

Hey everyone and welcome to this week's, The Universe and You, the show where I get to tell you guys about some wild thing in the universe. This week I have something a little special for you. The topic this week is, the Multiverse Theory

Ok so I admit this is cheating a little bit because, well, I guess it's not technically our universe, not always. In the past two episodes I have tried to give you a sense of the the scale of the void that surrounds our pale blue planet. We talked about the sheer magnitude of galaxies and the destructive, crushing power of black holes. But what if that's not it? What if even outside of the universe around us there's more? What if it's infinite? What if it's not outside of our universe, but overlaid on top of it? These are the questions that we're going to, well not answer, but maybe see the bare shape of the answer.

- Origin
 - Introduced in 1952 in Dublin by Erwin Schrodinger
 - "Might seem lunatic"
 - Equations suggest several distinct histories, all occurring at the same time.
 - Big Idea of the Multiverse
 - Varies in theory to theory
 - Has been a part of cosmology, physics, astronomy, religion, philosophy, transpersonal philosophy, and literature.
 - Is it science at all?
 - Because of its nature, the multiverse, in all prevailing theories, cannot be disproven
 - The ability to prove false is key to scientific method
 - Philosophical?
 - Dr. Paul Steinhardt argues no experiment can disprove something if the theory being tested allows for all possible outcomes
 - Basically, the infinite multiverse has infinite variety so no test could disprove its existence
 - A Nobel laureate once said that if the multiverse existed, it would become impossible to find definitive answers for primal sources of creation like the Big Bang
 - Evidence
 - None, the only evidence was later disproved as an imperfect interpretation of data and a result of poor resolution from the Wilkinson Microwave Anisotropy Probe
 - Advocates and Skeptics
 - Advocates
 - Stephen Hawking, Brian Greene, and Neil deGrasse Tyson
 - Skeptics
 - Steven Weinberg, Paul Steinhardt, and Paul Davies

- Paul Davies is the chair for SETI, so he's already known for fringe ideas.
- Criticisms
 - Multiverse arguments are reminiscent of theological ones
 - In the end, since the multiverse theory is largely unprovable, it requires a leap of faith
 - "Invoking an infinity of unseen universes to explain the unusual features of the one we do see is just as ad hoc as invoking an unseen creator. The multiverse theory may be dressed up in scientific language, but in essence it requires the same leap of faith." - Paul Davies
 - George Ellis took particular issue with the believed possibility of observable evidence.
 - Some advocates for the multiverse, especially the ones who also advocate String Theory and its varied oddities, describe the other universes, not as concurrent ones with ours, but as so distant that we could never hope to see evidence of them.
 - Ellis also takes the position that the multiverse theory answers none of the questions about existence it was meant to
 - "Why are we here and who are we"
 - This is metaphysics, not provable or sustainable
- Classification of Different Hypotheses
 - 2 sets, first from Cosmologist Max Tegmark taxonomy of universes outside of the observable universe
 - Level 1
 - Extension of our universe
 - There are several universes, each having a Hubble volume
 - A sphere outside of which objects will recede from the observer faster than the the speed of light
 - All share physical laws and constraints
 - Variation comes from the configuration and nature of matter
 - Some will be similar or the same as ours because there are infinite
 - Requires the assumption that our Hubble volume is not unique or special
 - Reminiscent of the heliocentric vs. geocentric argument
 - Level 2
 - Universes with different physical constraints
 - Uses chaotic inflation theory, a variant of the cosmic inflation theory used to predict the existence of bubble universes.

- Assumes space is forever expanding with many universes overlaid on each other expanding at the same rate, each having different physical constants which makes them stop growing and form a bubble universe, which then eventually forms a level 1 multiverse
 - Level 3
 - One of the common interpretations of quantum mechanics.
 - Quantum mechanics states that certain things cannot be perfectly predicted, only have the possibilities narrowed.
 - Each possibility forms a multiverse
 - 6 sided Die analogy
 - Tegmark believes that the primary difference between Level 1 and Level 3 is “where your doppelgangers reside”
 - Basically Level 1 has them somewhere out there in the greater existence, Level 3 has them in another quantum dimension in Hilbert Space.
 - Level 3 can contain Level 1 and 2 within itself as other quantum possibilities
 - Level 4
 - Tegmark sees his hypothesis as the ultimate mathematical multiverse theory
 - Considers all possible forms of the multiverse equally real and can all be described by mathematical analysis.
- Brian Greene’s nine types
 - Discussed not created
 - There are nine of them so in the interest of time, I will pick 2 which I find to be the most interesting or weren’t covered above
 - Quilted
 - The whole of reality that is populated by the multiverse is infinite. Each universe is a quilt square and since the speed of light is constant throughout, we cannot be aware of the other squares.
 - Brane
 - Every universe is a membrane floating in a higher dimension, or bulk
 - The membrane universes interact and when they collide there is a new big bang
 - Every universe has had multiple big bangs, the system is cyclical.
 - Associated with string theory
- M-theory
 - Similar to brane theory
 - Requires 11 spacetime dimensions, 7 additional ones

- There are several branes which are guided by a different number of dimensions, ours is simply the one that has 3 dimensions in space and time.
 - Levels of water analogy
 - Black-hole cosmology
 - Model is essentially that the observable universe is inside of a black hole, with the edges being the event horizon.
 - This multiverse theory builds itself into the mystery of black holes and the current universe model.
 - Every Black hole contains a universe, which contains more black holes which contain more universes etc.
 - The cat in Men in Black with the universe on its collar.
 - Also includes white holes, which are as fringe as theoretical physics can get.
- The Anthropic Principle
 - Multiverse theory used to explain how our universe is fine tuned for conscious life as we know it
 - If there are infinite universes, there must be others who have the natural laws conducive to producing life
 - If that's the case, there must be at least the potential life in other universes, all it needs is time.
 - The Weak Anthropic Principle
 - Dark application of the Anthropic Principle
 - Concludes that we, as conscious beings according to our understanding, exist in a finely tuned universe for our existence.
 - Because of this even if well tuned universes are rare, they are a natural thing to develop and do not require a creator to build a universe conducive to life, as we know it.
 - Similar to argument for life off of earth or habitable planets elsewhere.
- Closing
 - Thanks for listening this week
 - Next week: Quantum Mechanics
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 - This has been The Universe and You by the Signifying Nothing Network, a tale told by an idiot, have a good, existentially unimportant week.