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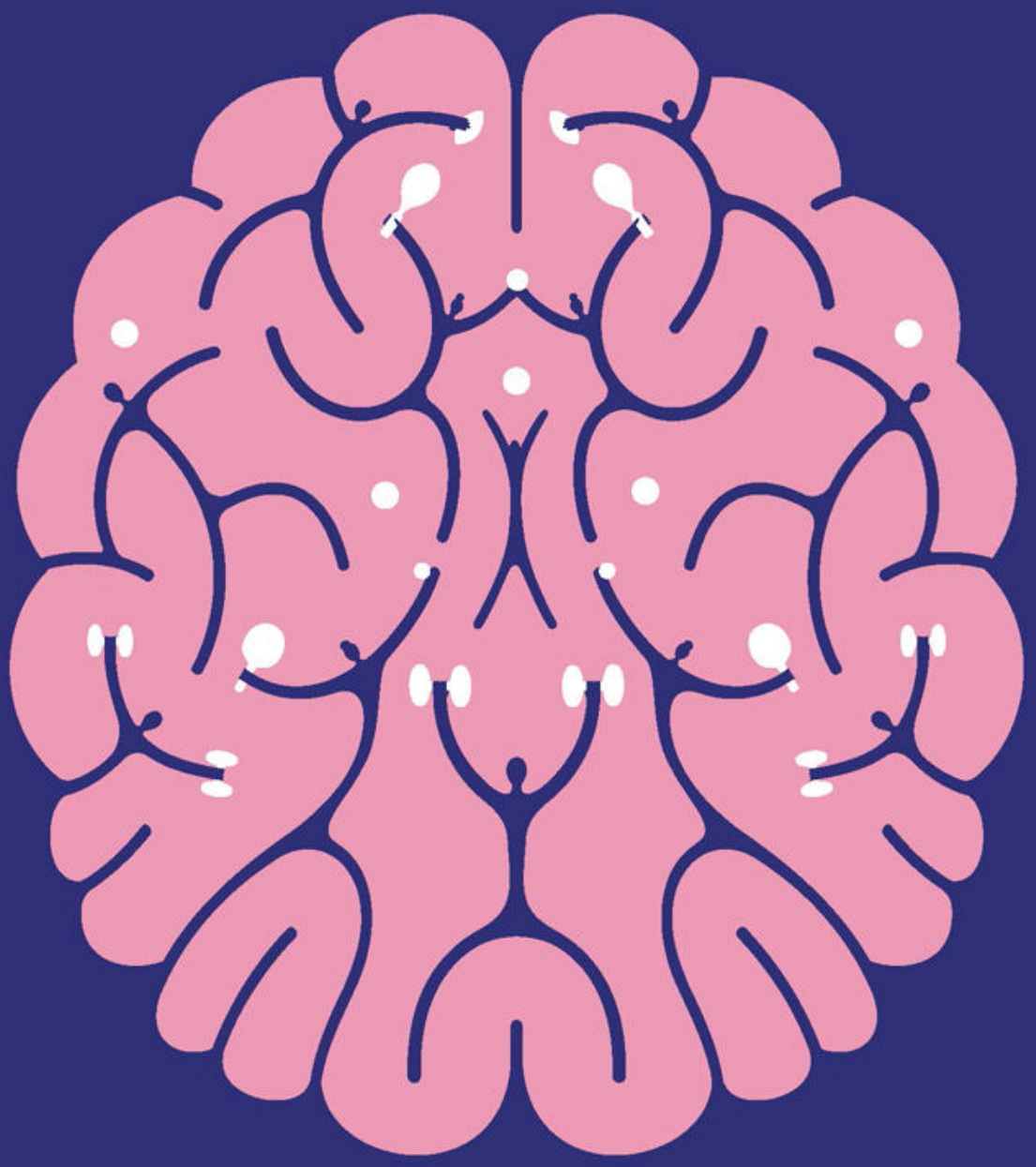

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Physics

Sunlight could cool a charged atom to its coldest possible limit

Karmela Padavic-Callaghan

CHARGED atoms could be taken to their lowest temperature allowed by the laws of physics with the help of sunlight.

