

Four famous physicists ponder why we are here

A symposium on the place of humans in the universe

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We exist, and that is a fact. However, the whole sequence of events that allowed for the existence of life depends on a few very precise physical constants, which, had they been only slightly different, might have led to a whole different universe, from which we might have been absent. Indeed, a stronger force of gravity could have caused the universe to collapse long before planets could have even formed. A lower value for the strong nuclear force, which holds protons together in the nucleus, might have made the formation of atoms impossible. This perspective has led to what is now called the anthropic principle, defined as “the principle that the observable universe has to be as it is, rather than any other way, otherwise we would not be able to observe it.”¹ Two positions have arisen among the scientific community: those in favour of the anthropic principle, believing that the fine-tuning of the universe is necessary to the emergence of life; and those against, claiming that such reasoning is beyond the domain of physics, and that our existence is simply a “lucky coincidence.”

In an attempt to shed some light on this enigma, four physics experts joined together at McGill University in Montreal on January 25th at the second annual Lorne Trotter Public Science Symposium, for a conference titled “A Cosmic Coincidence: Why is the Universe Just Right for Life?” Moderated by McGill professor Victoria Kaspi, the panel included Paul Davies, physicist, author and director of Beyond: Institute for Fundamental Concepts in Science, George Efstathiou, astrophysicist and director of the Institute of Astronomy of Cambridge University, David Gross, winner of the 2004 Nobel Prize in Physics and director of the Kavli Institute for Theoretical Physics, and Leonard Susskind, professor at Stan-

ford University and father of string theory.

After an introduction by Kaspi, each of the panelists were invited to present his point of view on the validity of the anthropic argument. Davies, who recently published the book *The Goldilocks Enigma: Why is the Universe Just Right for Life?* on the topic, was the first to speak. He exposed the two basic questions physicists are currently asking concerning the anthropic principle, namely, whether the universe could have been different and why it is, as Davies put it, “so suspiciously bio-friendly.” He then presented two different attitudes that have been adopted regarding the issue: either life exists because the universe happened to be favourable to it—the opinion supported by Gross—or the universe is part of a greater “multiverse.” The multiverse hypothesis states that our universe is only one of a multitude of unique universes, each with their own specific physical laws. Susskind covered this hypothesis in more detail later on in the symposium.

Efstathiou, the astronomer, followed by summarizing our current knowledge regarding the evolution of the universe. While he also explained the concept of the multiverse, Efstathiou took position against the anthropic principle throughout the debate, questioning its scientific validity.

Susskind, the string theorist, was the only panelist who was strongly in favour of anthropic reasoning. In the framework of string theory, it is speculated that there exists a very large number of distinct universes, including the one we live in. Susskind explained that, in that perspective, each universe then has a different set of laws of physics, and the values of the fundamental constants differ from one to the other. In that case, life exists only in those universes that happen to have the right properties for it to emerge.

Gross was the last panelist to speak, and he concluded the debate by adopting a position

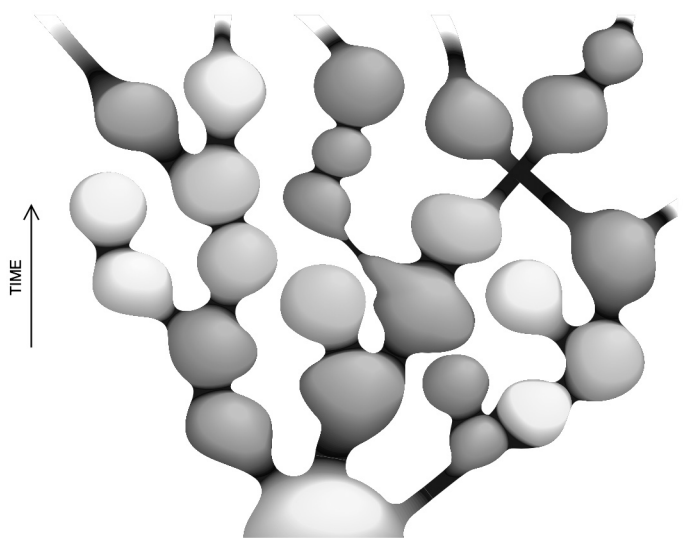
contrary to Susskind’s. From his point of view, the multiverse approach is unscientific since it is impossible to test, and therefore impossible to disprove, and as such it belongs more to the realm of philosophy rather than physics. Gross also stated that string theory is not a definite theory, and as we improve our understanding of the laws of physics, it appear that the universe has such properties because it is the only way that is physically viable. Any other set of constants may simply not be physically possible.

While the question remains unsettled, the four experts invited by McGill University offered the public a lot of insight on what is currently known about the universe, and on the current state of the debate among the physics community. Although we might never obtain a definite and final answer to that question, since the debate extends beyond the limit of what science can address, the discussion that went on at the Lorne Trotter Public Science Symposium allowed a sharing of ideas that can only benefit to the widening of our understanding of the universe that surrounds us.

REFERENCES

- ¹J. Daintith. *A Dictionary of Physics*. Oxford University Press. 2005.
- ²2nd Lorne Trotter Public Science Symposium, <http://www.physics.mcgill.ca/events/trotter-symposium/>.

ABOVE: The self-reproducing cosmos appear as an extended branching of inflationary bubbles. Individual bubbles represent mutations in the laws of physics from parent universes. The properties of space within each bubble does not depend on the time when the bubble was formed. In this sense, the universe might be stationary, even though the interior of each bubble is described by the big bang theory.



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