Why Einstein was wrong about being wrong

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If you want to get your mind around the research that won three astronomers the Nobel Prize in physics last week, it helps to think of the universe as a lump of dough - raisin-bread dough, to be precise - mixed, kneaded and ready to rise. Hold that thought.

Now consider Albert Einstein - not the wild-haired, elderly, absent-minded professor he became in his later years but a young, dashing scientist in his 30s. It's 1916, and he's just published his revolutionary general theory of relativity. It's not necessary to understand the theory (thank goodness). You just have to accept that it gave scientists the mathematical tools they needed to forge a better understanding of the cosmos than they'd ever had.

There was just one problem. Relativity told physicists that the universe was restless. It couldn't just sit there. It either had to be expanding or contracting. But astronomers looked, and as far as they could tell, it was doing neither. The lump of dough wasn't rising, and it wasn't shrinking.

The only way that was possible, Einstein realized, was if some mysterious force was propping up the universe, a sort of antigravity that pushed outward just hard enough to balance the gravity that was trying to pull it inward. Einstein hated this idea. An extra force meant he had to tinker with the equations of general relativity, but the equations seemed so perfect just as they were. Changing them in any way would tarnish their mathematical beauty.

Einstein did it anyway. The universe ought to behave according to the laws he had set out, but it simply wasn't cooperating. The "cosmological constant" - his name for the new antigravity force - became part of the theory.

Then, a decade or so later, the great astronomer Edwin Hubble went up to the Mount Wilson Observatory above Pasadena and used the world's most powerful telescope to peer deeper into the universe than anyone had before. Making excruciatingly careful measurements of the galaxies he could see beyond the Milky Way, Hubble was astonished to learn that they weren't stationary at all. The galaxies - the raisins in the bread dough - were in motion, each moving apart from the other. The dough was rising in all directions, and the raisins were going along for the ride.

This discovery ultimately lead to the Big Bang theory, which says that the cosmos was once tiny, with all matter packed tightly together, and that it's been expanding every since. When Hubble first announced his results, however, Einstein was more concerned with its consequences for general relativity. If the universe was expanding, the cosmological constant wasn't needed. His beautiful equations had been right to begin with. In 1931, Einstein came to Mount Wilson to shake Hubble's hand and thank him for saving relativity from the cosmological constant, whose invention Einstein denounced as "the greatest blunder of my life."

But this year's Nobel suggests that it was Einstein's statement, not the cosmological constant, that may have been the true blunder. Once astronomers accepted that the universe was expanding, they began to wonder if it would expand at the same rate forever. Or maybe, if there was enough gravity from all of those billions of galaxies pulling on each other, it would slow down, and or even slow to a stop someday and fall back on itself.

In the mid-1990s two independent teams of astronomers, one based at the Lawrence Berkeley National Laboratory and the other at observatories in Baltimore and Australia, decided to find out. Armed with telescopes far more powerful than anything available in Hubble's day, they began using supernovas - titanic explosions in which a single dying star briefly outshines an entire galaxy - as markers to measure the expansion speed at different times in the history of the universe. They could do it because telescopes are really time machines. The light from a distant supernova has taken so long to get here that when we finally see it, we're seeing a snapshot from billions of years in the past. If the supernova is relatively nearby, the snapshot is relatively recent.

By measuring the speed and distance of many different supernovas, from many different eras, you can see whether anything has changed over the billions of years of cosmic history. And when the astronomers looked, things had changed, but in a way nobody expected. The expansion of the universe wasn't slowing down. It was speeding up. The dough was, and still is, rising faster now than it was in the beginning. A baker would be astonished by this bizarre behavior. So were the astronomers. The only explanation that made sense: Einstein's "greatest blunder" was actually one of his greatest predictions. There really is a mysterious antigravity force. Einstein's only mistake was in rejecting it.

The 1998 discovery of the accelerating universe earned the Lawrence Berkeley Lab's Saul Perlmutter half of this year's Nobel. His competition - Brian Schmidt of the Australian National University and Adam Riess of the Space Telescope Science Institute, split the other half.

Only two questions remain. First, why did it take the Nobel committee so long to recognize such an important discovery? The answer is that they wanted to be really, really sure it was true.

The other question: What is this antigravity force, anyway? Theoretical physicists call it dark energy, but do they have ideas about what it actually is, how it works? Plenty, but are they convincing? "Well, no," Riess said in a telephone interview last week. "They really aren't."

Another Nobel awaits whoever figures that one out.

More information: Michael D. Lemonick is a senior writer for the nonprofit journalism organization Climate Central and is a contributor to Time, where he was a senior writer for 21 years. He wrote this for the Los Angeles Times.