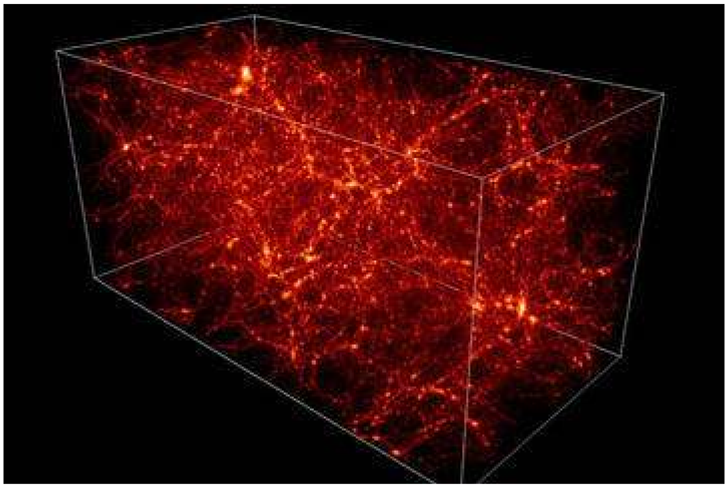
# New Study Throws Dark Matter Finding Into Question



The supposed distribution of dark matter throughout the Universe
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A new study of dark matter, the mysterious hidden stuff thought to pervade the universe, casts doubt on a previous finding that offered hope that dark matter had finally been seen.

In 2008, a European-Russian satellite called Payload for Antimatter Matter Exploration and Light nuclei Astrophysics (PAMELA) discovered a strange overabundance of particles called positrons, which are the antimatter counterpart to electrons. Matter and antimatter, which have the same mass but opposite charges, destroy one another when they meet.

According to theory, when a particle of dark matter collides with its antiparticle, they annihilate, unleashing a burst of energy and exotic particles. Dark matter is thought to make up 98 percent of all matter in the universe and 23 percent of its total mass and energy. Scientists have yet to directly detect invisible dark matter, but its existence is inferred based its gravitational pull on regular matter.

The positrons found by PAMELA were thought to be the products of dark matter annihilation with antimatter, and scientists were hopeful that the tantalizing discovery could prove the existence of the elusive dark matter.

But a new study has raised more questions about PAMELA's discovery. Researchers at the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) at Stanford University in California confirmed the overabundance of positrons, but when they did not see a sudden drop-off of this excess beyond a certain energy level, they knew something was wrong.

"If the antimatter we measure is coming from the annihilation of dark matter particles, then the positron excess should drop off fairly suddenly at an energy level that corresponds with the mass of the dark matter particle," study co-author Stefan Funk, an assistant professor of physics at Stanford University, said in a statement.

Rather, Funk and his colleague, Justin Vandenbroucke, found that the number of positrons continued to increase in line with the level of energy. [7 Surprising Things About the Universe]

"Some have concluded that this altogether rules out dark matter as a source of the antimatter we're measuring," Funk said. "At the very least this means that if the positrons are coming from dark matter annihilation, then dark matter particles must have a higher mass than allowed by the PAMELA measurement."

But the results are not necessarily a definitive strike against the finding, the researchers said.

"We're taking an observational point of view and simply reporting the data that we observe," Vandenbroucke said. "However, I know that articles are already appearing that say our result likely rules out the dark matter interpretation. Personally, I think that is too strong of an interpretation."


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Additional observations will be needed to settle the debate, the researchers said. One instrument in particular, the antimatter-hunting Alpha Magnetic Spectrometer (AMS), is expected to yield helpful results.

NASA's space shuttle Endeavour carried the AMS experiment to the International Space Station in May, where it was installed on the exterior of the complex. It has been operating ever since. This detector should be able to collect more precise data at higher energies, Vandenbroucke said.

"AMS has a very large magnet in its detector and so can naturally and very easily distinguish between electrons and positrons," Funk said. "That experiment will most likely be able to make a final statement on this. It's something we are all eagerly awaiting."

Funk and Vandenbroucke used NASA's Fermi Gamma-ray Space Telescope, which studies the highest energy forms of light. Since the telescope is designed to detect neutral light particles, called photons, it does not have a magnet to separate negatively charged electrons and positively charged positrons.

The researchers were forced to improvise, but luckily a natural magnet exists close to home: Earth. The planet's magnetic field naturally bends the paths of charged particles that almost continuously rain from space, they explained.

The scientists then studied geophysical maps of Earth and calculated how the planet filters out charged particles seen by the telescope, in a novel approach at the intersection of astrophysics and geophysics.

"The big takeaway here is how valuable it is to measure and understand the world around us in as many ways as possible," Vandenbroucke said. "Once you have this basic scientific knowledge, it's often surprising how that knowledge can be useful."

The researchers detailed their results in a paper submitted to the journal Physical Review Letters.