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Cosmology

Travelling through a wormhole may actually be possible

Leah Crane

PHYSICISTS have worked out a way to send someone through a wormhole, a tunnel between two black holes that connects distant regions of space-time. Normally it would be impossible to pass through one, but factoring in an extra dimension might make it possible.

Under Albert Einstein's theory of general relativity, which describes the behaviour of gravity and space-time, most wormholes would either close whenever something falls in or be extremely small and disappear immediately.

Juan Maldacena at the Institute for Advanced Study in New Jersey and Alexey Milekhin at Princeton University have figured out how a traversable wormhole could exist while following all of the laws of physics as we know them.

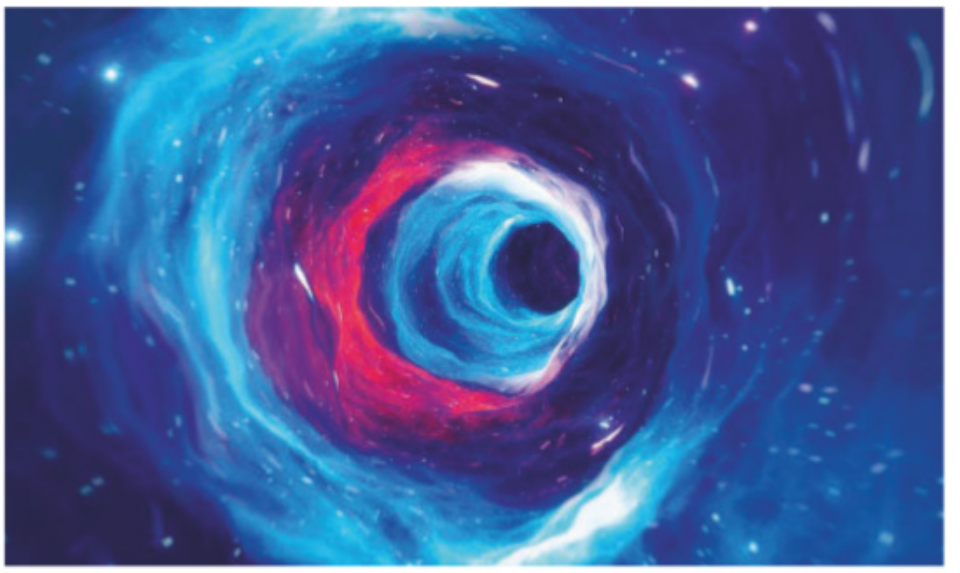
They calculated that if there were an additional dimension of space-time, it would allow for a large number of quantum fields. Fluctuations in quantum fields can produce negative energy, which could keep the wormhole from collapsing (arxiv.org/abs/2008.06618). There is no evidence that all these extra fields exist, but they theoretically could, says Maldacena.

"There are two questions here, which are: whether you would expect this to occur naturally – and there the answer is almost certainly no – and also if you could expect a sufficiently advanced civilisation to be able to make it," says Aron Wall at the University of Cambridge. "It could, in theory,

You could theoretically pass through a wormhole between two black holes

be made with mostly ordinary matter and quantum effects," he says. Whether that would be worth the effort is another question entirely, he adds.

In order to be physically possible, travelling through a wormhole to a distant location would have to take longer than flying there directly through space at the speed of light. However, because of the effects of general relativity, time would pass differently for the person inside the wormhole. "It wouldn't take very long from the perspective of the person inside, while everyone they knew on the outside gets old and dies," says Wall.



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Falling through the wormhole wouldn't be all that unpleasant, though, you would just slowly accelerate to extraordinarily high speeds, and then decelerate again when you emerge. "It'd be just like being in free fall – like there is a hole in the ground and you step in and just fall, and then 3 seconds later you'd emerge on the other side," says Don Marolf at the University of California, Santa Barbara.

Anything else that falls into the wormhole will also accelerate to nearly the speed of light. Unless the wormhole was thoroughly cleaned out and everything else blocked from entering it, falling in would mean certain death from high-speed collisions.

"Whenever you travel close to the speed of light, any particle or dust grain or anything that you hit will be problematic. Even a photon would cause you trouble," says Maldacena. "So that's a word of caution." ▮

Biofuels

Light-harvesting plastic helps algae convert more energy

ADDING a synthetic polymer to algae has increased the plant's rate of photosynthesis, which could lead to more efficient biofuels.

Less than 5 per cent of the sunlight absorbed by any plant is typically converted into energy. To make that process more efficient, Shu Wang at the Chinese Academy of Sciences and his colleagues fused a light-harvesting polymer with a species of freshwater green algae, *Chlorella pyrenoidosa*, which is commonly used to produce biofuel.

The team grew algae in a watery solution and added a polymer called PBF, which bonded to the surface of the algae's cells. PBF has a high rate of green light absorption, which led to increased rates of photosynthesis and the creation of more photosynthetic products such as oxygen and adenosine triphosphate (ATP), which carries energy in cells.

The experiment was mostly done in low light, but the team also tested the effect of brighter light on oxygen production. In the brightest light, the number of oxygen molecules produced increased by 12 per cent, compared with algae without PBF.

But under low-light conditions, the hybrid was more effective, leading to oxygen molecules increasing by 120 per cent and ATP molecules by 97 per cent. The maximum growth rate of the algae also increased by 110 per cent in low light (*Science Advances*, doi.org/d7jm).

Wang plans to test the method on other plants, and says it could make it easier to produce biofuels.

"This fantastic increase in photosynthesis rate is only seen under limited light conditions"

"This fantastic increase in photosynthesis rate is only seen under limited light conditions. It is less impressive under brighter conditions when the algae has reached its light saturation limit," says Richard Cogdell at the University of Glasgow in the UK.

"What I'd like to see is for these researchers to set up big ponds of algae, one with and one without this polymer, and really see the difference in efficiency under normal illumination," he says. ▮

Jason Arunn Murugesu