Reality in the melting pot

According to 'multiverse' theorists, life as we know it could be nothing but a Matrix-style simulation

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Five hundred years ago it was widely believed that the Earth lay at the centre of the universe and mankind was the pinnacle of creation. Then along came Copernicus and showed that our planet was merely one of several orbiting the sun. Since then the lesson of Earth's mediocrity has been reinforced again and again: ours is a typical planet around a typical star in a typical galaxy, of which there exist untold billions.

The Copernican principle - that our location in space is unremarkable - is the default assumption for most scientists. But recently this principle has been challenged by a group of cosmologists who claim that what we have all along been calling "the universe" is nothing of the sort. Rather, it is a tiny fragment of a much vaster and more elaborate system that, for want of a better word, has been dubbed "the multiverse".

The basic idea is simple. Cosmologists think the universe began with a big bang about 14bn years ago. This means we can't see anything farther than 14bn light years away, however good our telescopes may be, because light from those regions hasn't had time to reach us yet. But this doesn't mean there is nothing there, and for decades astronomers supposed that what lies beyond this horizon in space is likely to be more or less the same as we observe in our cosmic backyard - just more galaxies.

Now this assumption is in serious doubt following major developments in fundamental physics. A key premise of the more-of-the-same view of the universe is that the laws of physics are identical everywhere and for all time. But physicists have found that some features of nature thought to be law-like might actually be frozen accidents - properties that were locked in only as the universe cooled from its fiery birth.

Take the mass of the electron. Why does it have the value it does? Well, maybe the mass isn't decided in advance once and for all by some deep law, but just comes out at random, like the throw of a die, in the searing maelstrom of the big bang. In which case, it could come out differently somewhere else. In the same way, the strength of gravity or the number of space dimensions might also vary from place to place.

There is no evidence for any substantial variation in these features out as far as our best telescopes can peer. But that is no guarantee that a trillion light years away it will be the same. Electrons could be heavier there or space might have five dimensions. A God's-eye view of the cosmos would then resemble a patchwork quilt, with a haphazard pattern of properties. What we took to be universal laws of physics would be relegated to mere by-laws, appropriate only to our local "Hubble bubble", while far out in space other "bubbles", possibly generated by other big bangs quite distinct from ours, possess other laws.

Multiverse enthusiasts bolster their claims by pointing to the astonishing bio-friendliness of the universe. It has long been known that the existence of life depends rather sensitively on the exact form of the laws of physics. Change things a bit and life would never have happened. This looks suspiciously flukey, but it can be readily explained by the multiverse. Most of the cosmic patches in the quilt will be sterile, their physics all wrong for making life. Only here and there, in rare patches where all the numbers come out right, will life arise and observers like us evolve to marvel at it all.

History has thus turned full circle. According to the multiverse theory, if you look at Earth's location in space on a grand enough scale, then it does occupy a special and privileged position, namely one that can support life. Like winners in a gigantic cosmic lottery, we find ourselves in a rare bio-friendly patch for the simple reason that we could not exist in any of the bio-hostile ones.

If one accepts recent advances in fundamental physics, then some sort of multiverse seems inevitable. But how far down this slippery slope should one go? Max Tegmark, a cosmologist at the University of Pennsylvania, argues that there is no need to stop with properties like the strengths of forces or the masses of particles. Why not consider all possible mathematical laws? Don't like the law of gravity? No problem. There's a universe out there somewhere with gravity that waxes and wanes in a paisley pattern. Of course, there's nobody there to admire it.

Tegmark's speculation forces us to confront what is perhaps the deepest of all the deep questions of existence: why there is something rather than nothing. There are only two "natural" states of affairs. The first is that nothing exists. The other is that everything exists. The former we can eliminate by observation. So should we conclude that everything exists - all possible worlds? Those who would argue against this position must concede that there is some rule that divides what actually exists from what is merely possible, but not real. But where does that rule come from? And why that rule rather than some other?

These are murky waters, but they get even murkier when we scrutinise what is meant by the words "exist" and "real". In the Tegmark multiverse of all possible worlds, some worlds will have intelligent civilisations with computers powerful enough to create authentic-looking virtual worlds. Like in the movie The Matrix, it may be almost impossible for an observer to know which is the real world and which is a simulation. And if the simulation is good enough, is there any fundamental difference between the two anyway?

It gets worse. Mathematicians have proved that a universal computing machine can create an artificial world that is itself capable of simulating its own world, and so on ad infinitum. In other words, simulations nest inside simulations inside simulations ... Because fake worlds can outnumber real ones without restriction, the "real" multiverse would inevitably spawn a vastly greater number of virtual multiverses. Indeed, there would be a limitless tower of virtual multiverses, leaving the "real" one swamped in a sea of fakes.

So the bottom line is this. Once we go far enough down the multiverse route, all bets are off. Reality goes into the melting pot, and there is no reason to believe we are living in anything but a Matrix-style simulation. Science is then reduced to a charade, because the simulators of our world - whoever or whatever they are - can create any pseudo-laws they please, and keep changing them.

The final twist in this saga is that almost all multiverse theories predict the existence of infinitely many duplicate cosmic regions, including duplicate Earths and duplicate Guardian readers. There will also exist all possible variations on this theme.

So if you are uncomfortable with the multiverse idea, content yourself with the fact that there will be another you out there somewhere who has just read a thoroughly convincing refutation of the entire multiverse concept.

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