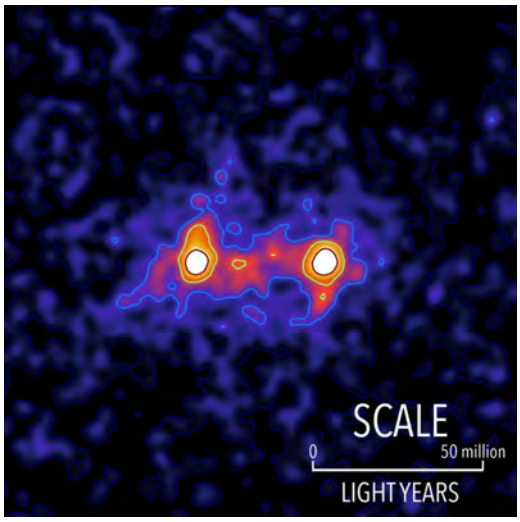
First-ever image of dark matter?

Scientists say this image, which combines images from more than 23,000 galaxy pairs, confirms Dark Matter's existence. Will other astronomers agree?



Dark matter filaments bridge the space between galaxies in this false-color map. The locations of bright galaxies are shown by the white regions and the presence of a dark matter filament bridging the galaxies is shown in red.

Researchers at the University of Waterloo in Waterloo, Ontario say they've captured the first composite image of something that – although astronomers have talked about it for decades – has been hitherto unseen, and in fact undetected. They say it's an image of Dark Matter, a connection point in the great cosmic web in which our universe's billions of galaxies are thought to be embedded. The Royal Astronomical Society, which published the new work in its peer-reviewed Monthly Notices, said in an April 12, 2017 statement:

The composite image, which combines a number of individual images, confirms predictions that galaxies across the universe are tied together through a cosmic web connected by Dark Matter that has until now remained unobservable.

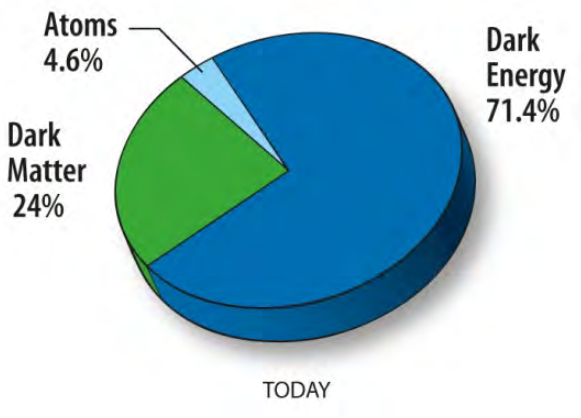
If this research is accepted – and replicated – by other astronomers, then it flies in the face of other astronomers' suggestions that perhaps Dark Matter doesn't exist, or doesn't exist in the way we think it exists, after all.

Why do astronomers think Dark Matter exists? After all no one has ever before claimed to have observed it directly, much less captured its image. Dark Matter holds an honoured place in astronomical theory because it is an integral part of the standard Big Bang cosmology – a widely accepted model of how our universe works and a model that agrees well with what astronomers believe they see, when they look out into deep space.

Some astronomers think we don't understand Dark Matter, or think it doesn't exist at all. For example, in 2016, physicist **Erik Verlinde** at University of Amsterdam released the latest installment of his new theory of gravity (see below), in which he said he doesn't need Dark Matter to explain the motions of stars in galaxies. Not long afterwards, a team led by astronomer **Margot Brouwer** of Leiden Observatory in The Netherlands tested Verlinde's theory by examining the lensing effect of gravity around more than 33,000 galaxies. **Her team concluded that Verlinde's theory "agrees well" with the observations.**

That sort of one-two punch is often seen in astronomy. A theory suggests something, and observations bear it out (or not). Of course, theories and observations can always be flawed and imperfect. What else could they be? **Scientists would have to be gods to comprehend the workings of the universe perfectly each time.**

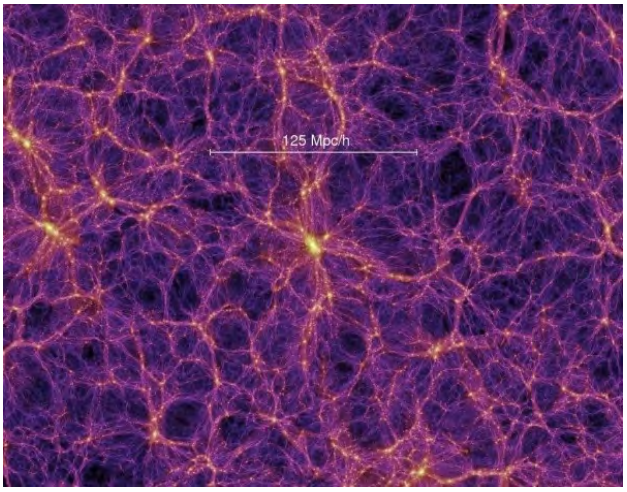
And so, what you're likely to see in the weeks and months and years ahead, are other astronomers either agreeing or disagreeing that this image represents what researchers at the University of Waterloo say it represents.



