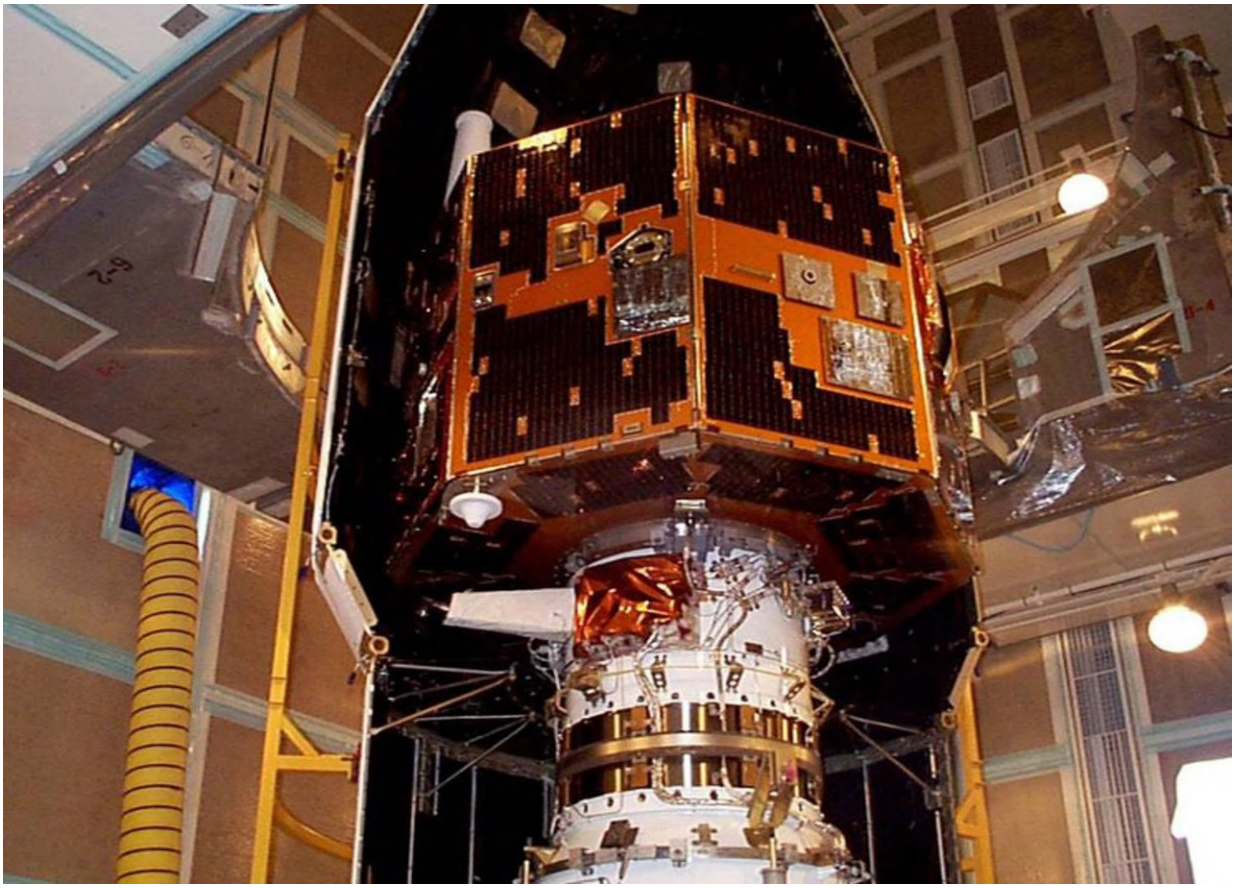
The IMAGE satellite's stunning return

February 7 2018



The IMAGE satellite, launched in 2000, lost contact with NASA in 2005. It was rediscovered by an amateur astronomer in January. Credit: NASA

One-sixty-six, where are you? Oh, there you are.

The Imager for Magnetopause-to-Aurora Global Exploration (IMAGE)

spacecraft – NASA ID 166 – was lost for more than a decade until an amateur astronomer found it last month, to the delight of Rice University's Patricia Reiff, one of the original scientists in charge of the mission that began in 1989 and launched into orbit in 2000.

