

The Goldilocks Universe

Is our cosmos the whole kaboodle, or is it merely one among an infinite number of universes?

Karl W. Giberson

January 1, 2003

Frederick Forsyth's 1971 thriller *The Day of the Jackal* tells the story of a fiendishly clever assassin who almost brings down Charles DeGaulle. Through a combination of elaborate planning, ingenious subterfuge, and great skill, the Jackal manages to get himself and a high-powered rifle into position to take a single shot at his target. At the last minute the target moves and the bullet buries itself in the ground, unnoticed by the cheering crowd. The 1973 Hollywood version of the novel, starring Edward Fox as the clever, elusive Jackal, was faithful to Forsyth's original scenario of ingenuity and cunning.

The 1997 remake, starring Bruce Willis, was another story. Gone was the elegant, understated assassin. The new Jackal goes after his target—this time the First Lady—with so much firepower that the assembled crowd flees in terror as shattered brick and glass from the front of the building rain down on them. In fact, so great is the carnage that a casual observer would have had some difficulty in determining the Jackal's exact target.

As the saying goes, there is more than one way to skin a cat. If you want to assassinate a highly protected figure you need copious quantities of either finesse or firepower—finesse to do it once and get it right, or firepower to blast away recklessly and eventually hit the target. Finesse and firepower often define the choice between means to a given end. You can write *Hamlet* with the finesse of a Shakespeare or the firepower of an infinite stadium of monkeys typing randomly; you can solve political problems with the finesse of diplomacy or the firepower of cruise missiles; and you can explain the marvelous design of our universe by the finesse of a wise creator or the firepower of some mindless cosmic machine extravagantly belching out alternative realities, some of which have the ingenious design of this one, but most of which do not—collateral damage on a cosmic scale.

Such alternative realities have long been the stuff of science

fiction; after all, who is not interested in the question of whether "our" reality is the only possibility? Are there alternative versions of ourselves in a parallel universe, new and improved? Could we find a way to bring these alternative realities into this familiar one? Could we, for example, freeze ourselves and get thawed out at some later time and live again, perhaps in a century when there were no more reality tv shows?

Speculation about alternative realities is hardly new. Democritus and the atomist philosophers of classical Greece were convinced that the universe contained an infinity of particles, combining in an infinity of random ways and producing every imaginable and unimaginable possibility. Rejecting all this cosmic firepower, Aristotle bequeathed to the Western tradition a compact, tidy, solitary, high-finesse universe with the Earth firmly anchored in the center of things.

This lasted until Copernicus unhooked the Earth and promoted it to the heavens with the other planets. Now that the Earth was a planet like the others, speculation about alternative realities was unleashed. Thus began a long-running debate over "the plurality of worlds." If there are planets besides Earth—so some argued—then they must be inhabited, for God makes nothing in vain, and empty planets would surely be a waste. Others contended that the Earth was uniquely favored in God's creation. The modern inheritors of this question continue to debate the likelihood of intelligent life elsewhere in the universe.

But what if the ante is upped? What if we envision not simply varieties of intelligent life within the almost inconceivable vastness of our universe but rather multiple universes? Until recently, such speculation has been limited almost entirely to science fiction. But the current crop of multiple universes has proceeded not from the fevered imagination of novelists but from leading scientists, whose theories have been expounded in legitimate scientific journals and popularized in countless science magazines.

One might suspect that such unprecedented speculation had emerged from some unusual observation. Maybe planets are disappearing; or space ships that venture beyond the asteroid

belt mysteriously lose contact with nasa. Perhaps new stars are popping into existence from nowhere. But such is not the case. This new cosmology is not based on observation of what appear to be intrusions from other universes. But it is based on new findings of another kind. The many universes on offer today are invoked as a way to explain this universe—in particular, to explain its improbable hospitability to human life.

Our universe, the one we live in, has been determined by contemporary cosmologists to be quite remarkable. The argument, which goes by the name of the Anthropic Principle, and is by now quite familiar, goes like this: if you change the laws of nature in our universe even slightly then the place becomes uninhabitable. Make gravity one percent stronger or weaker and the sun won't shine properly; change the electrical force just a bit and organic molecules won't form; make the universe expand just a little faster and there won't be any solar systems. And so on. All of the various features of this universe appear to have been optimized for life. Change any of them and the universe becomes boring and sterile. Our universe is neither too hot nor too cold; it is just right—a Goldilocks universe.

All this would occasion no surprise if it turned out that the laws of nature somehow have to have their current form, if there were some reason why gravity has its particular strength, electrons their mass, the photon its energy, and so on. But, as near as anyone can tell—and they seem to be able to tell quite nearly—there is no reason why the various features of our universe are the way they are, and not some other, equally plausible, way.

