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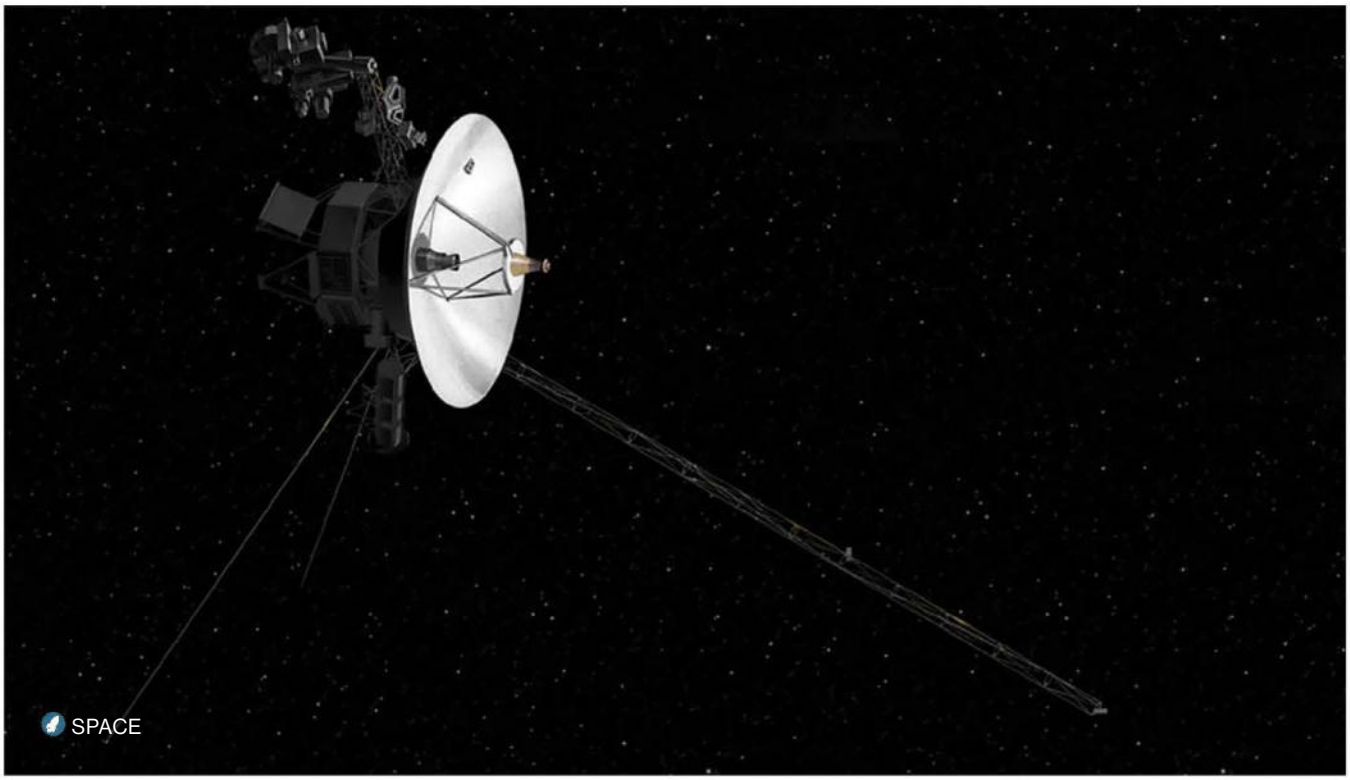

How did NASA lose and recover Voyager 2?

Tiny craft travelling for decades can still phone home.

FOR SUZANNE DODD, Project Manager of NASA's Voyager Interstellar Mission, the Voyager 1 and Voyager 2 spacecraft are "sort of my first love – and true love".

Her love for these vintage interstellar explorers, launched two weeks apart in 1977, has bloomed over many years. She began working on the Voyager mission in 1984, shortly after graduating from college, before leaving to work on other NASA projects, such as the Cassini-Huygens space research mission. Then, in 2010 she returned to where her career had started to take on her current role.

