

RIP Cassini – Spacecraft Makes Its Final Approach to Saturn

NASA'S CASSINI spacecraft was launched on October 15, 1997, and arrived in the Saturn system on June 30, 2004. After nearly two decades in space, Cassini had expended almost every bit of the rocket propellant it carried to Saturn.

On September 15, 2017, the Cassini spacecraft made its final approach to Saturn's atmosphere, and completed its orbital manoeuvres of its seven-year Solstice Mission. On command, it was directed to dive through the atmosphere to its inevitable death.

When NASA's Cassini spacecraft completed its first tour of Saturn in 2008, the mission team had to decide what would come next. Cassini could have departed the ringed planet. In 2009, studies showed that Cassini had enough fuel to reach Uranus or Neptune, or travel in the other direction, toward Jupiter. Another mission could have been to visit a group of asteroids known as the Centaurs in the outer limits of the solar system.

Instead, scientists chose to continue making discoveries about Saturn and its moons — first through a two-year extended mission known as the Cassini Equinox Mission, and then with a second extension in 2010 that would bring the spacecraft to the very limit of the fuel it carried. That made it clear that Cassini's third mission, the Solstice Mission, would be its last.

It was during these missions that scientists discovered that two of Saturn's moons, Titan and Enceladus, showed signs that they were well suited to life. So, why destroy the spacecraft?

"Scientists determined that its destruction would ensure the safe disposal of the spacecraft, and would leave no chance



By Henry M. Holden

of future contamination of Saturn's Moon Enceladus by any microbes that might have stowed away on board during its assembly," said Preston Dyches, of NASA's Jet Propulsion Laboratory (JPL).

Cassini's fiery ending to its 13-year tour of the Saturn system would ensure Saturn's moons, Titan, and in particular Enceladus, with its subsurface ocean and signs of hydrothermal activity — remain pristine for future exploration.

The spacecraft's fateful plunge was the final beat in the mission's Grand Finale, 22 weekly dives, which began in late April, through the gap between Saturn and its rings. No spacecraft has ever ventured so close to the planet before.

Cassini's discovery that Saturn's moons had the potential to produce life highlighted the importance of the mission, and further emphasized the need for the spacecraft to meet its dramatic end.

"Ending Cassini this way," said Dyches, "is the right thing to do scientifically, technically and ethically."

Cassini entered Saturn's atmosphere at an altitude of about 1 190 miles (1 915 kilometres)

above the planet's estimated cloud tops (the altitude where the air pressure is 1-bar, equivalent to sea level on Earth).

During its dive into the atmosphere, the spacecraft's speed was approximately 70 000 miles (113 000 kilometres) per hour.

When Cassini first encountered Saturn's atmosphere, the spacecraft's attitude control thrusters began firing in short bursts to work against the thin gas and keep Cassini's saucer-shaped high-gain antenna pointed at Earth to relay the mission's valuable final data.

The thickening atmosphere forced the thrusters to ramp up their activity, going from 10 percent of their capacity to 100 percent in the span of about a minute.

Once they fired at full capacity, the thrusters could not keep Cassini stable, and the spacecraft began to tumble.

When the antenna pointed just fractions of a degree away from Earth, communications were severed permanently.

The predicted altitude for loss of signal was approximately 930 miles (1 500 kilometres) above Saturn's cloud tops. From that point, the spacecraft began to

burn up like a meteor.

Within 30 seconds following loss of signal, the spacecraft began to come apart. Within minutes, all remnants of the spacecraft were consumed in the atmosphere of Saturn.

Due to the travel time for radio signals from Saturn, which changes as both Earth and Saturn travel around the Sun, events took place there 86 minutes before they were observed on Earth.

This means that, although the spacecraft began to tumble and go out of communication at 6:31 a.m. EDT at Saturn, the signal from that event was not received at Earth until 86 minutes later.

"The spacecraft's final signal was like an echo," said Earl Maize, Cassini project manager at NASA's JPL.

"It will radiate across the solar system for nearly an hour and a half after Cassini itself has gone. Even though we knew that, at Saturn, Cassini had already met its fate, its mission wasn't truly over for us on Earth as long as we're still receiving its signal."

Cassini's last transmissions were received by antennae at NASA's Deep Space Network complex in Canberra, Australia. →