

Cassini burns up in skies over Saturn, ends 20-year mission

NASA's Cassini spacecraft disintegrated in the skies above Saturn early on September 15 in a final, fateful blaze of cosmic glory, following a remarkable journey of 20 years.

Confirmation of Cassini's expected demise came about 7.55 a.m. EDT (5.25 p.m. IST). That's when radio signals from the spacecraft its last scientific gifts to Earth came to an abrupt halt. The radio waves went flat, and the spacecraft fell silent.

Cassini actually burned up like a meteor 83 minutes earlier as it dove through Saturn's atmosphere, becoming one with the giant gas planet it set out in 1997 to explore. But it took that long for the news to arrive at Earth a billion miles away.

The only spacecraft to ever orbit Saturn, Cassini showed us the planet, its rings and moons up close in all their glory. Perhaps most tantalising, ocean worlds were unveiled by Cassini and its hitchhiking companion, the [Huygens lander](#), on the moons Enceladus and Titan, which could possibly harbour life.

Cassini snapped its "last memento photos" of the Saturn system on September 14. Dutiful to the end, the spacecraft sampled Saturn's atmosphere on September 15 morning as it made its final plunge.

Programme manager Earl Maize made the final announcement: "This has been an incredible mission, an incredible spacecraft and you're all an incredible team," Mr. Maize said. "I'll call this the end of mission."

Flight controllers wearing matching purple shirts stood and embraced and shook hands.

More than 1,500 people, many of them past and present team members, had gathered at California's Jet Propulsion Laboratory for what was described as both a vigil and celebration. Even more congregated at nearby California Institute of Technology, which runs the lab for NASA.

Project scientist Linda Spilker noted Cassini has been running "a marathon of scientific discovery" for 13 years at Saturn. "So we're here today to cheer as Cassini finishes that race," she said.

The spacecraft tumbled out of control while plummeting at more than 122,000 kmph. Project officials invited ground telescopes to look for Cassini's last-gasp flash, but weren't hopeful it would be spotted from a billion miles away.

This Grand Finale, as NASA calls it, came about as Cassini's fuel tank started getting low after 13 years exploring the planet. Scientists wanted to prevent Cassini from crashing into Enceladus or Titan and contaminating those pristine worlds. And so in April 2017, Cassini was directed into the previously unexplored gap between Saturn's cloud tops and the rings. Twenty two times, Cassini entered the gap and came out again. The last time was last week.

The leader of Cassini's imaging team, Carolyn Porco, a visiting scholar at the University of California, Berkeley, was so involved with the mission for so long that now, "I consider it the start of life, part two."

Cassini departed Earth in 1997 and arrived at the solar system's second largest planet in 2004. The European Huygens landed on big moon Titan in 2005. Nothing from Earth has landed farther.

In all, Cassini collected more than 453,000 images and traveled 4.9 billion miles. It was an international endeavour, with 27 nations taking part. The final price tag was \$3.9 billion.

The [#GrandFinale](#) toolkit -- everything you need to know about why, how and when our mission is coming to a close: <https://t.co/TSA7uQe4KS> [pic.twitter.com/pn18YcsFt8](https://t.co/pn18YcsFt8)

5.32 p.m.: NASA says Cassini spacecraft has burned up in the skies over Saturn as planned, ending a 20-year mission. Earth received Cassini's final signal at 7:55 a.m. ET (5.25 p.m. IST). Cassini is now part of the planet it studied. Thanks for the science.

5.30 p.m.: Our Cassini spacecraft is now one with the planet it studied for so long. The rest is science. Goodbye Cassini, tweets [@NASAJPL](#).

5.27 p.m. IST: NASA announces end of mission. Our spacecraft has entered Saturn's atmosphere, and we have received its final transmission, tweets [@CassiniSaturn](#)

5.01 p.m. IST: @NASAJPL tweets: Cassini Mission Control update: Loss of signal expected ~4.54 a.m. PT (5.24 p.m. IST).

4.53 p.m. IST: @CassiniSaturn tweets: Cassini's final transmission is currently traveling at the speed of light past Jupiter.

4.01 p.m. IST: Cassini's final dive is happening at Saturn, with the **last signal expected on Earth at 5.25 p.m. IST**. This means the spacecraft is entering the planet's atmosphere. *(NASA's Cassini Grand Finale update)*

2.25 p.m. IST: Cassini engineers have received the signal that Cassini has started a five-minute roll to point the instrument that will sample Saturn's atmosphere into the optimal direction, facing the direction of the oncoming gases. Along with this roll, the spacecraft is reconfiguring its systems for real-time data transmission at a rate of 27 kilobits per second (3.4 kilobytes per second). Final, real-time relay of data starts immediately after. That relay marks the beginning of Cassini's final plunge. *(NASA's Cassini Grand Finale update)*

Why did we end [@CassiniSaturn](#) mission with this [#GrandFinale](#) dive into [#Saturn](#)? To protect moons from contamination: <https://t.co/mzKW5uDsTi> [pic.twitter.com/vJJvhkSnPR](https://t.co/vJJvhkSnPR)

Cassini flew by Titan one last time on September 12 before transmitting images and scientific data from the flight.