In the 1990s, several people won Nobel prizes for working out how to make atoms extremely cold with precisely controlled laser light. Now, Amanda Younes and Wesley Campbell at the University of California, Los Angeles, have found that some parts of the cooling process could be done with light straight from the sun.

The researchers calculated how a positively charged barium atom, or ion, kept in a device called an ion trap could be cooled in two steps.

First, it would be hit with a laser to slow it down, reducing its energy and therefore its temperature.

Then, the temperature could be lowered further by decreasing the atom's entropy – a measure of the disorder of the system. Younes and Campbell found that just getting some sunlight onto the ion would accomplish this. Normally, researchers would use a different-coloured laser.

"You could probably just do this outdoors, but it would be tricky to set up an ion trap outside," says Younes.

In the pair's scheme, sunlight would be transmitted onto the ion through one end of an optical fibre, with the other end on the roof focusing sunlight through a glass lens (arXiv, doi.org/kb9t).

The researchers calculate that electrons in the ion would absorb so much energy that they would become unstable. At this point, they would have to release some energy as light. This would decrease their entropy and they would end up stuck in their lowest possible energy state, only about a millionth of a degree above absolute zero.

Younes says she has already built the fibre to test the process and is expecting to shine it onto an actual barium ion soon. ▮

Space

Fake alien message sent to Earth to mimic first contact

Jonathan O'Callaghan

A MESSAGE has been sent to Earth from a spacecraft orbiting Mars, to simulate potential communication from an advanced alien civilisation.

On 24 May, a spacecraft at Mars, the Trace Gas Orbiter (TGO), was used to send a coded message – just a few kilobytes in size – to our planet. Picked up by radio receivers on Earth, groups of astronomers and enthusiasts then set to work decoding it, a potential dry run for first contact.

"This kind of experiment is long overdue," says Franck Marchis at the SETI Institute in California, who helped to coordinate the event. "We have been searching for extraterrestrial signals for more than 60 years, but we never really thought about what receiving and decoding such a signal would be like."

300m

Number of kilometres between the Martian orbiter that sent the signal and Earth

16

Number of minutes it took the transmission to reach Earth

The project, called A Sign in Space, was led by artist Daniela de Paulis in Rome, who was put in touch with the European Space Agency (ESA) to use the TGO spacecraft. The goal was to assess how, if we ever picked up a radio signal from an alien civilisation, humans might respond. "Having a Martian source makes the project immediately more relatable," she says. "The source of the signal is truly in outer space."

It took 16 minutes for the transmission to get from Mars to Earth owing to the current distance of nearly 300 million kilometres between the two planets. The data was picked up by several radio telescopes on Earth, including the SETI Institute's Allen Telescope Array in California and the Green Bank Observatory in West Virginia.

Groups on Earth then began trying to decode the message, the contents of which were kept closely under wraps. Neill Sanders at UK astronomy group Go Stargazing was one of those involved in attempting to decipher the message. "It's fascinating," he says. "It gives us a little sense of what would happen if we really did get a signal, everything from capturing the signal to processing the data."

SETH SHOSTAK/SETI INSTITUTE

The Allen Telescope Array in California detected the message

Golden record

The science mission of TGO, which studies the atmosphere of Mars from 400 kilometres above its surface, wasn't affected by the project, says Tiago Loureiro at ESA's European Space Operations Centre in Germany. "We explored options on how this could be done without disturbing the spacecraft's operations," he says.

Messages have been sent by humans into space before in attempts to make first contact, such as the Arecibo message in 1974 that was beamed to a nearby galaxy cluster. NASA's twin Voyager spacecraft – both now beyond the solar system – also contain a "golden record" with information about planet Earth. Despite the suspected billions of planets in our galaxy, however, we have never encountered a message coming the other way – until now.

The message had yet to be decoded as *New Scientist* went to press, but de Paulis hopes that its eventual decipherment will encourage discussion of what it might mean to make first contact. "How would we make sense of such a thing?" she says. "The project is really a way to highlight this very human philosophical process of making meaning around something." ▮