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M-theory: Doubts linger over godless multiverse

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STEPHEN HAWKING'S new book *The Grand Design* sparked a furore over whether physics can be used to disprove the existence of God. But few have noted that the idea at the core of the book, M-theory, is the subject of an ongoing scientific debate – specifically over the very aspect of the theory that might scrap the need for a divine creator.

That the laws of nature in our universe are finely tuned for life seems miraculous, leading some to invoke divine involvement. But if there is a [multiverse](#) out there – a multitude of universes, each with its own laws of physics – then the conditions we observe may not be unique.

Hawking suggests that M-theory, the leading interpretation of string theory, calls for a multiverse. Others are divided over the strength of this link. "My own opinion is that we don't understand the theory well enough to be able to say whether there is one single universe or a multitude of universes," says M-theorist [Michael Duff](#) of Imperial College London.

[String theory's](#) grand claim was that it would be able to unite quantum mechanics with general relativity. Until the mid-1990s, however, five different versions of it, each featuring 10 spatial dimensions, were vying with each other, along with a sixth model known as 11-dimensional super-membrane theory. M-theory [stitched these six theories together](#) into one overarching theory. But while these six areas are fairly well fleshed out in M-theory, other parts of the theory are threadbare.

One major gap is how and where the seven extra spatial dimensions, beyond the three we experience, are hidden. "The conventional view is that the extra dimensions are very small," Duff says. Alternatively, our universe could exist within a "bulk" that contains the extra spatial dimensions.

A multiverse is compatible with both pictures, so some versions of M-theory are constructed to include a multiverse. However, some theorists argue that being compatible with M-theory does not make a multiverse essential. Duff adds that with our current patchy understanding of M-theory, the multiverse seems plausible enough, but it might not work if we could see the bigger picture. Even then, assuming multiple universes remain mathematically possible, there would still be no proof that they are actually present.

For now, it is hard enough to test string theory, let alone M-theory. Two weeks ago, Duff and his colleagues made some progress by using string theory to

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Faithful to multiple universes (Image: Fredrick M. Brown/Getty)

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make predictions about the behaviour of entangled quantum bits (*Physical Review Letters*, DOI: 10.1103/PhysRevLett.105.100507). This demonstrates that aspects of string theory can be tested in the laboratory, but won't reveal if it is "the right theory to describe all the elementary particles, the big bang – the 'grand design' as Stephen describes it", says Duff.

"It's dangerous to pin your beliefs on any theory of physics," Duff adds, "because it might turn out to be wrong. But if Stephen wants to stick his neck out, I wish him good luck."



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