NBC NEWS MACH

The universe may be a billion years younger than we thought. Scientists are scrambling to figure out why.

New research suggests that the Big Bang that birthed the cosmos occurred 12.5 billion years ago.

The Large Magellanic Cloud, a satellite galaxy of the Milky Way, is nearly 200,000 light-years from Earth.
ESA / Hubble / Josh Lake / via AFP - Getty Images

By Corey S. Powell *- May 18, 2019*

We've all lost track of time at one point or another, but astronomers really go all in. Recent studies show they may have overestimated the age of the universe by more than a billion years — a surprising realization that is forcing them to rethink key parts of the scientific story of how we got from the Big Bang to today.

The lost time is especially vexing because, in a universe full of mysteries, its age has been viewed as one of the few near-certainties. By 2013, the European Planck space telescope's detailed measurements of cosmic radiation seemed to have yielded the final answer: 13.8 billion years old. All

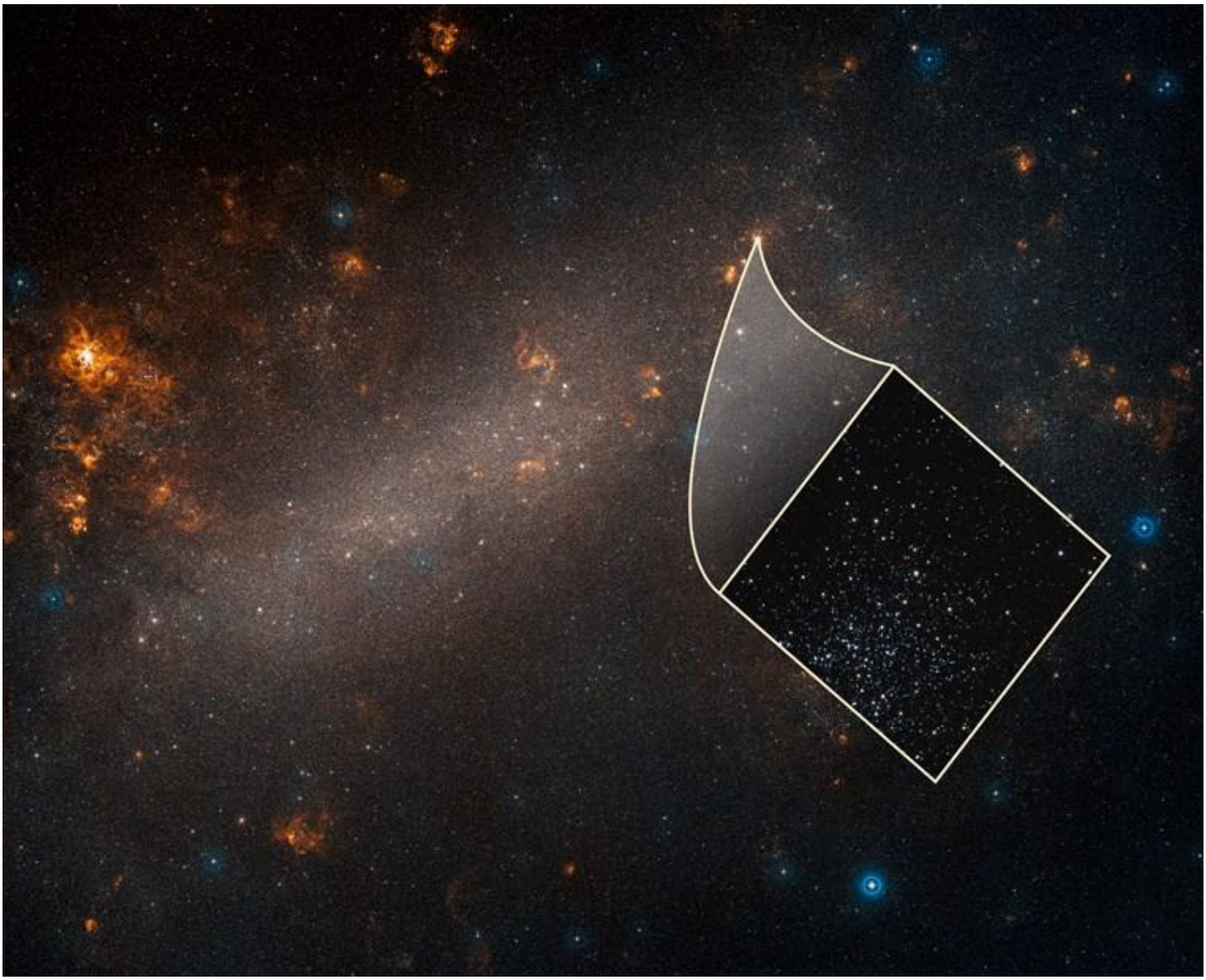
that was left to do was to verify that number using independent observations of bright stars in other galaxies.

Then came an unexpected turn of events.

A few teams, including one led by Nobel laureate Adam Riess of the Space Telescope Science Institute in Baltimore, set out to make those observations. Instead of confirming Planck's measurements, they started getting a distinctly different result.

"It was getting to the point where we say, 'Wait a second, we're not passing this test — we're failing the test!'" says Riess, co-author of a new paper about the research to be published in Astrophysical Journal.

He estimates that his results, taken at face value, indicate a universe that is only 12.5 billion to 13 billion years old.



