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Physics

Messages from the other side

It may be possible to send a signal back through a wormhole before it collapses

Leah Crane

WORMHOLES – bridges that create a shortcut between two distant locations in space-time – are still hypothetical, but models suggest they would be fragile and liable to implode if anything fell in. Now, simulations suggest a pulse of light may be able to outrace that collapse.

Ben Kain at the College of the Holy Cross in Massachusetts and two of his students simulated a traversable wormhole to examine what would happen when matter entered it. They found that normal matter would make the wormhole rapidly collapse, but not so fast that you couldn't, in theory, send a message home first.

The type of wormhole they simulated is held open by an exotic type of theoretical matter called ghost matter, which has negative energy. There is some evidence that very small amounts of negative energy can be created through quantum effects, but the idea that there could ever be enough to make a wormhole is still extremely speculative.

"We simply put a negative sign in front of the energy. From a physical standpoint, this may be completely ridiculous; such matter may have no relationship with reality," says Kain. "Wormholes are hypothetical to begin with, so using hypothetical matter maybe isn't the biggest stretch." The negative energy is required in the simulations to make the wormhole traversable.

"This is at the boundary of what is science and what is not," says Francisco Guzmán at the Michoacan University of Saint Nicholas of Hidalgo in Mexico. Nevertheless, simulating speculative objects could help us understand extreme space-time phenomena that are more likely to exist, he says.

This particular kind of wormhole wouldn't look like more traditional ones with black holes at either end. "It would look just like the space around it," says Kain. But add in a little regular matter and the bridge would begin to narrow and then close, and the entrances at either end would collapse and become two distinct black holes (*Physical Review D*, doi.org/jq4n).

While this process would be fast, it wouldn't be instantaneous. "We don't see a way that you could return after going through it, but you could get a signal back to your friends," says Kain. This means that one could hypothetically send a probe through this kind of wormhole to learn something about the other side – although in the simulations, not all of the matter made it through, so it is unclear whether the probe would make it in one piece.

Unfortunately, the fact that this type of wormhole would collapse when any matter fell in also means that it would be extraordinarily difficult to maintain one for any reasonable amount of time.

"Sure, once one of these wormholes forms, a signal could go through, but there's still a question of how you could form one in the first place," says Olivier Sarbach, also at the Michoacan University of Saint Nicholas of Hidalgo. ▮

Wormholes create a shortcut between two locations in space-time

ROST9/SHUTTERSTOCK

Technology

Golf robot navigates to a ball and sinks a putt by itself

A ROBOT called Golfi is the first to be able to autonomously spot and travel to a golf ball anywhere on a green and sink a putt.

Golf-playing robots have been developed before, but they have needed humans to set them up in front of a ball and program them to make the correct swing. The most famous is LDRIC, a robot that hit a lengthy hole-in-one at Arizona's TPC Scottsdale golf course in 2016.

In contrast, Golfi, engineered by Annika Junker at Paderborn University in Germany and her colleagues, can find golf balls and wheel itself into place thanks to input from a 3D camera that looks down on a green from above.

The camera scans the green and an algorithm then approximates the surface before simulating 3000 golf swings towards the hole from random points, taking into account factors such as the mass and initial speed of the ball once hit and the green's friction, which are described by physics-based equations.

This trains a neural network to work out how hard and from what angle the robot should hit any ball.

"It's like how professional golfers often practise their strokes on a green the day before they play," says Junker, who presented the robot at the IEEE International Conference on Robotic Computing in Naples, Italy, in December.

After this, Golfi and a ball can be placed anywhere on the green and the robot will navigate to the ball and try to hit it into the hole.

> "It's like how professional golfers often practise their strokes on a green the day before they play"

Golfi was able to sink more than 60 per cent of putts on a flat, 2-square-metre, indoor green. The robot isn't suited to outdoor greens because it requires a power connection and the 3D camera to be mounted above the green.

However, the idea of Golfi isn't to win golf tournaments. It is meant to show how robotic applications can be simplified by combining physics-based models with machine learning, says team member Niklas Fittkau, also at Paderborn University. ▮

Alice Klein