Cassini concludes pioneering mission at Saturn

September 18 2017

This movie sequence of images is from the last dedicated observation of the Enceladus plume by Cassini. Credit: NASA/JPL-Caltech/Space Science Institute

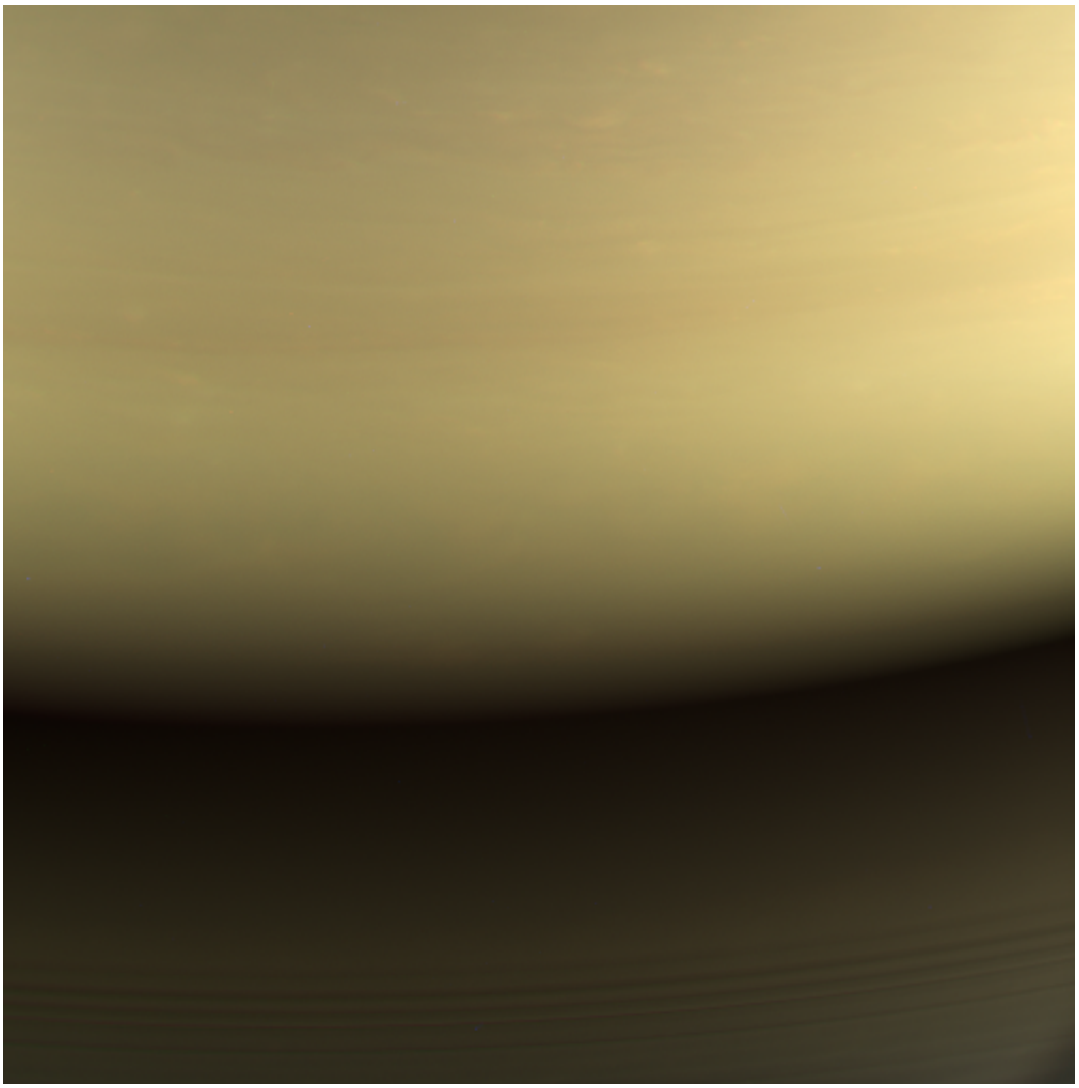
The international Cassini mission has concluded its remarkable exploration of the Saturnian system in spectacular style, by plunging into the gas planet's atmosphere.

