

NINE PERCENT

On the Distance Between Measuring and Asserting

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There is a number that describes how fast the universe is expanding. It is called the Hubble constant, it is among the most consequential quantities in physics, and at present we do not know what it is.

Not in the sense that nobody has measured it. In the sense that it has been measured twice, extraordinarily carefully, by two independent methods, and the two answers do not agree.

The Two Numbers

The first method reads the oldest light there is. The Planck satellite mapped the cosmic microwave background — the faint thermal residue of the early universe — and fit a physical model to the pattern of temperature fluctuations in it. Out of that fit comes an expansion rate: about 67 kilometers per second per megaparsec.

The second method climbs a ladder. Pulsating stars called Cepheids have a fixed relationship between how fast they pulse and how bright they truly are, which makes them measuring sticks: compare true brightness to apparent brightness and you have a distance. Cepheids calibrate Type Ia supernovae, which are visible much further out, and the chain extends across the observable universe. Adam Riess and the SH0ES team have spent years refining it. Their answer is about 73.

Those are not the same number. The gap is roughly nine percent, and both sides carry error bars far too small to absorb it.

The obvious explanation was that somebody's instrument was lying. That is what everyone expected, and it is the mundane way these things usually end. So the James Webb Space Telescope was pointed at the same galaxies and the same Cepheids that Hubble had observed, with a larger mirror and sharper infrared resolution, specifically to find the error.

It found no error. The ladder measurements held.

What They Did Next

Here is the part I actually want to talk about, and it has nothing to do with astronomy.

They published the disagreement. They gave it a name — the Hubble tension — and left it standing in the open. Nobody quietly retired the inconvenient number. Nobody averaged the two results into a comfortable middle and moved on. The people who had built their careers on one method did not announce that the other method's practitioners were fools.

And they went further, which is the part that gets left out of the popular telling. Other groups measuring the same quantity by other routes — using the tip of the red giant branch rather than Cepheids, for instance — have landed at intermediate values that do not clearly conflict with Planck at all. So there is not even consensus that there is a crisis. That dissent is published too.

The same discipline is running the same play one layer down. Recent results from the Dark Energy Spectroscopic Instrument have been read as evidence that dark energy is not constant after all — that the thing driving the expansion is itself changing. The strength of that evidence swings between roughly three and four sigma depending on which supernova sample you combine it with, and at least one prominent cosmologist has argued in print that the whole signal may be a systematic error in the supernovae rather than a discovery about the universe.

Notice what that is. A field with a hundred years of accumulated method, billions of dollars of instrumentation, and the most precise measurements humans have ever taken, saying plainly: *we have two answers, we do not know which is right, here is our uncertainty, here is the strongest argument against our own result.*

That is what knowing something looks like from the inside. It is mostly bookkeeping about what you do not know.

The Asymmetry

Now hold that next to the ordinary traffic of human certainty.

The intentions of whatever brought the universe into existence are reported daily, in enormous detail, by people who have measured nothing. Its preferences are known. Its instructions were transcribed. Its dietary requirements were recorded. And the confidence attached to those claims is not nine percent short of certain — it is total, and it is held by people who would be unable to state the mass of the object they are standing on.

I want to be exact about the comparison, because the sloppy version of it is a cheap shot.

The point is not that scale humbles us. Everyone already agrees the universe is large; nobody's behavior changes. The point is not that scientists are smarter, either — plenty of them are certain about things they should not be, and the history of the field is a graveyard of confident consensus.

The point is a standard, and it is available to anyone at no cost: **proportion your confidence to your evidence, and publish your disagreements.** Cosmology is not admirable here because it is right. It is admirable because it is uncertain out loud, in public, in writing, with the size of the uncertainty stated numerically. That is a discipline, not a credential, and the fact that it is practiced by people with telescopes does not mean it requires one.

Nine percent is enough uncertainty to unsettle a field. Zero percent is what you find in the places with no measurements at all.

What Heat Death Says, and What It Does Not

Follow the same expansion far enough forward and you get a projected ending. Galaxies pass beyond one another's horizons. Star formation ceases when the gas runs out. The last stars burn down. Matter is spread so thin that even a chance encounter between two atoms becomes effectively impossible, and there is nothing left to happen — which means, in any operational sense, no more time.

That is heat death, and it is worth asking what it implies about a creator.

Against the process I have argued for elsewhere, it implies nothing at all. A generative principle with no preferences owes no account for running down. It was never aimed anywhere, so arriving nowhere is not a failure of the plan; there was no plan to fail.

Against the purposive sovereign, it is heavier. A creation aimed at a destination, superintended by a being with intentions, that terminates in maximum entropy and permanent silence — that is a strange shape for a purpose to have. It looks exactly like what you would expect from a process that was never aiming, which is the same conclusion the wasp and the mass extinctions push toward from the other end.

But now the discipline has to apply to me, or this essay is worth nothing.

Heat death is not a certainty. It is the leading scenario *conditional* on dark energy behaving as a true constant. If its equation of state is even slightly different — if it strengthens, or weakens, or reverses — you get a rip, or a collapse, or a cycle instead. And per the section

above, that parameter is precisely what is currently under dispute. The expansion rate is unresolved to nine percent and the nature of the thing driving it is an open question with published evidence on both sides.

So anyone using heat death to close an argument about God — in either direction — is doing the thing this essay is about. The ending is not known. It is modeled, conditionally, on parameters we are still arguing over.

The Charitable Reading, Which Is Also the Correct One

It would be easy to end by calling the confident majority deluded. I have felt that impulse and I do not trust it, because it is the same error wearing my colors.

Declaring millions of people insane is a claim about the interior states of individuals I have never met, made from exactly the distance I have spent this essay saying disqualifies a person from certainty. Certainty is the tell. It does not come with an exemption for the person who happens to have the better argument.

And there is a better explanation available, one that does not require anybody to be defective. We are built to acquire our picture of the world from the people around us — that is not a bug, it is the mechanism that makes culture possible, and it runs before deliberation gets a vote. We are also, all of us, poor witnesses to our own reasoning; the research on that is old, replicated, and unflattering to everyone including me. A person raised inside a certainty, surrounded by people who hold it, who has never been given the instrument for examining it, is not disturbed. They are doing exactly what a human being is constructed to do.

The failure is not in the people. It is that we never taught the discipline. Nobody sits in a classroom and learns to say *my confidence here should be about sixty percent* and mean it. Nobody is graded on publishing the strongest case against their own position. We teach conclusions and call it education, then wonder why the adults produced by it hold conclusions the way they were taught to.

The astronomers did not inherit that discipline from their brain chemistry. They built it, deliberately, over centuries, because they kept getting things wrong and got tired of it. It is a technology. It can be taught to anyone.

That is the whole argument. Not that the universe is too vast for us — it obviously is, and saying so changes nothing. It is that the people who have looked hardest at it are the ones least willing to tell you what they know, and that this is not modesty. It is what the evidence actually supports, stated accurately.

Nine percent, published. That is the standard. Everything else is assertion wearing the clothes of knowledge.

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