Vialet says that the Yunxian 3 skull should be compared with Chinese as well as European hominin fossils, such as the 1.4-million-year-old face from the Sima del Elefante cave in Atapuerca, Spain, discovered in July. She is currently comparing Yunxian 2 with European hominin fossils, and says that the Yunxian people could be more similar to European populations from the middle Pleistocene epoch than they are to later specimens from China.

If the Yunxian 3 skull has teeth, especially molars, they could be useful for discerning evolutionary relationships with other early humans, says Clément Zanolli at the University of Bordeaux in France.

Once the Yunxian 3 skull is excavated, probably in the next few months, dating it will be an important task. Several techniques have been used to estimate the age of Yunxian 1 and Yunxian 2.

Hominin fossils in China are often more difficult to date than fossils in Africa, because China lacks volcanic sediments that can be reliably dated by measuring the amounts of radioactive isotopes in the rock, says Wei Wang, a geochronologist at Shandong University.

Jean-Jacques Bahain at the National Museum of Natural History in Paris dated sediments collected from the Yunxian site using electron spin resonance and uranium-series dating[3]. This requires a close comparison between values taken from the fossil and the quartz in the sediment. But he says that the samples he measured weren't collected at the same time and location as the Yunxian 1 and 2 skulls.

"More complete Chinese *Homo erectus* like Yunxian 3 are crucial to answer questions."

The discovery of Yunxian 3 is an opportunity to collect sediment samples from the ground that the skull sits in, he says.

Small animal fossils surrounding the Yunxian 3 skull are slowing the extraction process, according to Gao. Bahain says that such specimens could help to pinpoint the age of the Yunxian 3 skull, and connect it to early human remains elsewhere in China.

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DID PHYSICISTS CREATE A WORMHOLE IN A QUANTUM COMPUTER?

An unusual teleportation experiment was inspired by tunnels in an exotic 'toy' universe.

By Davide Castelvecchi

Physicists have used a quantum computer to perform a new kind of quantum teleportation, the ability to transport quantum states between distant places, as though information could travel instantly. Although teleportation is an established technique in quantum technology, the purpose of the latest experiment was to simulate the behaviour of a passage called a wormhole through a virtual universe.

The researchers behind the experiment, described in *Nature* on 30 November (D. Jafferis *et al. Nature* **612**, 51–55; 2022), say that it is a step towards using ordinary quantum physics to explore ideas about abstract universes in which gravity and quantum mechanics seem to work harmoniously together. Quantum computers could help to develop a quantum theory of gravity in these 'toy' universes. (Developing a quantum theory of gravity for our own Universe is one of the biggest open problems in physics.)

"It's a test of quantum-gravity ideas on a real lab experimental test bed," says Maria Spiropulu, a particle physicist at the California Institute of Technology in Pasadena who led the study.

Tunnels in space-time

Physicists Albert Einstein and Nathan Rosen proposed the idea of wormholes – passages through space-time that could connect the centres of black holes – in 1935. They calculated that, in principle, wormholes were allowed by Einstein's general theory of relativity, which explains gravity as an effect of the curvature of space-time. (Physicists soon realized that even if wormholes exist, they are unlikely to allow anything like the interstellar travel that features in science fiction.)

Because the latest teleportation experiment used an exotic toy universe, it didn't simulate anything resembling the kind of wormhole that could conceivably exist in our Universe, as suggested by Einstein and Rosen. But it can be interpreted as analogous to a wormhole in the researchers' virtual system – quantum information fed into one side of the 'wormhole' reappeared on the other side.

"The surprise is not that the message made it across in some form, but that it made it across unscrambled," write the authors of an accompanying News and Views article (A. R. Brown and L. Susskind *Nature* **612**, 41–42; 2022). "However, this is easily understood from the gravitational description: the message arrives unscrambled on the other side because it has traversed the wormhole."

Exotic physics

The experiment was inspired by earlier research linking the physics of exotic universes and their own versions of gravity to more standard – but still virtual – quantum systems. The main idea is that some abstract versions of space-time emerge from the collective behaviour of ordinary quantum particles living in a sort of 'shadow world' – similar to how a 2D hologram can create the illusion of a 3D image. That 'holographic' behaviour dictates how the emergent space-times curve on themselves, producing the effects of gravity.

Although physicists do not yet know how to write quantum theories of gravity for emergent universes directly, they know that such phenomena should be fully encapsulated in the physics of the shadow world. This means that gravitational phenomena such as black holes – which still pose riddles to theoretical physicists – or wormholes must be compatible with quantum theory.

The latest experiment follows a scheme that co-author Daniel Jafferis, a theoretical physicist at Harvard University in Cambridge, Massachusetts, and his collaborators proposed in 2017 (P. Gao *et al. J. High Energy Phys.* **2017**, 151; 2017). That work focused on the simplest such holographic correspondence, known as SYK after the initials of its creators. In this toy model universe, space has only one dimension, rather than three.