Confirmation of the end of mission arrived at NASA's Jet Propulsion Laboratory at 11:55 GMT/13:55 CEST with the loss of the spacecraft's signal having occurred 83 minutes earlier at Saturn, some 1.4 billion km from Earth.

With the rocket propellant for manoeuvering the spacecraft fully expended as planned touring Saturn and its moons for the last 13 years, the mission concluded with the intentional plunge into the gas planet. This ensures that Saturn's icy moons, in particular ocean-bearing Enceladus, do not risk being contaminated by microbes that might have remained on board the spacecraft from Earth, and are left pristine for future exploration.

Cassini spent the last five months diving between Saturn's rings and atmosphere in a series of 22 grand finale orbits culminating in a final farewell to Titan on Monday, which set it on course for Saturn.

The grand finale orbits were supported by ESA ground stations, which received signals from Cassini to gather crucial radio science and gravitational science data.



Cassini's final image – natural colour view. Credit: NASA/JPL-Caltech/Space Science Institute

Atmospheric entry began about a minute before loss of signal, and the spacecraft sent scientific data in near real-time until its antenna could no longer point towards Earth. Its last images were sent yesterday, before the final plunge, and during its final moments it made the deepest ever measurements of the plasma density, magnetic field, temperatures and atmospheric composition in Saturn's atmosphere.

"Cassini has been revolutionising our views of the Saturn system since the moment it arrived, and for 13 incredible years right until the very end today," says Alvaro Giménez, ESA's Director of Science.

"This mission has changed the way we view ocean-worlds in the Solar System, offering tantalising hints of places which could offer potentially habitable environments, with Titan giving us a planet-sized laboratory to study processes that may even be relevant to the origin of life on Earth."

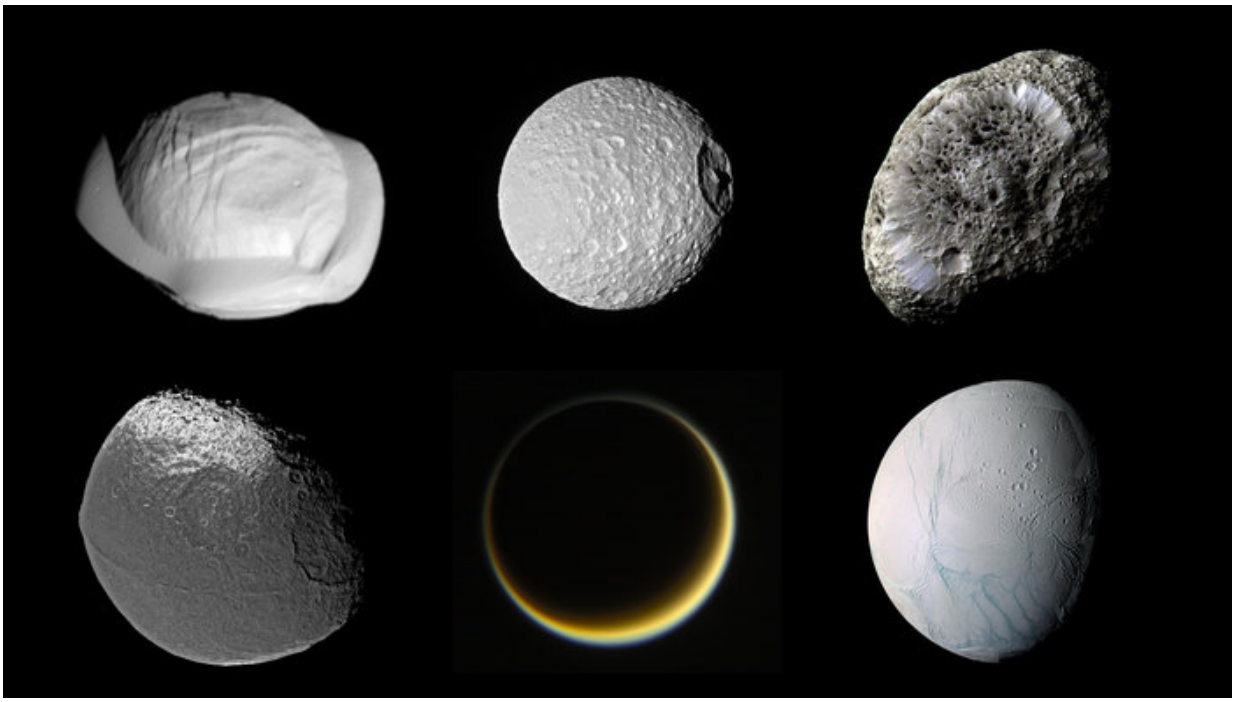
This image was returned on 14 January 2005, by ESA's Huygens probe during its successful descent to land on Titan. This is the colour view, following processing to add reflection spectra data, gives a better indication of the actual colour of the surface. Initially thought to be rocks or ice blocks, they are more pebble-sized.

