

## The Physics of God

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In the scientific world there's a snobbery that places the more ethereal and "harder" disciplines at the top and the human-orientated, "softer" ones at the bottom. This is illustrated by the joke that biology isn't a real science because it's just applied chemistry. And chemistry is just applied physics.

At the top of this heap, physics is often portrayed as the pursuit of fundamental truths. In recent years several physicists have attempted to find a foothold on the most fundamental truth: the existence and nature of God. Paul Davies (author of some of the more lucid works on this topic) has opined that "science offers a surer path to God than religion". How can a layperson evaluate such an opinion? At its extremes (cosmology and the sub-atomic) modern physics has transcended common sense. This is not to say that it has become arbitrary or irrational - but that it has become so convoluted and complex that its findings seem to defy reason. (Indeed some physicists seem to take a perverse pride in being opaque. One famous scientist when accused of being so obscure that only three people in world could understand his work, retorted that the other two were lying.) Let us then try to make something out of this.

If a physicist claims to prove (or disprove) God, what exactly do they mean? Practitioners of Shinto, Christianity and animism would have considerable difficulty coming to a meaningful consensus about what "God" means. (Interestingly an almost universal fault of the "God-through-physics" school is the assumption that religion is typified by a very conservative Judeo-Christian model.) What does a physicist mean by "God"? The definition is simple and pragmatic. God (whatever else it is) is the ultimate reason, the final irreducible fact, the reason things are the way they are and not any other way. If this strikes you as less than profound, consider its corollary: if God is the reason the universe is the way it is, understanding the creation of the universe will lead us to understand of the mind of God ...

The quest for God is thus tangled intimately with the creation of universe. The choice between cosmological creation models is simple: either the universe always existed or it sprung into existence at some point. Whilst the first model has occasionally been in vogue, it's been discredited for a variety of good reasons and overwhelming evidence for the alternative. So we have to conclude that the universe was created at some point in the past. Evidence suggests the creation event was a massive explosion, a "big bang", some 15 to 30 billion years ago. The aftershocks of this can still be detected, as the matter created expands outwards. This leads us into the puzzle-palace of physics. If the big bang was the first event, what happened before it? What caused it?

The answer is: nothing. One might mistakenly picture the big bang as taking place in some large pre-existing void. In fact physics (via the theorist le Maitre who strangely enough was a Belgian priest) indicates that nothing existed at all, not even emptiness. There was no void for the big bang to take place in as there was no space, no "here". Space and dimensionality was created in the big bang. Even more bizarrely, time came into existence with the big bang. Nothing happened before the big bang, because there was no before.

So if nothing came before the big bang, what caused it? One could be forgiven for concluding it could only be God. But, if our only reason for believing in God is that it is necessary to explain the universe, could we not just believe that the universe is this way because it is necessary? One ad hoc assumption is as good as another. Such reasoning is marginal anyway, explains nothing and is only to be used when you have no other option. So again, what caused the creation if nothing came before creation? Perhaps we are just prejudiced in thinking that the cause of an event must come before that event.

This is exactly what some recent findings seem to indicate. Time, far from being an unstoppable tyrant moving ever onward, in fact deforms and occasionally runs backwards. More to the point the cause of an event may be preceded by its effect, leading to a startling conclusion : the universe could have caused itself to come into existence, boot-strapping its own creation. Systems that cause their own creation and growth (so-called auto-catalytic systems) are prevalent in biology, so it is perhaps unsurprising that the universe would use a grander version of the same device. Events in the future of the universe retrospectively effect the past.

If this chicken-and-egg explanation is dissatisfying there is alternate possibility. The idea of time abruptly beginning is problematic for a lot of reasons, including the fact physical laws fall into a heap trying to cope with it. Rather than such an all-or-none event it's possible to suppose the universe just "fuzzed" into existence. At the sub-atomic level existence gets blurry and things exist not as discrete objects but as smears of probabilities, a set of images if you like that might average out to give a single particle. It is at this level that perhaps the only truly random processes in the universe take place as particles "choose" from their set of probable states. (More than one scientist and many theologian have suggested that these random events are one way for God to intervene in the universe without breaking any physical laws.) The side-effect of this is that perturbations on the sub-atomic level can result in things appearing from literally nowhere. So rather than time and space just appearing fully blown, we can sidestep the idea of a cause for the universe by honestly saying it came out of nothing.