In the latest study, Jafferis, Spiropulu and their colleagues simulated an even more stripped-down version of such a hologram using the quantum bits, or qubits, of Google's Sycamore processor. They expected their simulated quantum particles to reproduce some behaviours of gravity in the virtual universe – but the models were limited by the capabilities of current quantum computers. "We had to find a model that kind of preserves the gravity properties and that we can code on a quantum processor that has a limited amount of qubits," says Spiropulu. "We shrunk it down to a baby model, and we checked that it preserves gravitational dynamics."

"Before we worked on this project, it wasn't obvious that a system with such a small number of qubits could exhibit this phenomenon," Jafferis adds.

Some researchers think that this line of research is a promising pathway for developing a quantum theory of gravity for our own Universe, although others see it as a dead end. The theory tested on the Google processor "only has a very tangential relationship to any possible theories of quantum gravity in our Universe", says Peter Shor, a mathematician at the Massachusetts Institute of Technology in Cambridge.

PARASITE GIVES WOLVES WHAT IT TAKES TO BE PACK LEADERS

Study is one of the few to show the behavioural effects of *Toxoplasma gondii* in wild animals.

By Emma Marris

Wolves infected with a common parasite are more likely than uninfected animals to lead a pack, according to an analysis of more than 200 North American wolves. Infected animals are also more likely to leave their home packs and strike out on their own (C. J. Meyer *et al*. *Commun. Biol.* **5**, 1180; 2022).

The parasite, *Toxoplasma gondii*, makes its hosts bold — a mechanism that increases its survival. To reproduce sexually, *T. gondii* must reach the body of a cat, usually when its host is eaten by one. That becomes much more likely if the parasite alters the host's behaviour, making it foolhardy. Research results are mixed, but in rodents, infection generally correlates with decreased fear of cats and increased exploratory behaviour. Physical and behavioural changes have also been found in people: testosterone and dopamine production are increased and more risks are taken.

Warm-blooded mammals can catch the parasite by eating an infected animal or ingesting forms of *T. gondii* shed in the faeces of infected cats. After a period of acute infection, semi-dormant cysts form in muscle and brain tissue, and persist for the rest of the host's life. Up to one-third of humans might be chronically infected.

Unique data set

Toxoplasma gondii is known to infect wildlife, but few studies have examined its behavioural effects. In one work, infected hyenas in Kenya became more likely to be eaten by lions (E. Gering *et al*. *Nature Commun.* **12**, 3842; 2021). Connor Meyer and Kira Cassidy, wildlife ecologists at the University of Montana in Missoula, thought of a rare opportunity to link infection with behaviour in wild wolves: data on grey wolves (*Canis lupus*) collected intensively in Yellowstone National Park, Wyoming, over nearly 27 years. Some wolves in Yellowstone live near, and sometimes steal prey from, cougars (*Puma concolor*), which are known to carry the parasite. Wolves could become infected by eating the cats — or their faeces.

The team looked at 256 blood samples from 229 wolves, which had been carefully watched throughout their lives, and had their life histories and social status recorded.

Meyer and Cassidy found that infected wolves were 11 times more likely than uninfected ones to leave their birth family to start a new pack, and 46 times more likely to become pack leaders — often the only wolves in the pack that breed.

"We got that result and we just open-mouth stared at each other," Meyer says. "This is way bigger than we thought it would be."

Dan Macnulty, a wolf biologist at Utah State University in Logan, says the study "provides compelling evidence of the profound influence that pathogens can have on the ecology and behaviour of wild animal populations". He adds that it demonstrates the immense value of the long-term study of wolves and other wildlife in Yellowstone National Park.

Ecosystem effects

In future, the team hopes to look at whether infection might make wolves more likely to reproduce successfully — and what the ripple effects of low or high infection rates might be across ecosystems.

Wolf populations with high rates of *T. gondii* infection might expand more quickly across a landscape as individual wolves make the choice to disperse. Aggressive and risk-taking pack leaders could influence how entire packs act — possibly even increasing their chances of encountering cougars and exposing more members to infection.

For Meyer, the moral of the story is that parasites can be major players in ecosystems. "Parasites might have a much larger role than anyone generally gives them credit for," he says.

However, it's unclear how infecting wolves helps the parasite to reach the body of a cat to reproduce. Wolves are known for killing cougars, so even bold, risk-taking ones infected with the parasite are not likely to end up as lunch for the cats, Meyer says. He speculates that, in the past, infected wolves could have been more likely to be preyed on by American lions (*Panthera atrox*), massive feline predators weighing around 200 kilograms, which prowled North America until they went extinct more than 11,000 years ago.

MTNMICHELLE/GETTY

Some wolves in Yellowstone National Park, Wyoming, have become infected with parasites.