The two rock-like objects just below the middle of the image are about 15 centimetres (left) and 4 centimetres (centre) across respectively, at a distance of about 85 centimetres from Huygens. The surface is darker than originally expected, consisting of a mixture of water and hydrocarbon ice. There is also evidence of erosion at the base of these objects, indicating possible fluvial activity. Credit: ESA/NASA/JPL/University of Arizona

Launched on 15 October 1997 and arriving in Saturn's orbit on 30 June 2004 (PDT), Cassini carried ESA's Huygens probe that landed on Titan on 14 January 2005. During its two and half hour descent it revealed the surface that had been previously been hidden by the moon's thick hazy atmosphere, showing a world with eerily Earth-like landscapes.

Cassini would continue to make exciting discoveries at Titan from orbit, with its radar finding lakes and seas filled with methane and other hydrocarbons, making it the only other known place in our Solar System with a stable liquid on its surface. In the moon's atmosphere Cassini detected numerous complex organic molecules, some of which are considered building blocks of life on Earth.

Saturn's moons continued to surprise, with one of the major discoveries of the entire mission the detection of icy plumes erupting from fissures in the southern hemisphere of Enceladus. Later discoveries would indicate hydrothermal activity at the bottom of a sea floor, hinting at this world as one of the most promising places to search for life beyond Earth.



Top row: tiny ravioli-shaped Pan, which has a maximum width of about 35 km; Mimas (396 km wide) which resembles the Death Star from Star Wars with its 139 km-wide crater that dominates the surface, and irregular-shaped Hyperion (~360 x 266 x 205 km), which looks like a giant sponge. Bottom row: Iapetus (1470 km wide) with its curious 20 km-wide topographic ridge that coincides almost exactly with the geographic equator; Titan, the largest of Saturn's moons, at 5150 km, with a thick atmospheric haze, and icy Enceladus (504 km wide) with its 'tiger stripe' fissures in the southern hemisphere from which plumes are seen to erupt, pointing to an underground reservoir of water. Credit: NASA/JPL-Caltech/Space Science Institute

The mission also showcased the unique characteristics of Saturn's many other moons, from Iapetus and its equatorial ridge to Hyperion, which looks like a giant sponge, and from ravioli-shaped Pan, to Mimas, which resembles the Death Star from Star Wars.

Many of Cassini's discoveries can be attributed to the longevity of the

mission, which included two mission extensions, allowing the spacecraft to cover half of Saturn's seasonal cycle.

First, a two-year extension was granted to observe changes as Saturn reached equinox, when the Sun shone edge-on to the rings. Subsequently, an additional seven years was given to follow up on earlier discoveries at Enceladus and Titan, and watch as summer sunlight fell on to the northern hemisphere of Saturn and its moons while winter darkness moved in on the south.

