

## The Anthropic Principle and Arguments by Design in Physics

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### Summary

The anthropic principle was first formally enunciated by Brandon Carter in 1974. The principle states that the Copernican vision of the universe (i.e. that the Earth's position is unprivileged) must be limited by the fact that "our location in the Universe is necessarily privileged to the extent of being compatible with our existence as observers." At first sight, this might just appear to be a statement of the obvious, but detailed analysis leads to some surprising conclusions. For example, calculations show that the properties of the universe are extremely sensitive to the values of the fundamental constants, (e.g. Planck's constant  $h$ ), and that the observed values of these constants appear to be "finely-tuned" to the needs of humans.

The fine tuning of the universe is considered by most physicists to be an established, non-controversial fact that begs an explanation. Three obvious possibilities are:

1. that we are just extremely lucky;
2. that many universes exist, each with different fundamental constants, (the "multiverse" theorem) and that we must exist in the one that suits us;
3. that the universe has been intelligently designed for the human race.

The first explanation might be true, but does not offer any further insight. In my opinion the second should be ruled out by Ockham's razor (i.e the principle that complicated, unverifiable explanations that make no predictions are contrary to the scientific method.) The third will obviously appeal to those who believe in an intelligent Creator. Christian theology certainly posits the existence of such a creator, but history warns us of the danger of postulating a mere "God of the gaps" to fill holes in our scientific understanding. Invariably, these holes are plugged by later scientists, and the "God of the gaps" turns out to be a purely human invention, thereby discrediting serious debate between science and religion. I strongly suspect that the intelligent designer that emerges from the discussion of the anthropic principle is just another example of the God of the gaps. At the same time, there is nothing in the science that in any way disproves the existence of an intelligent Creator. What does emerge is the wonder of the universe and the excitement of cosmology.

### Further reading

Barrow & Tipler, *The anthropic cosmological principle*, Oxford University Press, 1985.

G. Tanzella-Nitti, *The Anthropic Principle*, in the Interdisciplinary Encyclopedia of Religion and Science, <http://www.disf.org/en/>

### Biography

Mark Fox obtained both his undergraduate and doctoral degrees from the University of Oxford. After a period of post-doctoral research at Bell Laboratories in the USA, he returned to Oxford as a Royal Society University Research Fellow. He took up his present post at the University of Sheffield in 1998, where he currently holds a Personal Chair in physics. His research interests include semiconductor nanostructures and quantum optics. He is the author of *Optical Properties of Solids* and *Quantum Optics: an Introduction*, both published by Oxford University Press.