outer detector, used to cancel out radioactivity that can mimic a dark matter signal. Credit: Matthew Kapust/Sanford Underground Research Laboratory.*

“We’re very intrigued to see this event in the data, in the region where we expect dark matter to show up and the competing backgrounds are very low,” said Rick Gaitskell, a professor at Brown University and the spokesperson for LZ. “With only one event, we don’t want to get ahead of ourselves. We are not claiming to have seen dark matter. But we have seen something interesting that we want to share with the scientific community for their input.”

LZ is an international collaboration of 250 scientists and engineers from **39 institutions.** The LZ detector is managed by the U.S. Department of Energy’s Lawrence Berkeley National Laboratory (Berkeley Lab) and operates nearly one mile below ground at the Sanford Underground Research Facility (SURF) in South Dakota. The experiment uses 10 tonnes — more than 22,000 pounds — of ultrapure liquid xenon to search for dark matter and is optimized to look for WIMPs, or weakly interacting massive particles. WIMPs are a hypothetical class of subatomic particles put forward to explain dark matter, which can pass through normal matter and light unseen.

LZ searches for dark matter by looking for signature flashes of light from energy deposited in the detector. The collaboration leverages multiple methods to prevent or account for particle interactions caused by normal matter. This includes the mile of rock that shields the detector from cosmic rays from space, a water tank and outer detectors that protect the central detector from background neutrons, and a suite of computational tools that disentangle particle interactions and reject dark matter mimics.

Researchers at Penn State have worked on the construction of the LZ detector, making key contributions to the cryogenics and liquid xenon systems, and have led several key analyses, including background modeling, detector calibrations, sensitivity projections, and statistical analyses of possible dark matter signals.

"It's genuinely thrilling to consider whether this might be an early glimpse of dark matter finally revealing itself," said **Luiz de Viveiros,** associate professor of physics at Penn State and member of the LZ experiment. "We're still racking our brains over whether some rare background process could account for it, but so far nothing has turned up. In my time on this and other experiments, I've never seen an outlier hold up this well under scrutiny. Normally, when you dig deeper, these things resolve into some kind of background. This one hasn't.”

The LZ collaboration studies experimental data in batches, explained Carmona, who also serves as the Norman & Trygve Freed Early Career Professor of Physics at Penn State. In the new result, researchers analyzed 220 live days of data collected between March 2023 and April 2024. The collaboration had previously searched this dataset for faint signals from the simplest kinds of WIMP interactions. The new analysis searched for a broader range of possible WIMP interactions that could deposit more energy in the detector. LZ is particularly sensitive to such signals while also minimizing false positives.

If the anomalous event was caused by dark matter, the WIMP that generated it would likely have a mass of at least 200 GeV/c2 (gigaelectronvolts), or more than 200 times the mass of a proton, according to the researchers. It would also suggest a specific type of interaction between WIMPs and ordinary matter beyond the simplest model.

The LZ results have not reached “5-sigma” significance, the statistical threshold considered a discovery in physics, Carmona explained. The new analysis is 2.6 sigma, meaning there is approximately a 0.5% chance that the event could be explained by known backgrounds.

With additional data, researchers can test whether the finding continues to grow in significance or fades away. LZ has already accumulated the world's largest dark matter dataset and will continue to accrue WIMP search data, substantially improving their search statistics, de Viveiros said.

Other Penn State researchers involved with the experiment are Jack Genovesi, postdoctoral researcher; Yen-Ting Chin, Katherine Wild, and Wei Zha, graduate students in Penn State’s Eberly College of Science Department of Physics.

LZ is supported by the U.S. Department of Energy, Office of Science, Office of High Energy and Nuclear Physics, and the National Energy Research Scientific Computing Center, a DOE Office of Science user facility. LZ is also supported by the Science & Technology Facilities Council of the United Kingdom; the Portuguese Foundation for Science and Technology; the Swiss National Science Foundation; the Australian Research Council Centre of Excellence for Dark Matter Particle Physics; and the Institute for Basic Science, Korea. **Thirty-nine institutions** of higher education and advanced research provided support to LZ. The LZ collaboration acknowledges the assistance of the Sanford Underground Research Facility.

*Editor's note: This story has been adapted from a news release by Lawrence Berkeley National Laboratory.*

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