EL REINO DE LO INVISIBLE · EPISODE 17

Hidden Dimensions: What if the 'dark' stuff just lives in the 5th dimension?

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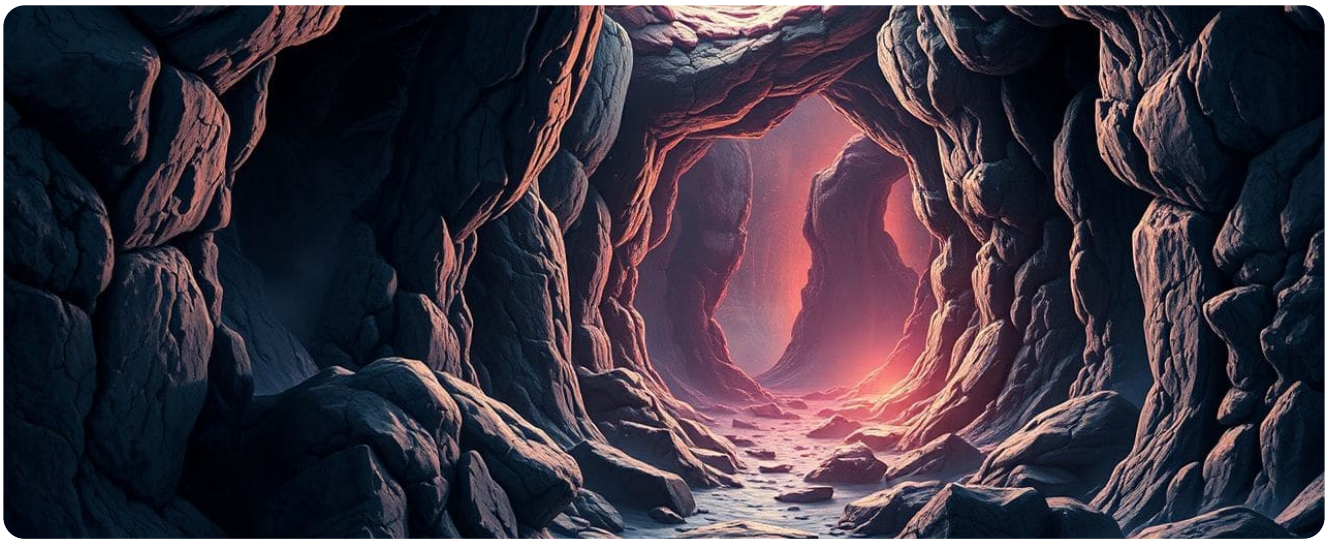

Hey there, cosmos explorers! Have you ever had that tingling feeling that there's something beyond what we see? That, despite how immense and complex our universe already is, perhaps we're only scratching the surface of a much, much deeper reality? Well, today we're going on a mind-bending journey to explore an idea that could change everything: hidden dimensions.

Since we were kids, we've been taught that the world has three spatial dimensions: up/down, left/right, and forward/back. And of course, there's time, the fourth dimension. But what if I told you that scientists have been toying with the possibility for decades that there aren't just four, but many more? Extra dimensions that we can't see or feel, but which could be influencing everything around us!

Think about this: our universe is full of mysteries that leave us awestruck. There's something we call 'dark matter' and 'dark energy'. We can't see them, they don't interact with light, but we know they're there because their gravity and expansive effects are shaping entire galaxies and the fate of the cosmos. Dark matter is like an invisible glue that holds galaxies together, and dark energy is a mysterious force that accelerates the expansion of the universe. Together, they make up almost 95% of everything in the universe! And we, well, us and everything we see (stars, planets, you, me), are just the remaining 5%.

It's as if we're in a movie where 95% of the cast is invisible to us, but their actions are actually what drive the plot. Frustrating, right? We've racked our brains searching for exotic particles that make up this dark

matter or new theories for dark energy. But what if the answer isn't in something we can't see *in our dimensions*, but in something that exists *outside of them*?

Imagine you're a fish in a pond. You can only move forward, backward, left, and right. Your entire universe is flat, 2D. One day, a basketball falls onto the surface of the pond. You, the fish, only see a circle growing and shrinking. You don't understand what it is, because the ball exists in a dimension (up/down) that you can't perceive. What if we are those fish, and dark matter and dark energy are like that basketball, an echo or a manifestation of something residing in a higher dimension?

It's a bold, fascinating idea that opens our minds to infinite possibilities. But how exactly does this theory of hidden dimensions work? And most importantly, could the 'realm of the invisible' —all that dark and mysterious stuff— really just be something that lives in the 5th dimension, or even beyond? Get ready, because the answer is far stranger and more wonderful than you ever imagined...

What an exciting journey to continue exploring such a powerful idea! We've just seen how dark matter and dark energy have us baffled, making up most of our universe without us knowing exactly what they are. The hypothesis of hidden dimensions is one of the most elegant and, why not, most science-fiction-like answers that theoretical physics has given us. But how did we get here? And why is it so difficult for us, three-dimensional beings, to understand it?

Our Everyday Dimensions: A Starting Point

Let's think about our dimensions. Imagine a point: it has no dimensions. If you move that point, you create a line: one dimension. If you move that line perpendicularly, you create a square: two dimensions. And if you move that square, you create a cube: three dimensions. This is how we perceive our world: height, width, and depth. To this, we add time as the fourth dimension, through which we always move forward, never backward. With these four dimensions, we describe everything that happens to us.

But what if there was a fifth dimension? One that we cannot see because, perhaps, it is too small, or because our senses are simply not equipped to perceive it. It's time to dive in!

