

## 'Dark matter' doubters not silenced yet

by Bend\_Weekly\_News\_Sources

Astro-nomers have believed for decades that most of the matter in the cosmos is unseen. It betrays itself only through its gravitational pull on visible objects, whose movements are often hard to explain without this "dark matter." And the past year has seen increasingly bold claims that astromers have "proved" the stuff's existence. Despite that, there's a core of doubters who aren't going away. Many of them are sticking by an alternative theory that holds that tweaking our understanding of gravity could explain things better than invoking some unseen substance unlike any we know. This Hubble Space Telescope-composite image shows a ghostly "ring" of presumed dark matter in the galaxy cluster Cl 0024 17. It was called one of the strongest pieces of evidence to date for the existence of dark matter, an unknown substance that pervades the universe. (Credits: NASA, ESA, M.J. Jee and H. Ford [JHU])

One such modified-gravity theory has been "remarkably resilient," wrote astronomer Stacy McGaugh of the University of Maryland in College Park, Md. in the Aug. 3 issue of the research journal *Science*. That theory, known as Modified Newtonian Dynamics or MOND, was proposed in 1983 by the Israeli physicist Mordehai Milgrom. Astronomers have suspected dark matter's existence since the 1930s, when the Dutch astronomer Jan Oort found that galaxies did not contain nearly enough visible mass for their own gravitational force to hold them together. Oort suggested there must be more, unseen matter. Researchers still haven't been able to find it. But several cosmological theories suggest particles that could form it. And evidence for it has been mounting, according to many astronomers. A year ago, researchers claimed that "proof" of dark matter could be found in a stupendous crash between two galaxy clusters. The event had wrenched apart "dark" and "normal" matter which normally hang around close together "letting astronomers detect each separately. The dark matter was again detectable through its gravity, they said, which subtly alters the paths of light rays from galaxies in the background. Other similar findings appeared more recently, in the June 1 issue of *The Astrophysical Journal*. This time researchers using NASA's Hubble Space Telescope said they found a huge, ghostly "ring" of dark matter in a galaxy cluster called Cl 0024 17, five billion light-years from Earth, again thanks to a collision. NASA billed the finding as some of "the strongest evidence yet" for dark matter. Yet problems keep cropping up, McGaugh wrote. A study in the May 10 issue of *Science* found that the bizarre gravitational effects attributed to dark matter were showing up even where they weren't expected to under dark matter theory itself. Modified-gravity theory "according to which gravity is stronger on intergalactic scales than the standard laws of gravity suggested" explained the puzzle neatly, he wrote. The *Science* study, by Frédéric Bournaud, of the AIM Laboratory in Gif-sur-Yvette, France, and colleagues, examined a "dwarf galaxy" that had formed from a larger galaxy's ejected debris in a crash. Computer simulations had found that only normal matter should be ejected in these collisions; yet in conflict with this, the dwarf galaxy seemed to contain the same proportions of dark matter seen elsewhere.

This suggests the "dark matter" there-in is just some hidden form of ordinary atoms, researchers said "not the familiar, exotic substance that astronomers traditionally postulate most dark matter is, based on several alternative theoretical considerations. Conventional models hold that of the 27 percent of the universe that consists of matter, more than 98 percent is unseen; about five-sixths of that in turn is non-baryonic, meaning not ordinary atoms. Bournaud proposed the stuff in the dwarf galaxy is just hard-to-see hydrogen. The findings may "pose an existential crisis for non-baryonic," or exotic, dark matter, McGaugh wrote. On the other hand, awkwardly for MOND, certain galaxy clusters still seem not to have enough mass even after that theory is

applied. So “MOND appears to require dark matter itself” a considerable embarrassment for a theory that seeks to supplant the need for invisible mass,” McGaugh wrote. MOND research continues, though it’s less popular than dark matter studies. Arxiv.org, an online repository of physics papers, lists 12 papers with MOND in the title for this year to date, four of which are accepted for publication in scientific journals. By comparison there are 39 papers with “dark matter” in the title. Future experiments could find dark matter in the laboratory, if it exists: physicists believe the Large Hadron Collider, a particle accelerator to be built near Geneva, might do so. “Regardless of how these experiments play out, there is clearly a great deal of fundamental physics left for us to learn,” McGaugh wrote.

Courtesy World Science staff

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