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Legendary Arecibo telescope will close forever – scientists are reeling

New satellite image reveals the damage that shut down the facility, ending an era in astronomical observation.

Alexandra Witze



Damage to the Arecibo telescope from a 6 November cable break is too extensive to repair, the US National Science Foundation says. Credit: University of Central Florida/Arecibo Observatory

One of astronomy's most renowned telescopes – the 305-metre-wide radio telescope at Arecibo, Puerto Rico – is permanently closing. Engineers cannot find a safe way to repair it after two cables supporting the structure suddenly and catastrophically broke, one in August and one in early November.

It is the end of one of the most iconic and scientifically productive telescopes in the history of astronomy – and scientists are mourning its loss.

"I don't know what to say," says Robert Kerr, a former director of the observatory. "It's just unbelievable."



Arecibo telescope wins reprieve from US government

"I am totally devastated," says Abel Méndez, an astrobiologist at the University of Puerto Rico in Arecibo who uses the observatory.

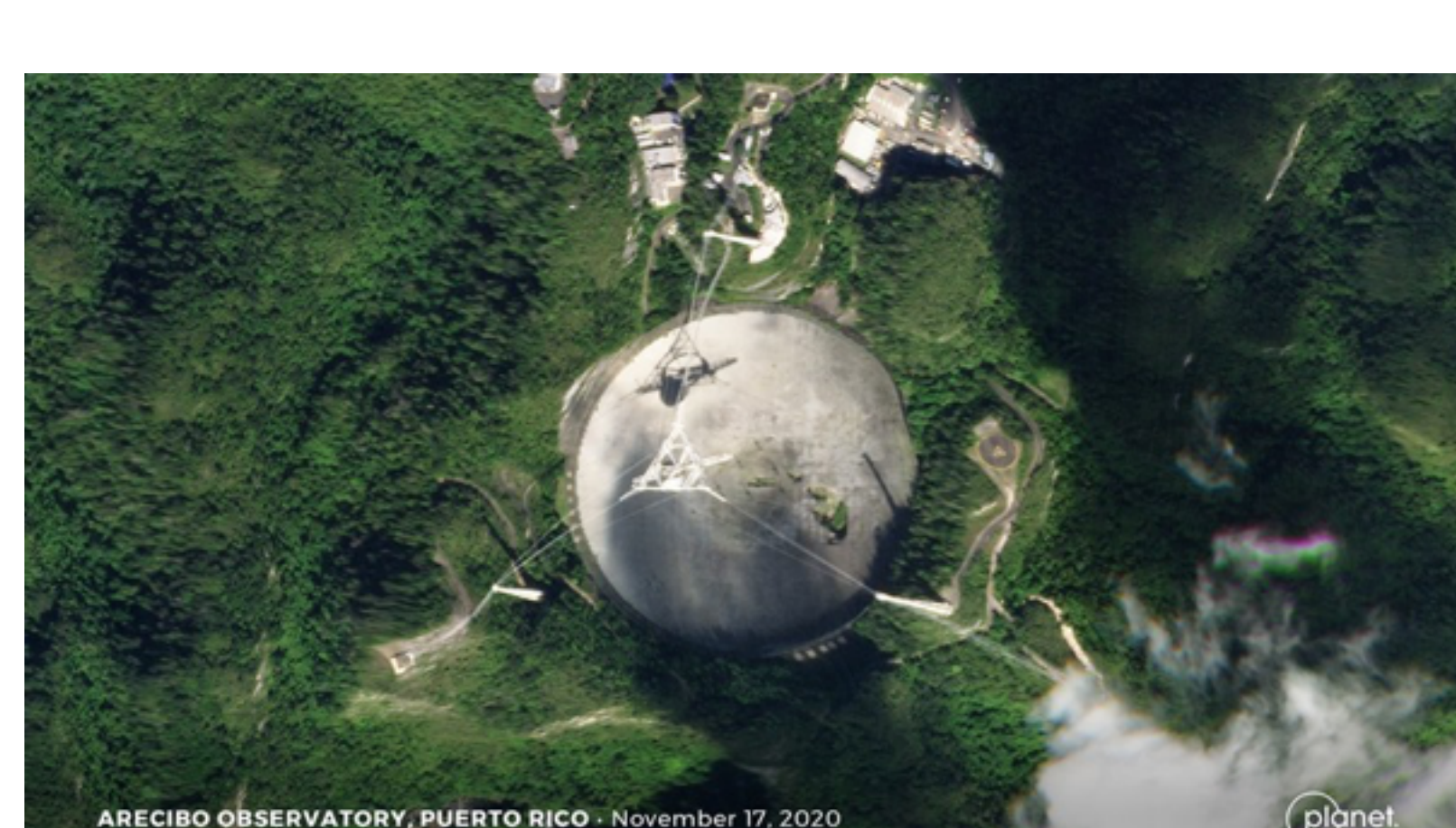
The Arecibo telescope, which was built in 1963, was the world's largest radio telescope for decades and has historical and modern importance in astronomy. It was the site from which astronomers sent an interstellar radio message in 1974, in case any extraterrestrials might hear it, and where the first known extrasolar planet was discovered, in 1992.