All this makes our gigantic 15-billion-year-old universe seem rather puzzling, with its various parameters so finely adjusted to accommodate us so nicely. Fred Hoyle, one of the past century's greatest cosmologists, said that some "superintellect" must have "monkeyed with the physics"; Freeman Dyson, after looking closely at the cosmic history that preceded our timely arrival, suggested that somehow "the universe knew we were coming." John Wheeler has even suggested that in some really bizarre (meaning quantum mechanical) way, the existence of our universe is dependent on our existence. No people, no

universe—the ultimate symbiosis.

But to many scientists, Hoyle's superintellect and Dyson's intentional universe are hardly satisfactory answers to the mystery of our high-finesse, Goldilocks universe. Such explanations, they complain, are too traditional, too theological, too high on finesse and intelligence in an age that prefers heavy-duty cosmic firepower.

The requisite cosmic firepower comes in the form of some truly mind-boggling speculations about the existence of multiple universes. And by multiple we don't mean seven or eight, or even a few hundred. We are talking about an infinite number of real live universes, with real stuff in them, real matter governed by real laws, and perhaps even alternative reality television programs.

The first really serious proposal for multiple universes came from a quantum theorist named Hugh Everett, who thought that the problems of quantum mechanics were so deep that they could only be solved if the universe was constantly splitting off into slightly different futures. This idea has been rather eloquently updated by the extraordinary and eccentric Oxford physicist David Deutsch. In a few short pages in *The Fabric of Reality*,^{[1](#)} Deutsch shows how the behavior of electrons passing through a slit reveals the presence of other universes.

Deutsch even has a proposal for a quantum computer that will perform half its calculations in some other universe, and thus run twice as fast as the old-fashioned kind that have to do everything in just one universe. He believes that it may one day be possible to build such a computer to test this strange idea. (He does not say how we will know that the extra calculations are being done in another universe, rather than in some hidden spot in this one.) The many universes that you get with quantum theory are the ultimate in cosmic firepower: simple interactions, of the sort that are happening on your retina as you read these words, are splitting the entire universe, making multiple copies of everything that exists—every star, every galaxy, every television set.

Cosmologist Lee Smolin offers another ingenious mechanism to

get lots of universes. His idea runs like this: at the "centers" of black holes are tiny regions of infinite density called "singularities" where the laws of physics appear to completely break down (because of incompatibilities between relativity and quantum theory that cosmologists would like to resolve with a proper quantum theory of gravity that nobody has been able to find, although Smolin claimed in Princeton in March 2002 that he had such a theory). If the laws of physics break down, and it appears that they do in the middle of black holes, then anything can happen. All bets are off. If anything can happen in the middle of the black hole, then maybe a new universe might erupt there, disconnected from this one.

Smolin argues that this is exactly what happens, but that these "daughter" universes are slightly different from their parents. If some daughter universes differ in ways that give them more firepower to generate black holes, then that configuration will be favored in a sort of cosmic Darwinism. As time passes, this cosmic Darwinism will result in universes that are quite prolific, as universes that produce black holes have more "children" than those that do not. And, as luck would have it, universes that are good at making black holes are also good at making planets like ours.

In the prologue to his fascinating *The Life of the Cosmos*,² Smolin humbly labels his idea a "frank speculation" and a "fantasy." Leading cosmologist Sir Martin Rees, however, in an essay in the anthology *Many Worlds*,³ says that Smolin's proposal is a "reasonable reaction" to the mystery of our just-right Goldilocks universe. After all, if there are an infinity of different universes with all manner of different characteristics, then it is not in the least remarkable that one of them happens to look like ours; and it is not remarkable that we happen to live in one of the universes that is compatible with our existence.

On the other hand, if there is but one universe, then it certainly looks like it was designed by some transcendent intelligence. The two choices, which we have been calling finesse and firepower, are very different. A designed universe requires information, lots of information, of the sort that even skeptics are prepared to attribute to "God." An infinity of universes, with one accidentally

looking like ours, needs very little information. If you have enough universes then some of them will naturally and fortuitously look like this one; the impression of design, however, will be illusory.

It may be that an ingenious observational test might one day be devised to detect these alternative universes. But it is hard to see how such a test could be conclusive. If Deutsch's quantum computer does run twice as fast, can we confidently attribute the extra speed to the assistance of an otherwise undetectable alternate universe? All kinds of strange things happen in the world of the quantum; but most physicists are reluctant to suppose that the strangeness is coming from some other universe.

Our universe is remarkable in so many ways. Those who understand this most clearly offer extraordinary explanations: the universe is the product of a transcendently information-rich source, like the traditional creator, or our universe—the scope of which strains our conceptual apparatus to the very limit—is but one of a vast ensemble of universes. The choice toward which one gravitates depends very much on where one starts. If history is any guide, human ingenuity will always be up to the task of devising plausible explanations that are consistent both with one's presuppositions and with generally accepted scientific notions.