By then, the twin craft had long completed their primary mission of conducting closeup studies of Jupiter and Saturn. Each is equipped with a range of instruments, including television cameras, infrared and ultraviolet sensors and cosmic-ray and charged-particle sensors, as well as a gold-plated record containing sounds and images selected to portray life and culture on Earth to anyone or anything who might find them.

On 25 August 2012, Voyager 1 left our solar system and entered interstellar space. Six years later, Voyager 2 achieved the same milestone.

In the years since, the two spacecraft have continued transmitting the information they collect about things such as the interstellar magnetic field and cosmic rays, back to Earth via the Deep Space Network (DSN) – NASA's trio of giant radio antennas located equidistantly around the world, which support interplanetary spacecraft missions.

But on 21 July, NASA suddenly lost contact with Voyager 2. To make a fine adjustment to Voyager 2's antennae so that it pointed more closely to Earth, flight controllers had built a precise command to send to the spacecraft. But they'd realised that the command had the wrong parameters in it.

"We rebuilt the command with the correct parameters," Dodd explains. "But what happened is that we accidentally sent the earlier version of the command – not the updated one."

This caused Voyager 2's antennae to point 2° away from Earth, severing communication with flight controllers. Although Dodd was confident that contact with Voyager 2 would have been restored in mid-October when the spacecraft was due to automatically realign itself with Earth using the Sun and Canopus, she didn't want to rely on this protection feature.

But how to manually restore contact with a spacecraft the size of an old Volkswagen beetle that was more than 19 billion kilometres from Earth and hurtling through deep space at a speed of over 56,000 km/h?

Critical to this very ambitious goal was the Canberra Deep Space

NASA

Communication Complex (CDSCC), one of the three facilities that form the DSN.

As Glen Nagle from the CDSCC explains: "After Voyager 2's encounter with Neptune in 1989, it headed southward out of the planetary ecliptic. And it's now so far south that our sister stations in the Northern Hemisphere can't see it because Earth is in the way.

"So, since 2002, it's kind of been exclusively ours," Nagle laughs.

The first part of the plan involved using Deep Space Station 43 to listen for its carrier signal – "the heartbeat of the spacecraft", according to Nagle. Promisingly, scientists at CDSCC detected a faint signal that resembled Voyager 2's. They listened to the sounds of deep space a second time and detected the same whisper.

After processing the data "to eliminate the junk mail of the universe" – as Nagle puts it – the scientists in Australia sent it to Dodd and her team in the United States for analysis, which confirmed that the signal was from Voyager 2.

Following this, the CDSCC transmitted what Nagle calls an "interstellar cooee". This transmission was approximately 250% stronger than normal ones to increase the chances of the spacecraft's antennae detecting it.

> They will ultimately outlast the Earth and the Sun

Voyager 2 flew by Jupiter's moon Europa (top) in 1979. Suzanne Dodd (above) is NASA's mission project manager.

"And that transmission contained a single command," Nagle says. "'which was: 'reorientate your antennae back to Earth.'"

A long wait ensued: it would take 18.5 hours for the transmission to reach Voyager 2 – and another 18.5 hours for scientists to know if it did. They weren't confident. But after 37 nervous hours, a signal arrived. There was no doubt where it had come from: contact with the spacecraft was restored.

"There were cheers and high-fives in the control room," Nagle says.

Dodd says her team at NASA is conducting a thorough investigation into the incident to help ensure that something like it doesn't happen again. But she knows that eventually the plutonium power source of the spacecraft she loves will eventually run dry – and contact with the two Voyagers will be lost forever.

"If you want to think really long term," Nagle says, "they will ultimately outlast the Earth and the Sun and be the last reminder that we ever existed in the universe." And maybe – just maybe – they will prove to an alien civilisation that there is – or at least once was – other life out there.

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