Mission engineers will use the information gathered from the encounter they dubbed "the goodbye kiss" to make sure the vessel is following the right path to plunge into the gas giant's atmosphere.

"The Cassini mission has been packed full of scientific firsts, and our unique planetary revelations will continue to the very end of the mission as Cassini becomes Saturn's first planetary probe, sampling Saturn's atmosphere up until the last second," said Linda Spilker, Cassini project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California. "We'll be sending data in near real time as we rush headlong into the atmosphere — it's truly a first-of-its-kind event at Saturn."

Cassini is expected to lose communications with Earth one or two minutes into its final dive, but 10 of its 12 scientific instruments will be working right up until the last moment to analyze the atmosphere's composition. That data could help understand how the planet formed and evolved.

On the eve of its final descent, other instruments will make detailed observations of Saturn's aurora borealis, temperatures and polar storms.

Cassini's final maneuvers began at 7.14 a.m. GMT (12.44 pm IST) on September 15, although the signal will only reach NASA 86 minutes later.

At 10.31 a.m. GMT (4.01 pm IST), the spacecraft is due to enter Saturn's atmosphere with its antennas pointed toward Earth and its motors running full blast in order to hold its trajectory. Just a minute later, at some 1,500 km above Saturn's clouds, the probe's communications will stop before Cassini begins to disintegrate moments later, NASA predicts.

"The Grand Finale represents the culmination of a seven-year plan to use the spacecraft's remaining resources in the most scientifically productive way possible," said Earl Maize, Cassini project manager at the Jet Propulsion Laboratory. "By safely disposing of the spacecraft in Saturn's atmosphere, we avoid any possibility Cassini could impact one of Saturn's moons somewhere down the road, keeping them pristine for future exploration."

The mission is a cooperative project of NASA, the European Space Agency (ESA) and Italy's space agency. NASA's European and Italian partners built the Huygens probe Cassini carried until dropping it on Titan.

The Cassini-Huygens mission's total cost is about \$3.26 billion, including \$1.4 billion for pre-launch development, \$704 million for mission operations, \$54 million for tracking and \$422 million for the launch vehicle.

The United States contributed \$2.6 billion to the project, the European Space Agency \$500 million and the Italian Space Agency \$160 million.

Italian astronomer Giovanni Cassini discovered four of Saturn moons in the 17th century, although scientists have since identified more than 60. During the same era, Dutch mathematician Christiaan Huygens found that Saturn had rings. He also was the first person to observe Titan.

Cassini rocketed from Cape Canaveral, Florida, on October 15, 1997, carrying with it the European Huygens lander. The spacecraft arrived at Saturn in 2004. Six months later, Huygens detached from Cassini and successfully parachuted onto the giant moon Titan. Cassini remained in orbit around Saturn, the only spacecraft to ever circle the planet. In April 2016, NASA put Cassini on an ever-descending series of final orbits, leading to the September 15 swan dive. Better that, they figured, than Cassini accidentally colliding with a moon that might harbour life and contaminating it.

After more than a decade exploring [#Saturn](#), its moons and rings, we've embarked on our [#GrandFinale](#): <https://t.co/0ZbfbX6DNs> [pic.twitter.com/qW4Ad5gUBr](https://t.co/qW4Ad5gUBr)

The spacecraft

Travelling too far from the sun to reap its energy, Cassini used plutonium for electrical power to feed its science instruments. Its separate, main fuel tank, however, was getting low when NASA put the spacecraft on the no-turning-back Grand Finale. The mission already had achieved great success, and despite the chance of pounding Cassini with ring debris, flight controllers directed the spacecraft into the narrow gap between the rings and Saturn's cloud tops. Cassini successfully sailed through the gap 22 times, providing ever better closeups of Saturn.

The rings

Cassini discovered swarms of moonlets in Saturn's rings, including one called Peggy that made the short list for final picture-taking. Scientists wanted one last look to see if Peggy had broken free of its ring. Data from the spacecraft indicate Saturn's rings which consist of icy bits ranging in size from dust to mountains may be on the less massive side. That would make them relatively young compared with Saturn; perhaps a moon or comet came too close to Saturn and broke apart, forming the rings 100 million years ago. Or perhaps multiple such collisions occurred. On the flip side, more massive rings would suggest they originated around the same time as Saturn, more than 4 billion years ago.

The moons

Saturn has 62 known moons, including six discovered by Cassini. The biggest, by far, is the first one discovered way back in the 1655 — Titan, which slightly outdoes Mercury. Its lakes hold liquid methane, which could hold some new, exotic form of life. Little moon Enceladus is believed to have a global underground ocean that could be sloshing with life more as we know it. Incredibly, geysers of water vapor and ice shoot out of cracks in Enceladus' south pole. Project scientist Linda Spilker said if she could change one thing about Cassini, it would have been to add life-detecting sensors to sample these plumes. But no one knew about the geysers until Cassini arrived on the scene.

Next up

Scientists would love to return to Enceladus or Titan to search for any potential life. Nothing is firmly on the books right now. But there are proposals to go back, submitted under NASA's New Frontiers programme. So stay tuned.

A study of nearly 300 people living in different parts of India found that nine single-base variants (single-nucleotide polymorphisms or SNPs) account

END

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