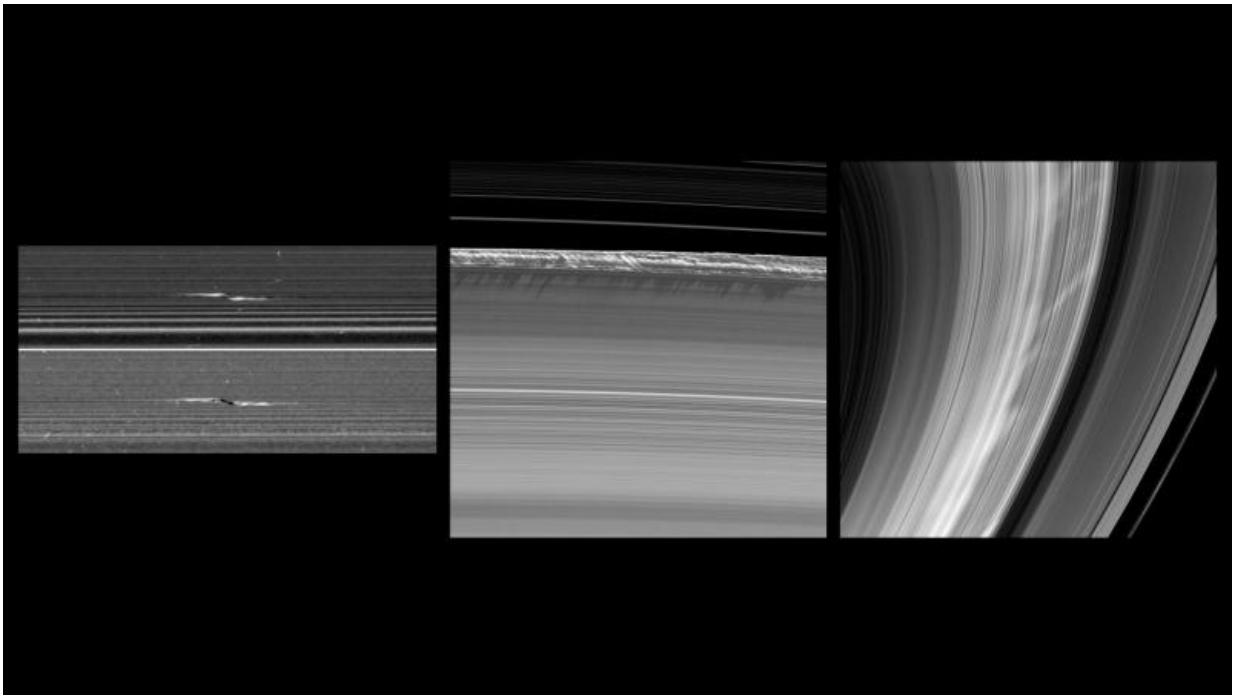
With this view, Cassini captured one of its last looks at Saturn and its main rings from a distance. The Saturn system has been Cassini's home for 13 years, but its journey will end on 15 September. Credit: NASA/JPL-Caltech/Space Science Institute

This long-term monitoring allowed scientists to watch seasonal changes,

including how weather patterns in Saturn's dynamic atmosphere evolved, and revealing the long-lived north polar vortex inside a hexagon-shaped jet stream. Cassini also watched how Titan's hydrocarbon cycle evolved with the seasons, its clouds raining methane onto the surface.

The extended mission time was also crucial to track the evolution of small-scale dynamical features in the rings, like the 'propellers', disturbances in the rings created by moonlets. Over time the 'spokes' in Saturn's rings – features that rotate along with the rings like the spokes in a wheel – appeared and disappeared with the seasons. And at equinox, the exquisite detail of the vertical structures in the rings, driven by gravitational perturbations of nearby moons, was revealed.