It has also done pioneering work in studying near-Earth asteroids, observing the puzzling celestial blasts known as fast radio bursts, and exploring many other phenomena. All of those lines of investigation are now shut down for good, although limited science continues at some smaller facilities at the Arecibo site.

Assessing the damage

The cables that broke helped support a 900-tonne platform of scientific instruments, which hangs above the main telescope dish. The first cable slipped out out of its socket and smashed panels at the edge of the dish, but the second broke in half and tore huge gashes in a central portion of the dish.

A high-resolution satellite image, produced at *Nature's* request by Planet, an Earth-observing company, shows the extent of the damage wrought by the second cable; the green of the vegetation below shows through large holes in the dish. A second photograph, released this week by observatory officials, also reveals the destruction. They are some of the only public glimpses of the damage to date.



A high-resolution satellite image of the Arecibo dish shows gashes in the main dish through which green vegetation below is peeping through. Credit: Planet Labs, Inc.

If any more cables fail – which could happen at any time – the entire platform could crash into the dish below. The US National Science Foundation (NSF), which owns Arecibo Observatory, is working on plans to safely lower the platform down in a controlled fashion.

But those plans will take weeks to develop, and there's no telling whether the platform might crash down uncontrollably in the meantime. "Even attempts at stabilization or at testing the cables could result in accelerating the catastrophic failure," said Ralph Gaume, director of the NSF's astronomy division, at a 19 November media briefing.



So NSF decided to close the Arecibo dish permanently. "This decision is not an easy one to make, but safety is the number-one priority," said Sean Jones, head of NSF's mathematical and physical sciences directorate.

The closure comes as a shock to the wider astronomical community. A social-media campaign with the hashtag #WhatAreciboMeansToMe sprung up almost immediately, with astronomers, engineers and other scientists – mostly from Puerto Rico – sharing stories of how the observatory had shaped their careers. "Losing the Arecibo Observatory would be a big loss for science, for planetary defense, and for Puerto Rico," said Desirée Cotto-Figueroa, an astronomer at the University of Puerto Rico at Humacao, in an email prior to the announced closure.

NSF officials insist that the cable failures came as a surprise. After the first, engineering teams spotted a handful of broken wires on the second cable, which was more crucial to holding up the structure, but they did not see it as a major problem because the weight it was carrying was well within its design capacity. "It was not seen as an immediate threat," says Ashley Zauderer, programme director for Arecibo at the NSF.



The main cable that failed experienced wire breaks (shown) before its sudden and unexpected collapse. Credit: University of Central Florida/Arecibo Observatory

But that main cable, which was installed in the early 1960s, was apparently degrading over time. Over the years, external review committees have highlighted the ongoing need to maintain the telescope's ageing cables. Zauderer said that maintenance had been completed according to schedule.

Before this year, the last major cable problems at the observatory were in January 2014, when a magnitude-6.4 earthquake caused damage to another of the main cables, which engineers repaired. The ageing structure has suffered other shocks in recent years, including Hurricane Maria in 2017 and a series of earthquakes in January of this year.

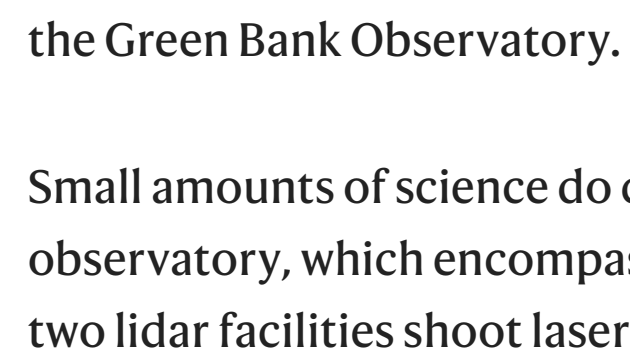
There is no estimate yet on the cost of decommissioning the telescope.