The Secret History of Extra Dimensions

The idea of additional dimensions is not new. In fact, it's almost a century old. In the 1920s, a physicist named Theodor Kaluza proposed a fascinating theory. He wanted to unify two of the fundamental forces of nature: gravity and electromagnetism (the force that generates light, electricity, magnetism...). To achieve this, he suggested that, in addition to our three spatial dimensions and time, there was a fifth

dimension! This extra dimension was so small, 'curled up' on itself, that we didn't perceive it. Think of a garden hose. From afar, it looks like a one-dimensional line. But if you get closer, you see that it actually has a second dimension 'curled up' around its circumference. That's the classic analogy for compactified dimensions.

The Kaluza-Klein theory, as it became known, was a first step. But the real revolution came with String Theory and its evolution, M-theory, in recent decades. These theories postulate that fundamental particles are not points, but tiny vibrating 'strings'. And for these strings to work mathematically and unify all the forces of nature (gravity, electromagnetism, strong and weak nuclear force), they need many more dimensions! We're talking about 10, 11, or even 26 dimensions in some versions. Like in Kaluza-Klein, most of these extra dimensions would be 'compactified' or 'curled up' on scales so incredibly small that they are undetectable to us, perhaps trillions of times smaller than an atom.

Dark Matter: A 'Ghost' in Another Dimension?

Now, let's connect this with our beloved dark matter. If our universe has additional dimensions, what implications would this have for that invisible substance that does not interact with light or other forces (except gravity)?

- **Gravity that 'leaks':** Imagine that our observable universe (everything we see, all the particles we know, even us) is confined to a kind of three-dimensional 'membrane' or 'brane' floating in a higher-dimensional space, which we call the 'bulk'. Think of a cloth stretched in the air, and everything we know lives on the surface of that cloth.

- **'Extra-dimensional' particles:** What if dark matter particles live in these other dimensions and rarely, if ever, interact with our brane? The only force that could 'escape' or 'be felt' between dimensions is gravity. Why gravity? Because gravity is not confined to the brane; it can propagate through all dimensions, the 'bulk'.

- **The 'ghost' effect:** So, dark matter wouldn't be 'dark' in the sense that it doesn't emit light, but 'dark' because it's simply not entirely in our dimension. It's like a ghost that can walk through walls; it's not that it's invisible, it's that it operates under a different set of dimensional rules. We would only feel its gravitational pull because gravity, being a 'transdimensional force', affects us even if the source is elsewhere.

This would perfectly explain why we cannot detect dark matter with our telescopes or particle detectors. If its particles primarily reside in another dimension, we would only perceive its gravitational 'shadow'. It's like the fish that feels the water distortion from the basketball, but doesn't see it because the ball is in an 'up' dimension!

Dark Energy: The Pressure of an Extra Dimension?

And dark energy, could it fit into this model? Absolutely. Dark energy is that mysterious force that seems to be 'pushing' the universe, causing its expansion to accelerate. It's a real headache for cosmologists.

- **The 'bulk' tension:**Some models suggest that dark energy could be a manifestation of the energy associated with these extra dimensions, or perhaps the 'pressure' or 'tension' of spacetime itself in the 'bulk'.

- **The extra-dimensional 'vacuum':**Quantum vacuum fluctuations (particles appearing and disappearing out of nowhere, even in empty space) are known in physics. If extra dimensions exist, the vacuum in those dimensions would also have fluctuations and, therefore, an associated energy that could manifest as the dark energy we perceive in our universe.

Imagine that our universe-brane is not just a cloth in the air, but a cloth being stretched by something in the 'bulk'. That stretching force would be what we perceive as dark energy, accelerating the expansion of our universe!

Searching for Clues in the Dark and Beyond

Okay, the idea is great, but how do we prove it? This is where it gets interesting:

- **The Large Hadron Collider (LHC):**Particle accelerators like the LHC at CERN, by colliding particles at extremely high speeds and energies, could generate 'mini black holes' or particles that 'vanish' into these extra dimensions. If a collision occurred with enough energy and a particle disappeared, that could be a sign that it 'escaped' into a higher dimension. We would look for a loss of energy that cannot be explained by any known particle.

- **Variations in gravity:**If gravity can 'leak' into other dimensions, that means that at very, very small scales, its strength could be different from what we expect according to Newton's (or Einstein's) law of gravity. Experiments that measure gravity with millimeter precision look for these anomalies. So far, no significant deviations have been found, which implies that if these extra dimensions exist, they are extremely small or gravity 'leaks' very subtly.

- **Gravitational waves:**The detection of gravitational waves (the 'ripples' in spacetime) has opened a new window to the universe. Some models predict that these waves could interact with extra dimensions, leaving a detectable 'signature'.

What if 'Dark' Isn't 'Dark', But Just 'Different'?

The beauty of the extra dimensions theory is that it turns our biggest mysteries —dark matter and dark energy— from insoluble problems into potential clues of a larger, more complex reality. It's not that these things are 'dark' or 'exotic' in themselves, but simply that they belong to a part of the cosmos that is beyond our direct perception, in dimensions we cannot see.

It's as if we lived in a house and could only see the living room, but most of the house's life (and the energy that keeps it standing) happened in the upstairs bedrooms and the basement, invisible to us. What we perceive as 'dark' could simply be the 'light' from other rooms, filtering through in a way we don't yet fully understand.

This is not just science fiction; it's one of the most promising avenues of modern theoretical physics, seeking to unify everything and give us a complete picture of reality. If it turns out to be true, not only would we have solved the enigma of dark matter and dark energy, but we would have opened the door to an indescribably richer universe, with landscapes and entities that we can barely begin to imagine. A universe where the apparent 'darkness' was simply an invitation to look beyond the obvious, towards a realm of the invisible that is far vaster than we ever dreamed. And that, explorers, is a thought that leaves us breathless. What other secrets await us in the Realm of the Invisible?