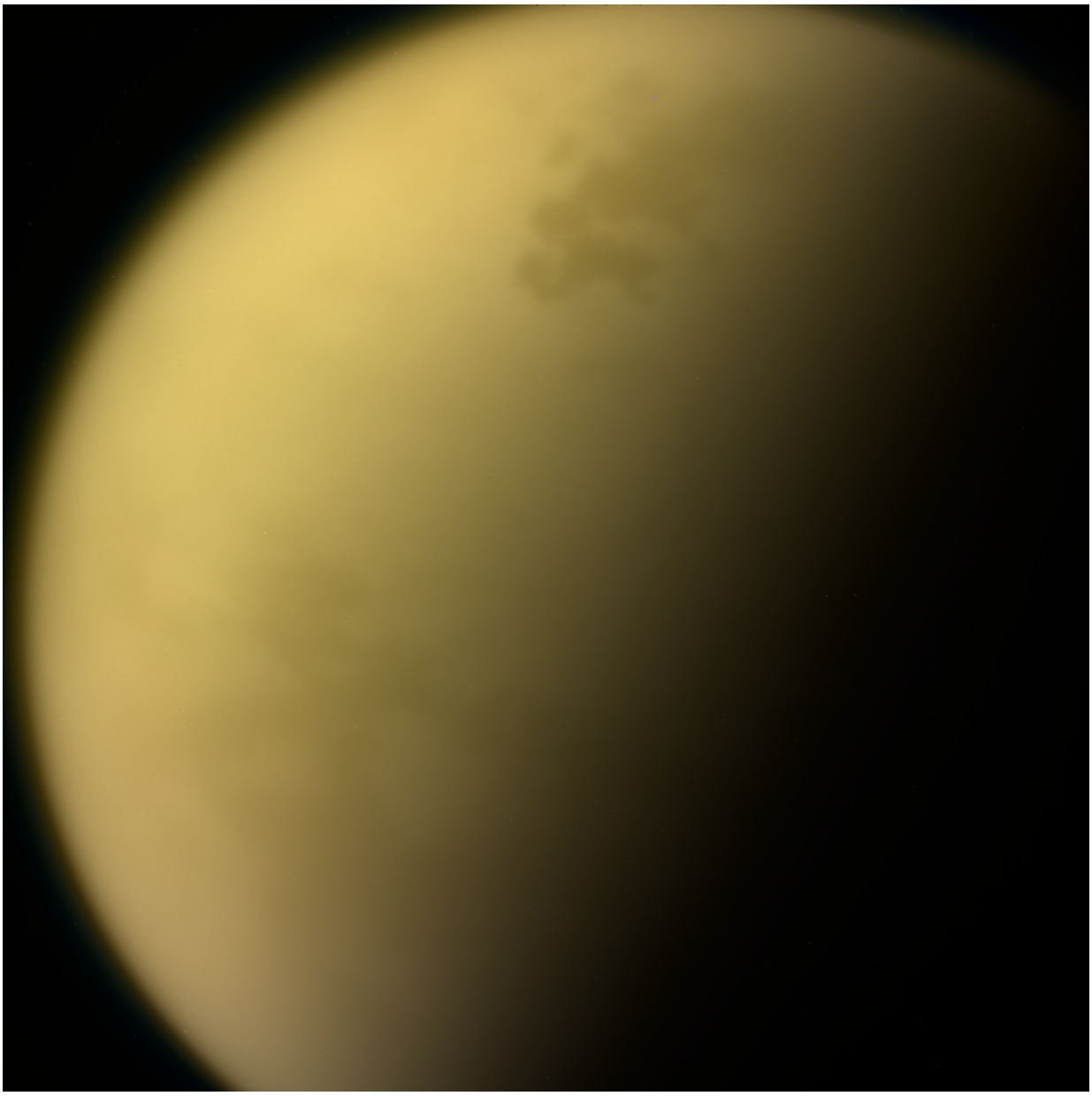
"Cassini and Huygens represent an astonishing scientific, technological, and human achievement," says Nicolas Altobelli, ESA's Cassini project scientist.



