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The Science of Child Care

Mysterious Cosmic Explosions

How the Brain Builds Reality

AGE OF THE MAMMALS

After the dinosaurs died, our ancestors thrived

ADVANCES

Scientists propose sending a message to space using California's Allen Telescope Array (*seen here*) or China's Five-Hundred-Meter Aperture Spherical Radio Telescope.

Seth Shostak/SETI Institute

INSIDE

SPACE

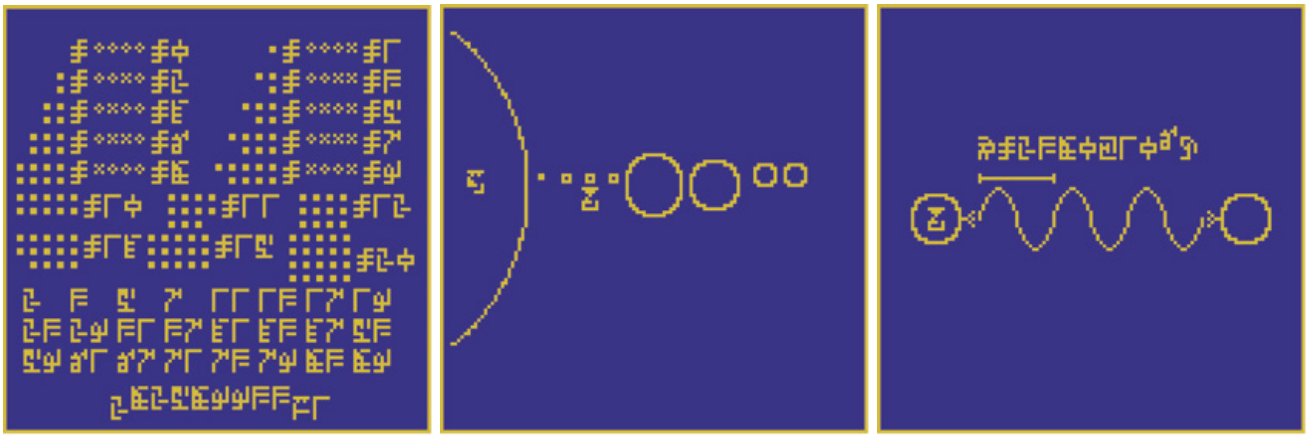
Long-Distance Call

An updated proposal for beaming a message to the stars

If we ever encounter intelligent life beyond Earth, a key first question will be: "How can we communicate?" An international team of researchers, led by Jonathan H. Jiang of the NASA Jet Propulsion Laboratory, recently detailed a new missive intended for reaching out to extraterrestrial recipients. The 13-part "Beacon in the Galaxy" updates the 1974 Arecibo message—humanity's first attempt to send a communication that extraterrestrial intelligence might understand.

Jiang and his colleagues propose aiming the message toward a dense ring of stars near the Milky Way's center that are likely to host promising planets. The transmission also features a freshly designed return address that will help any alien listeners pinpoint our location so they can—the researchers hope—kick off an interstellar conversation. "The motivation for the design was to deliver the maximum amount of information about our society and the human species in the minimal amount of message," Jiang says. "With improvements in digital technology, we can do much better than 1974."

Nearly all the messages humans have broadcast into space so far start with an attempt to establish common ground using basic science and mathematics, which are presumably familiar to both ourselves and any extraterrestrials advanced enough to receive a radio signal. But scientists must



Pages from "Beacon in the Galaxy" codifying numbers, illustrating the solar system and inviting the receiver to reply at a specific frequency. Researchers propose transmitting the message's 13 parts using binary code for the recipient to assemble into images.

choose how to encode these concepts. Rather than using arbitrary human languages or numeral systems, many attempts (including the new "Beacon in the Galaxy") opt to design their messages as a bitmap, a method of creating a pixelated image using binary code.

A bitmap is a logical approach; the on/off, present/absent nature of a binary system seems like it would be recognized by any intelligent species. But this strategy is not without shortcomings. When Frank Drake, a pioneer in the search for extraterrestrial intelligence (SETI), created a prototype of the Arecibo transmission, he mailed the binary message to several colleagues—including some Nobel laureates. None understood its contents, and only one realized it was a bitmap.

And even if space aliens manage to decode the message, they might not be able to see any images within. "One of the key ideas is that because vision has evolved independently many times on Earth, that means aliens will have it, too," says Douglas Vakoch, president of METI (Messaging Extraterrestrial Intelligence) International, a nonprofit organization that studies how to communicate with other life-forms. "But that's a big 'if,' and even if they can see, there is so much culture embedded in the way we represent objects."

Jiang and his colleagues based much of their design, published in the journal *Galaxies,* on the 2003 "Cosmic Call" message broadcast from the Yevpatoriya RT-70 radio telescope in the region of Crimea. This featured a custom bitmap "alphabet" designed to be robust against transmission errors. After an initial transmission of a prime number to mark the broadcast as artificial, Jiang's message uses this alien alphabet to introduce our base-10 numeral system and basic mathematics. The missive then uses a universal phenomenon—the radio wave a hydrogen atom releases when switching energy states—to explain the idea of time and to mark when the transmission was sent from Earth. The message also introduces common elements from the periodic table and depicts DNA's structure and chemistry.

The final pages are potentially the most interesting to extraterrestrials but also the least likely to be understood. They feature a sketch of a male and a female human, a map of Earth's surface, a diagram of our solar system and the radio frequency that the extraterrestrials should use to respond to the message. Plus, they offer the coordinates of our solar system, referenced to the locations of globular clusters—stable and tightly packed groups of thousands to millions of stars that would likely be familiar to space-watching entities anywhere in the galaxy.

The researchers propose sending their communication from either California's Allen Telescope Array or China's Five-Hundred-Meter Aperture Spherical Radio Telescope (FAST). Since the recent destruction of the Arecibo telescope in Puerto Rico, these are the world's only radio telescopes actively courting SETI researchers. For now, however, both can only listen to the cosmos; Jiang acknowledges that outfitting either telescope with transmission equipment would not be a trivial project. But it is possible, and Jiang says he and his coauthors are discussing ways to work with FAST researchers to make it happen.

A far deeper question is whether we *should* send a message at all, a controversy among many SETI researchers: Could this entire effort be a waste of time, or could it invite attack by malicious entities? "I don't live in fear of an invading horde, but other people do. And just because I don't share their fear doesn't make their concerns irrelevant," says Bowling Green State University researcher Sheri Wells-Jensen, an expert on the linguistic and cultural issues associated with interstellar message design. But "just because it would be difficult to achieve global consensus on what to send, or whether we should send, doesn't mean we shouldn't do it. It is our responsibility to struggle with this and clue as many people in as possible."

Many insist that the potential rewards of "active SETI" far outweigh the risks. First contact would be one of the most momentous occasions in the history of our species, the argument goes—and if we just wait around for someone to call us, it may never happen. As for the risk of annihilation by malevolent space aliens, we blew our cover long ago. Any extraterrestrial capable of traveling to Earth would likely be more than capable of detecting evidence of life in the chemical signatures of our atmosphere or the electromagnetic radiation that has been leaking from our radios, televisions and radar systems for the past century.

"This is an invitation to all people on Earth to participate in a discussion about sending out this message," Jiang says. "We hope, by publishing this paper, we can encourage people to think about this."

—Daniel Oberhaus

"A Beacon in the Galaxy: Updated Arecibo Message for Potential FAST and SETI Projects," by Jonathan H. Jiang et al., in *Galaxies;* March 25, 2022