

## Parallel Universes

Max Tegmark, a physicist/astronomer highly respected as an international expert on the nature of the universe, has argued that there must be parallel universes: other areas of space that are about the size of the universe that is visible to us and that are exact replicas of our own visible universe. (The “visible universe” consists of a sphere around us whose farthest point is the longest distance from us that light has been able to travel during the 14 billion years since the Big Bang began everything.) Such a replica of our visible universe would have to contain “a person who is not you but who lives on a planet called earth, with misty mountains, fertile fields and sprawling cities.... The life of this person has been identical to yours in every respect.”

The idea that there must be another area of space that is an exact copy of our visible universe—and that contains an exact copy of you—is required by the fact that astronomers have concluded that the entire cosmos—that is, everything that extends beyond our visible universe—is infinite and is uniformly filled with galaxies, stars, and planets like our own visible universe. A volume of space the size of our own visible universe, if it were fully packed with matter, could contain only up to  $10^{118}$  protons. In a different volume of space the same size, each of these protons may or may not, in fact, be present. Hence there are, at most, only 2 to the  $10^{118}$  different possible arrangements of protons in a volume of space the size of our own visible universe. That means, that in a volume of space larger than 2 to the  $10^{118}$  times the volume of our own visible universe, the arrangements of protons would have to

start repeating. Beyond that huge volume, then, there would have to be a volume of space the size of our own visible universe that was, proton for proton, an exact copy of our own visible universe. Because observations of the cosmos beyond our visible universe indicate that it is infinite in volume, this means that somewhere in that infinite volume there must be an area of space the size of our own visible universe that is an exact replica of the volume of space we call our “visible universe” and that therefore includes an exact replica of you.

### QUESTIONS

1. Tegmark makes assumptions about what lies beyond the visible universe (the part of the universe that we cannot perceive with even the most powerful telescopes or any other instruments we could possibly invent). In what sense do you think such parallel universes are “real”?
2. What would a materialist, an idealist, a pragmatist, a phenomenologist, or a logical positivist probably have to say about the reality of these parallel universes?
3. Tegmark says his parallel universes are not part of the “domain of metaphysics” but belong to the “frontiers of physics.” What do you think he means by this? Do you agree?

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Source: Max Tegmark, “Parallel Universes,” *Scientific American*, April 14, 2003; see also Joel Achenbach, “The Multiverse,” *National Geographic*, August 2003.