

Measurement of Universe's expansion rate creates cosmological puzzle

Discrepancy between observations could point to new physics.

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X-ray: NASA/CXC/SAO; Optical: Detlef Hartmann; Infrared: NASA/JPL-Caltech

Data from galaxies such as M101, seen here, allow scientists to gauge the speed at which the universe is expanding.

The most precise measurement ever made of the current rate of expansion of the Universe has produced a value that appears incompatible with measurements of radiation left over from the Big Bang¹. If the findings are confirmed by independent techniques, the laws of cosmology might have to be rewritten.

This might even mean that dark energy — the unknown force that is thought to be responsible for the observed acceleration of the expansion of the Universe — has increased in strength since the dawn of time.

"I think that there is something in the standard cosmological model that we don't understand," says astrophysicist Adam Riess, a physicist at Johns Hopkins University in Baltimore, Maryland, who [co-discovered dark energy in](#)



1998 and led the latest study.

Kevork Abazajian, a cosmologist at the University of California, Irvine, who was not involved in the study, says that the results have the potential of “becoming transformational in cosmology”.

Dark matter may feel a “dark force” that the rest of the Universe does not

Uncertainty limits

In the accepted model of cosmology, the Universe evolves mostly through the competing action of dark matter and dark energy. Dark matter’s gravity tends to slow cosmic expansion, while dark energy pushes in the opposite direction and makes it accelerate. Earlier observations made by Riess and others suggest that dark energy’s strength has been constant throughout the history of the Universe.

Much of what scientists know about the relative contributions of dark matter and dark energy comes from the relic radiation left behind from the Big Bang, called the cosmic microwave background. The most exhaustive study of it — essentially a [portrait of the young Universe](#) at about 400,000 years of age — was done in recent years by the European Space Agency’s [Planck observatory](#). Based on Planck’s measurements, cosmologists can predict how that young Universe will evolve, including how fast it expands at any point in its history.

For years, those predictions have disagreed with direct measurements of the current rate of cosmic expansion — also known as the Hubble constant. But until now the error margins in this constant were large enough that the disagreement could be ignored.



'Half-pipe' telescope will probe dark energy in teen Universe

The Hubble constant is calculated by observing how rapidly galaxies in the relatively nearby Universe move away from the Milky Way, using stars of known intrinsic brightness called '[standard candles](#)'.

For their latest paper, Riess's team studied two types of standard candles in 18 galaxies using hundreds of hours of observing time on the Hubble Space Telescope. “We’ve been going gangbusters with this,” says Riess.

Their paper¹, which has been submitted to a journal and posted on the arXiv online repository on 6 April, reports that they measured the constant with an uncertainty of 2.4%, down from a previous best result² of 3.3%. They find the speed of expansion to be about 8% faster than that predicted based on Planck data, says Riess.



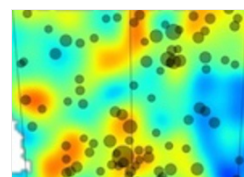
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Dark matter mystery

If both the new measurement of the Hubble constant and the earlier measurements by the Planck team are accurate, then something in the standard model has to change, Riess says. One possibility is that the elementary particles that constitute dark matter have properties that are different than currently thought, which would affect the evolution of the early Universe. Another option is that dark energy is not constant but has become stronger in recent eons.

Planck researcher François Bouchet of the Institute of Astrophysics in Paris says he doubts that the problem is in his team’s measurement, but that the new findings are “exciting” regardless of what the solution turns out to be.

Another possibility is that standard candles themselves that are not reliable when it comes to precision measurements, says Wendy Freedman, an astronomer at the University of Chicago in Illinois who in 2001 led the first precision measurement of the Hubble constant³. She and her team are working on an alternative method based on a different class of stars.



Dark matter mapped at cosmic scale

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