According to the most accepted theories of the universe, dark energy is thought to contribute 73 percent of all the mass and energy in the universe. Another 23 percent is Dark Matter, which leaves only 4 percent of the universe composed of regular matter, such as stars, planets and people. Pie chart via NASA.

In the meantime, know that – according to the most popular models of the universe – Dark Matter comprises about a quarter of the "stuff" of our universe. This mysterious substance doesn't shine, absorb or reflect light, although its effects are thought to be recognizable via the workings of gravity. According to these theories, dark matter is integral in creating what astronomers call the cosmic web, the basic structure of our universe. This great web, in fact, is thought to consist of a network of filaments of dark matter. **Mike Hudson**, the University of Waterloo astronomy professor who led this research said of his team's work:

For decades, researchers have been predicting the existence of dark-matter filaments between galaxies that act like a web-like superstructure connecting galaxies together. This image moves us beyond predictions to something we can see and measure.

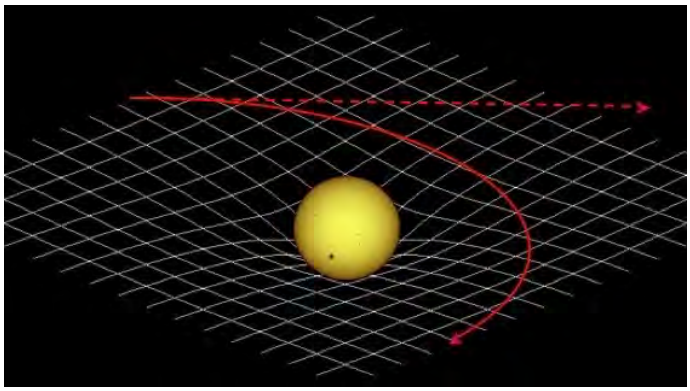


This often-seen image is an artist's illustration of a honeycomb-like structure, sometimes called the "cosmic web." The bright areas are galaxy clusters and groups, with sparsely populated regions devoid of galaxies in between.

How did the University of Waterloo astronomers obtain their image of Dark Matter? Hudson and co-author **Seth Epps**, a master's student at the University of Waterloo at the time, used a technique called weak gravitational lensing, an effect that causes the images of distant galaxies to warp slightly under the influence of an unseen mass such as a planet, a black hole, or in this case – these scientists say – Dark Matter. They combined lensing images from more than 23,000 galaxy pairs located 4.5 billion light-years away to create this composite image. Their results suggest the dark matter filament bridge is strongest between systems less than 40 million light years apart.

Can we still visualise our Universe without Dark Matter? Theoretical physicist Erik Verlinde has a new theory of gravity, which describes gravity not a force but as an illusion. The theory says gravity is an emergent phenomenon, possible to be derived from the microscopic building blocks that make up our universe's entire existence. This week he published the latest installment of his theory, showing that – if he's correct – there's no need for Dark Matter to describe the motions of stars in galaxies. According to a statement released in November 8, 2016:

… gravity is not a fundamental force of nature, but an emergent phenomenon. In the same way that temperature arises from the movement of microscopic particles, gravity emerges from the changes of fundamental bits of information, stored in the very structure of spacetime. Dark Matter came to be necessary when astronomers found they couldn't explain why stars in galaxies moved as they did. The outer parts of galaxies, including our own Milky Way, rotate much faster around their centers than they should, according to the theories of gravity as explained by Isaac Newton and Albert Einstein. According to these very accepted theories, there must be more mass in galaxies than what we can see, and they've been speaking of Dark Matter, and trying to understand it, ever since.



If Verlinde's theory of gravity is true, it's a revolution in science, since essentially all of modern cosmology – including the Big Bang theory – is based on Einstein's theory of curved space gravity. It doesn't mean Einstein's theory is wrong, but just as Einstein's theory was a refinement in our traditional way of thinking about gravity, Verlinde's theory, if correct, would be a refinement of Einstein's ideas and a chance to have a deeper understanding of the way our universe works. Verlinde commented in his statement:

Many theoretical physicists like me are working on a revision of the [accepted modern theories of gravity], and some major advancements have been made. We might be standing on the brink of a new scientific revolution that will radically change our views on the very nature of space, time and gravity.

AK, with EarthSky and Wikipedia Notes