A devastating problem for multiverses is that our universe looks more special, more fine-tuned, than is required merely for observers to arise in it. On the basis of a multiverse we would expect to be in a universe which was just ordered enough for us to exist. This could be a single solar system surrounded by chaos, but is utterly unlikely to be a universe with all the order and structure we see, with 100 billion galaxies, each with its 100 billion stars and their planets.

So the design argument would seem to be robust. Of course, if we accept this argument, it only gets us so far in terms of the picture of God we can draw from it. At most, we have a powerful and majestic Creator. What we do not have is a picture of God interacting with his creation in history or, supremely for the Christian, in the life, death and resurrection of our Lord Jesus Christ. To fill out the picture of God we need to go far beyond what cosmology alone can tell, and delve into the historical and documentary evidence, and into the experience of the Church which Christ brought into being.

We have a powerful and majestic Creator

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Further information

www.cis.org.uk – Christians in Science

www.faraday-institute.org – The Faraday Institute for Science and Religion

Suggested reading

Popular:

Holder, Rodney. *Big Bang Big God: A Universe Designed for Life?* Lion Hudson, 2013.

Davies, Paul. *The Goldilocks Enigma: Why is the Universe Just Right for Life?* Allen Lane, 2006.

Advanced:

Holder, Rodney. *God, the Multiverse, and Everything: Modern Cosmology and the Argument from Design,* Ashgate, 2004.

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addressing questions of science and faith

Fine Tuning

What does it mean for our universe to be fine-tuned?

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Thinking about...

Fine Tuning

Rev Dr Rodney Holder

Modern cosmology tells us that the universe began as an incredibly concentrated fireball of energy some 13.8 billion years ago – the Big Bang. The universe at its earliest moments was remarkably uniform, with only small variations in overall density. However, as the universe expanded and cooled, regions which were slightly denser than average collapsed under the influence of gravity to form galaxies and, within the galaxies, stars.

During the first few minutes of the universe's existence, the temperature was hundreds of millions of degrees. Matter was entirely in the form of elementary particles – protons, neutrons and electrons. The conditions at this early time were just right for protons and neutrons to fuse together to form helium.

How did the universe begin and how has it evolved?

In the interiors of stars temperatures also reach hundreds of millions of degrees and the conditions are again just right for nuclear reactions to take place. The whole of the rest of the periodic table of elements – carbon, nitrogen, oxygen, etc. - is built up through these nuclear reactions in stars. These are the chemical elements necessary for life to come about in the universe.

When stars run out of nuclear fuel, some of them explode in spectacular fashion as supernovae. The cover of this article shows the Crab Nebula seen with the Hubble Space Telescope. Supernovae explosions make the chemical elements manufactured in stars available so that subsequent generations of stars can have planets and ultimately, on one or more of these planets, life can arise.

What is meant by saying that the universe is fine-tuned?

Over the last 40 years cosmologists have discovered that very special conditions are required if the above sequence of events is to proceed this way so that life does indeed come about. The constants which go into the laws of physics, such as the strengths of the fundamental forces of nature and the masses of the elementary particles, need to be 'fine-tuned', that is, to take values very close to the values they do in fact take. Similarly, the conditions at the beginning of the universe, such as the expansion rate, also need to be fine-tuned.

For example, unless the mean density of matter-energy a mere one second after the Big Bang was within one part in 10^{15} (1/1,000,000,000,000,000) of its actual value, the universe would not give rise to life. If it is outside this narrow band, the universe will either re-collapse too quickly or expand too quickly for anything interesting to happen.

Cambridge cosmologist Sir Fred Hoyle discovered an effect essential to the production of carbon and oxygen in stars in just the quantities needed for life. Unless the strong nuclear force, the force which binds atomic nuclei together, is within 0.4% of its actual value, either no carbon will made at all, or all the carbon will be turned into oxygen. Since both elements are necessary for life, the end result in either case would be a lifeless universe.

The most obvious conclusion to draw from the fine-tuning is that the universe was designed to give rise to carbon-based life. We have a new form of design argument for the existence of God.

What conclusions can we draw from the fine-tuning?

If you are an atheist the main alternative to design is the existence of a multiverse. This is a vast (usually infinite) collection of universes in which the constants I have mentioned, and others, take all possible values. This idea is fraught with problems, not least the fact that no universe apart from our own can ever be observed. And in any case the theist could argue that a multiverse requires a 'universe generator' which has to produce just the right kind of law-governed universes so that one or more of them contain life.