A legendary site

Among the science that has ground to a halt are Arecibo's world-leading asteroid studies. The telescope could ping radio waves at near-Earth asteroids to reveal the shape and spin of these threatening space rocks. Not having Arecibo "will be a big loss," says Alan Harris, an asteroid scientist in La Canada, California. (China's relatively new FAST radio telescope, which measures 500 metres across, does not currently have the ability to do such radar studies.)

Some of the observatory's scientific projects may be able to be transferred to other facilities. Gaume said – and that he expects scientists to propose where to shift their research to. Much of the work done at Arecibo, though, could only be done with its unique array of astronomical instrumentation. "The Arecibo telescope is irreplaceable," said a statement from two major US radio astronomy organizations, the National Radio Astronomy Organization and the Green Bank Observatory.

Small amounts of science do continue at other portions of the Arecibo observatory, which encompasses more than the 305-metre dish. For instance, two lidar facilities shoot lasers into the atmosphere to study atmospheric phenomena.



The Arecibo telescope had been regularly upgraded, with several new instruments slated to be installed in the coming years. "The telescope is in no way obsolete," says Christopher Salter, an astronomer at the National Radio Astronomy Observatory in Green Bank, West Virginia, who worked at Arecibo for years.

Future upgrades that were underway are now on hold, including a US\$5.8-million antenna that was being developed for the telescope's platform and would have dramatically increased its sensitivity. Brian Jeffs, an engineer at Brigham Young University in Provo, Utah, who heads the project, says his team expects to eventually discuss options for its future with NSF. "Our greatest concerns are for the wonderful scientific, technical, management, and support staff" of the observatory, he says.

The observatory is a major science-educational centre for Puerto Rico, fostering the careers of many astronomers and engineers. And it has become a part of the pop culture lexicon, featuring in major movies such as *Contact*, based on a Carl Sagan novel, and the James Bond film *GoldenEye*.

The last major radio telescope disaster happened in 1988, when a 300-foot-wide antenna at the observatory in Green Bank, West Virginia, collapsed one night due to structural failure.

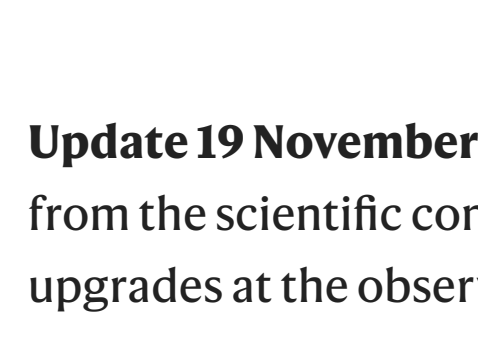
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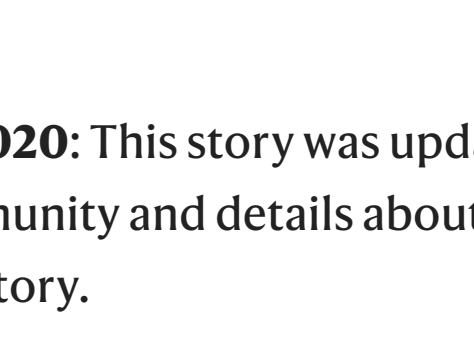
Update 19 November 2020: This story was updated to include more reaction from the scientific community and details about the ongoing research and upgrades at the observatory.

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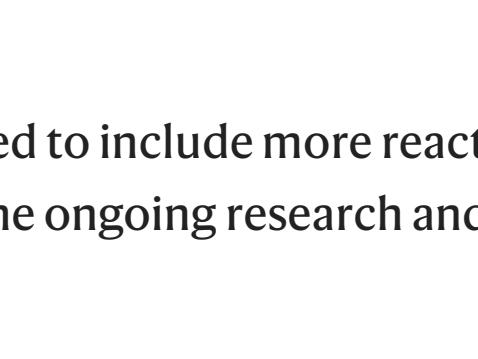
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