In 2005, after 5 1/2 years of successful operations, the satellite stopped communicating for unknown reasons. It had fulfilled the parameters of its mission and provided astrophysicists with a wealth of data on the magnetosphere, the region of space controlled by the planet's magnetic field and the host to plasmas that can't easily be seen by Earth-bound instruments.

There had been no further communications from the satellite until Canadian ham radio operator and space enthusiast Scott Tilley recently heard radio signals and figured out they were from IMAGE.

Reiff was stunned when she got the news Jan. 24 from Rice alumnus and IMAGE principal investigator James Burch, who in turn emailed other scientists. "Burch is like me; he works all the time," she said. "He sent it out to the team at 3 in the morning.

"I normally get up at 5:30 or 6, and l do my email before I come in," Reiff said. "So I opened up my laptop and went, 'WOW!' By 7 a.m., everybody on the team knew about it."

She said the best reaction came from the team member who wrote, "I've managed to clean all the coffee off my laptop that I spit on when I saw Burch's email this morning."

NASA confirmed the identity of the spacecraft Jan. 30, and tests over the next couple of weeks will determine how well its various instruments have held up. NASA scientists speculate that the spacecraft's primary power distribution unit, which underwent an unexpected reboot in 2004,

a year before its backup failed, has now come back online.

Though IMAGE may be old in technological terms, Reiff said she and her colleagues believe it can make a strong contribution to space-weather science if it can be fully revived.

"The questions now are, first, Are the instruments and the spacecraft healthy? And second, Can we control it?" she said.

Reiff noted some good news: The spacecraft and control software was stored on 4-millimeter cassette cartridges and NASA's ongoing SOHO mission has a tape drive that can read them.

Reiff anticipates that if IMAGE is truly active, the control code will be rewritten for modern computers, and if funded, the spacecraft can be put back to work watching for auroral activity over the North Pole, among other tasks.

That task is one she's most interested in. IMAGE may once again provide real-time imaging of the polar aurora (often referred to as the northern and southern lights). Such imaging has been missing since IMAGE went dark, though the data it provided is still being analyzed.

"I published a paper last year using IMAGE data, with extended analysis on the motion of the auroral zones based on magnetic fields in the solar wind," she said.

"The auroral zones are very dynamic," Reiff said, noting the Polar satellite that covered the South Pole in her paper went dark in 2008. "For 10 years, we have not had a global imager watching the aurora from space, and that is the easiest way to know that space weather's happening—to watch the aurora go crazy. We have ground-based imagers but they only see little pieces of the oval."

Like its Polar counterpart, IMAGE follows an orbit that takes it close to the South Pole and high over the North Pole once every 14 hours. "It zips around the South Pole so it can linger at apogee for four or five hours over the north and capture images," she said. "It's basically in almost exactly the orbit it was launched into, which is ideal."

A real-time view of the aurora could predict when major solar storms put power lines at risk. "If the auroral zone expands so much that it goes over a big transmission line, then we could have gigantic power outages," she said. "Another problem is that if the space station goes poleward of the aurora, that puts them into a different particle environment and that puts them in some danger from energetic particles from the sun and the galaxy."

She said IMAGE could become an important contributor to a suite of current and future satellites designed to study the upper atmosphere and space weather, including the four-spacecraft array called Magnetospheric Multiscale (MMS), which studies magnetic reconnection. Reiff is a co-principal investigator of that mission as well.

"What's cool about IMAGE in conjunction with MMS is that IMAGE can give global context, where all our individual spacecraft are in individual orbits and measure conditions only where they happen to be," she said.

"These two missions came out of the same community workshop as the most important missions for the 21st century," Reiff said. "The idea was IMAGE was the telescope and MMS was the microscope.

"In addition to other missions flying now, like the Van Allen Probes some of our people are working with and the THEMIS, there are two ionospheric missions this year," she said. "One was launched last week, called GOLD, and another called ICON is going to be launched this fall.

IMAGE would provide wonderful context for those two ionospheric missions because we can see the ionosphere all at once.

"I think a really strong case can be made that if it's healthy and if the instruments are healthy, then IMAGE needs to be reactivated," Reiff said.

If nothing else, she's happy to hear from her teenage satellite. "IMAGE has phoned home," she said, smiling, "and finally, we answered."

Provided by Rice University