Studies of star clusters in a neighboring galaxy (inset) add to the evidence that the universe is younger and faster-expanding than expected.

Space Telescope Science Institute Office of Public Outreach / NASA, ESA, A. Reiss (STScI/JHU)

At first, the common assumption was that Riess and the other galaxy-watchers had made a mistake. But as their observations continued to come in, the results didn't budge. Reanalysis of the Planck data didn't show any problems, either.

If all the numbers are correct, then the problem must run deeper. It must lie in our interpretation of those numbers — that is, in our fundamental models of how the universe works. "The discrepancy suggests that there's something in the cosmological model that we're not understanding right," Riess says. What that something could be, nobody knows.

Discovery of the dawn of time

The current discrepancy traces its origin way back to 1929, when astronomer Edwin Hubble discovered that galaxies are fleeing from Earth in all directions. More shocking, Hubble found that the farther away the galaxies are, the faster they're moving apart. That pattern means they're all fleeing from each other as well. "The only way all of this can be true is if space is expanding," Riess says.

If the idea of an expanding universe seems bizarre to you, welcome to the club.

"It's still bizarre to me, too," Riess says. "But that's what all of the data show, and that's what our theory predicts." Even Hubble never fully accepted the implications of his own work.

An expanding universe implies that the universe has a definite age, because you can retrace the action back to a time when everything in the cosmos was crammed together in an extremely dense, hot state: what we call the Big Bang.

"This is another hard concept for people to get their heads around," University of Chicago cosmologist Wendy Freedman said, adding that the Big Bang didn't go off like a kind of bomb. "The Big Bang is an explosion of space, not into space," she said.

In other words, galaxies are not flying away from each other through space. Space itself is stretching between them, and it has been ever since the Big Bang. So it's meaningless to ask where the Big Bang occurred. It occurred everywhere. As Freedman puts it, "There is no center or edge to the explosion."

But in the expanding universe, there is a beginning of time — at least, time as we know it. By measuring the rate at which galaxies are moving apart, astronomers realized, they could figure out the moment when the cosmos blinked into existence. All they had to do is figure out how to get their galactic measurements exactly right.

Clocking the cosmos

Freedman has been working on that problem for more than three decades, far longer than she ever expected. "This is an incredible challenge," she says. "Imagine making measurements out to hundreds of millions of light years to 1-percent accuracy!"

Hubble himself flubbed the test. His original calculations implied a universe younger than Earth, because he had drastically underestimated the distances to other galaxies.

The difficulty of making direct observations of other galaxies is one of the reasons why scientists created the Planck space telescope. It was designed to detect radiation left over from the Big Bang. The pattern of that radiation indicates the exact physical state of the early universe, if you know how

to decode it. In principle, then, the Planck readings should tell us everything we want to know about what the universe is made of, and how old it is.

Planck has been a resounding success, pinning hard numbers onto the soft riddles of the cosmos. It indicated that 26 percent of the universe consists of dark matter, invisible material that helps hold galaxies together. It also confirmed the surprise discovery that the universe is dominated by dark energy, an unknown force that permeates all of empty space. (The detection of dark energy is what earned Riess a shared 2011 Nobel Prize.)

The likely implication of these findings is that the universe will keep expanding forever, faster and faster, into an ever-deeper darkness. It's an uncomfortable thought, one that Riess would rather not dwell on: "The scale of time is so beyond that of humanity, I don't think of it in human terms."

Most satisfying, perhaps, Planck finally completed the job that Hubble began, determining how quickly the universe is expanding and how long it has been around. Or so it seemed.

Something big is missing

Fortunately, Freedman and Riess and their colleagues didn't give up on their alternate approach to determining the age of the universe. They kept improving their observations, and are now getting close to that ambitious target of 1 percent accuracy. Which brings us to the current dispute — what the scientists politely refer to as "the tension."

The latest galaxy studies indicate an expansion rate about 9 percent faster than the answer from Planck. That might not sound like much of a disagreement, but over cosmic history it adds up to that full billion years of lost time.

Given the stakes, everyone involved is checking and rechecking their results for possible sources of error. Increasingly, though, it looks like the problem lies not with the observations but with the theories of cosmology that underpin them. If those theories are wrong or incomplete, the interpretation of the Planck readings will be flawed, too.

"There's currently no consistent story that works for all our cosmological data," says Princeton University astrophysicist Jo Dunkley, who has extensively analyzed the Planck results. "That means there is fascinating work to be done, to see if there is something out there that can explain all of it."

The "tension" reminds scientists of just how much they still don't understand about the underlying laws of nature. Dunkley points to the ghostly particles known as neutrinos, which are extremely abundant throughout space. "We measure neutrinos in the lab and put them in our cosmological model assuming that they are behaving just as we expect them to, but we simply don't know if that's true," she says. "I wouldn't find it surprising if dark matter turned out to be more complicated than we think, too."

Then there's the enigma of dark energy. "We have no good ideas for what it is. Perhaps there are also elements completely missing from the model side, still to be discovered," Freedman says. Theorists have no shortage of ideas: new types of dark energy, new fields, new particles.

Figuring out which explanation is correct — if any — will require another vast improvement in how we measure what the universe is actually doing. Freedman isn't coy about the magnitude of our ignorance: "The question is, what do we have yet to learn? I'd love to come back in a hundred or a thousand years and find out!"