DARK MATTER AND A DEFINITE NON-DEFINITE

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The Alpha Magnetic Spectrometer experiment is a particle detector which was lofted to the International Space Station onboard the Space Shuttle Endeavour about two years ago. | Image courtesy of NASA.

Charles Rousseaux
Senior Writer, Office of Science

When is a definite non-definite worth noting? Perhaps when there's something that's definitely -- or at least almost certainly -- there.

That’s definitely true for dark matter. It’s responsible for much of the gravitational glue that holds galaxies and great galaxy clusters together, whose fast-moving stars would otherwise be flung far apart. In fact, there is thought to be five times more dark matter than any of the regular stuff we can see -- the stars and planets and people -- and, based on the most recent results of the Planck mission, dark matter makes up almost 27 percent of the entire mass-energy in the universe.

However, even though scientists have been confident that dark matter exists for more than eighty years, they’re still struggling to understand what it’s actually made of and why there seems to be so much of it. They suspect it consists of WIMPs, Weakly Interacting Massive Particles, but they can’t see it, since dark matter is, well, dark. As a consequence, scientists can only measure it in indirect ways, such as through the effects of its gravity or the truly-tough-to-track-traces of possible collisions.

The latter is where the definite non-definite detection comes in. Recent results from the Alpha Magnetic Spectrometer (AMS) pointed to the detection of something that could be dark matter. The AMS experiment is a particle detector which was lofted to the International Space Station onboard the Space Shuttle Endeavour about two years ago.

Since it was installed, the AMS experiment, which is supported by the Energy Department, NASA and CERN, plus more than 50 institutions from 16 countries around the world, has been capturing cosmic rays, the broken-up bits of atoms that fly across the universe at near light speed, driven by star explosions (supernovae) and other natural but incredibly powerful particle accelerators.

According to current theories, WIMP collisions could produce cosmic rays, especially cosmic rays composed of positrons, the positively-charged antimatter partners of electrons. However, positrons can also be produced from other sources such as pulsars, rapidly-rotating stars with incredibly powerful magnetic fields. So, if WIMPs are out there, their collisions could show up as a slight excess of positrons against those produced by other sources.

That’s what the AMS experiment was designed to do -- to capture and count cosmic rays and then to tease out any potential positron signals of dark matter. And that’s what researchers discovered a hint of, in findings announced at NASA Headquarters.

Specifically, researchers found an excess of cosmic rays, especially positrons. And the positrons that the AMS detected fell in the energy range of most models of colliding WIMPs. However, the findings went no further than those wispy, potential signals of dark matter. It was a definite non-definite detection, nothing further.

But there’s ample time for searching, since the AMS experiment could last another twenty years, and there will always be new mysteries to explore. That’s the service of the Office of Science, exploring the cosmos and capturing new insights. And that’s a definite that’s definitely worth noting.

http://energy.gov/articles/dark-matter-and-definite-non-definite