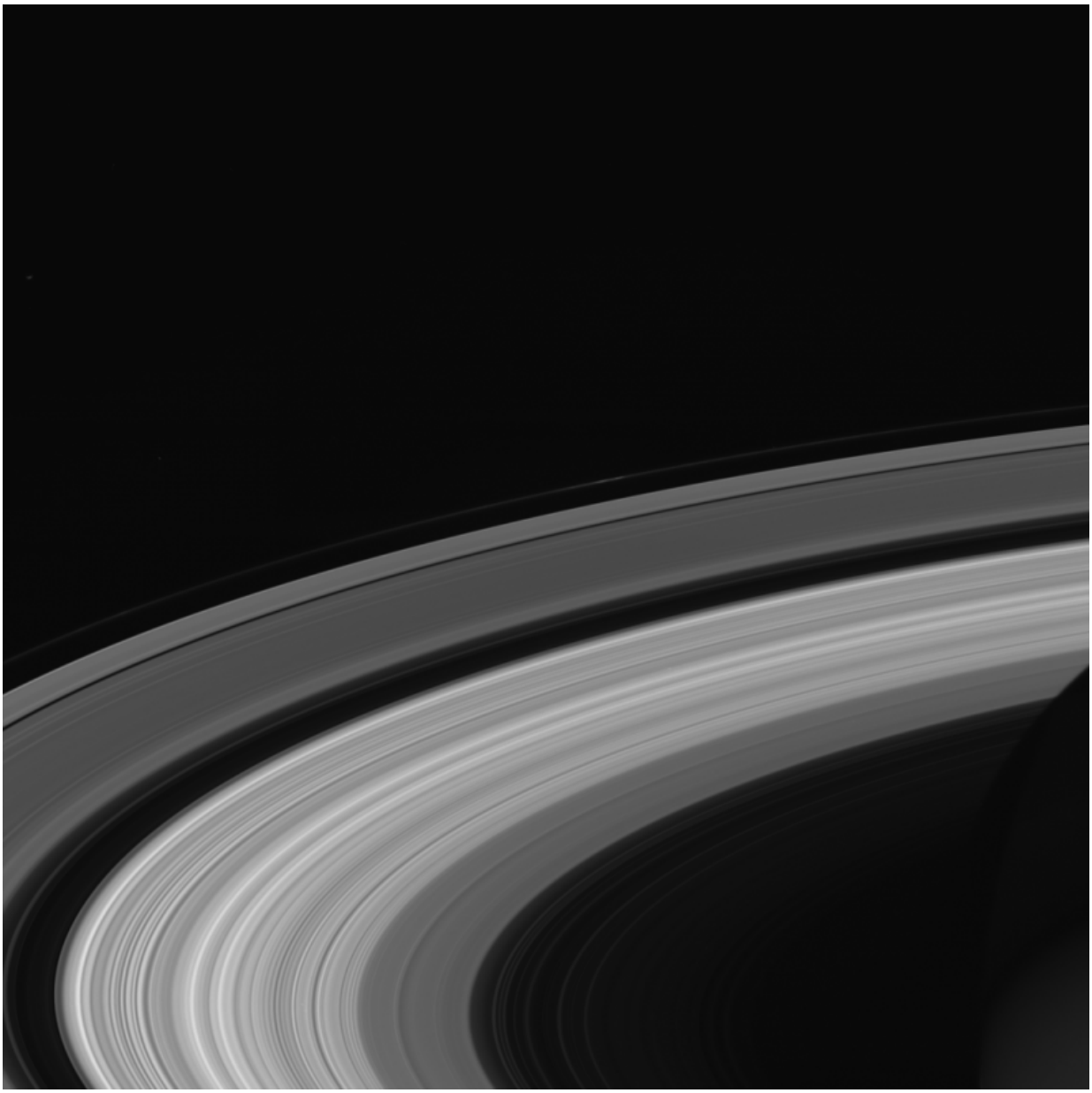
Left: small-scale dynamical features known as ‘propellers’ are disturbances in the rings created by moonlets. The propeller seen here in Saturn’s A Ring was imaged on 21 February 2017 (image scale is 207 m/pixel). The width of the gap is estimated to be about 2 km, with a tiny central moonlet thought to be driving the feature. Middle: the exquisite details of vertical structures in the rings was revealed at equinox. They are driven by gravitational perturbations of nearby moons, with the peaks rising to about 2.5 km above the plane of the rings. The image shows a 1200 km long section imaged on 26 July 2009, and the image scale is 2 km/pixel. Right: ‘spokes’, features that rotate along with the rings like the spokes in a wheel, were seen to appear and disappear with the seasons. This image shows the radial markings as the planet approached equinox in August 2009 (image scale is 30 km/pixel). Credit: NASA/JPL-Caltech/Space Science Institute

"The mission has inspired us with awe-inspiring images, including those humbling views looking across more than a billion kilometres of space back to the tiny blue dot of our home planet. While it is certainly sad when a mission ends, it is also a time to celebrate this pioneering journey, which leaves a rich scientific and engineering legacy to pave the way for future missions."

Mission planners already have the next generation of ocean-world explorers lined up, although this time it's Jupiter that will get the limelight. ESA is preparing to launch the Jupiter Icy Moons Orbiter, Juice, in 2022, with a key focus on the habitability potential of the large ocean-bearing satellites Europa, Ganymede and Callisto, while NASA is planning the Europa Clipper mission for dedicated flybys of that icy moon.



One of Cassini's last views of Titan, Saturn's largest moon, before the mission concluded on 15 September. Credit: NASA/JPL-Caltech/Space Science Institute



This image of Saturn's rings was taken by Cassini on 13 September 2017. It is among the last images Cassini sent back to Earth before concluding its mission on 15 September. Credit: NASA/JPL-Caltech/Space Science Institute