These answers just shift the mystery to another level and lead us to once more confront the question of God. Even if one accepts that the universe does not have a cause (or at least not a cause in its past), we are still left asking "why?". Why this universe and not another? Who decided that  $1 + 1 = 2$  and that gravity attracts rather than repels? Why are things the particular way they are? You could say the question is irrelevant since if the universe was not the way it is, we would not be around to ask that question. In other words, the form of the universe is necessary. But this is just a piece of intellectual legerdemain : being necessary is far from being arbitrary. The universe may not need a cause but it does require a reason.

The simplest answer is the "many worlds" theory. We've already discussed how at the sub-atomic level things exist as a set of possible states rather than single objects. Particles choosing between these states are truly random. So the history of the universe can be seen as a series of choices between possible states. But imagine if every time a choice had to be made between one state and the next, the universe went both ways. Instead of settling for state A or B, the universe could split into two identical copies, one which took A and the other B. From inside these universes it would look as if a single choice had been taken, and the existence of the other would be invisible. In time other choices would be made and these child universes

would split again. Creation would consist of an infinite tree of universes, each of which was one of all the possible universe. Thus our universe is the way it is because there is one of every possible universe.

This is a disturbing and provocative thought. Free will, destiny and fate would seem to be meaningless in such a scheme as every possibility is played out in some universe. God is also absent from this theory, as all possible universes are realised and equivalent : intervention is ruled out. Perhaps fortunately for our sanity such a theory is unprovable one way or another as each universe is entirely isolated from the others. It also seems wasteful, that in order to explain this universe we must invoke the existence of infinite others.

So we are still left wondering how this universe was chosen out of many others. Paul Davies amongst other believes that the laws of this universe (effectively "the way things are") are reflections of a more fundamental mathematical reality. In effect, things work the way they do because that is how they are fixed in the mind of God. In support of this idea, it's interesting to note that the only true immutable physical laws we know are mathematically based. Conversely this may be due to a failure of imagination on our part to seek out and define non-mathematical laws. While many mathematicians have expressed a belief that they are discovering mathematical proofs and theories rather than inventing them and that they feel "something is out there", this evidence is entirely anecdotal. ("The Mind of God" explores these stories further and, in my opinion, too uncritically. It does point out however interesting similarities between the elation of scientific discovery and religious revelation.)

One final take on the selection of universes is possible. Freeman Dyson once commented that this universe was the most interesting of all possible universes. Some recent theories, notably the so-called Anthropic Principle, agree with this and assert that the universe is constructed in such a way as to favour the appearance of intelligent beings like ourselves. Note that is a very different proposition to that raised above of the universe being necessary for us to exist. What it proposes in effect is that the dice are loaded to favour intelligent life. Evidence for this point of view includes examinations of the universes early history in which very, very minor changes would have made life as we know it impossible. Somehow the deck has been stacked in our favour ...

So can physics tell us anything about God? While it is debatable that it can tell us the whole story, certainly it seem to provide some valuable clues. A non-physicist trying to come to grips with this material however might wonder if a set of beliefs that require an degree in quantum physics are any more credible than a set based on religious revelation. It is not my intention now to give an absolute answer to that question, but to simply point out two advantages bestowed by the use of physics. Firstly, it is not as important for any of the physical theories to be actually correct as it is for them to have the potential to be correct. In this way our relationship with God is shaped not as fear of the unknown and unknowable but as wonder and (partial) comprehension.

Secondly and most importantly the discoveries of sciences are not restricted by birth, creed or race but are for everyone. As Stephen Hawking ended his book "A Brief History of Time" :

If we do discover a complete theory, it should in time be understandable by everyone in broad principle, not just a few

scientists. Then we shall all, philosophers, scientists and just ordinary people be able to take part in the discussion of why it is that we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason -- for then we would know the mind of God.

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