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## THANK YOU CASSINI

Ken Tapping, 22<sup>nd</sup> August, 2017

On 15 September the Cassini spacecraft will take its final dive into Saturn's atmosphere, where it will burn up, marking the end of a very successful space mission, lasting years longer than planned.

On 15 October, 1997, a Titan 4B carried two spacecraft into space: Cassini, a joint project between NASA and the European and Italian space agencies, and Huygens, a project by the European Space Agency. The mission objectives were ambitious. Cassini would spend several years exploring Saturn and its moons, and Huygens would attempt a soft landing on Titan, Saturn's largest moon. The spacecraft were named after two astronomers who studied Saturn and its moons: Giovanni Cassini and Christiaan Huygens. The Titan 4B was the largest available launcher at the time, but was still not powerful enough to put the spacecraft onto a direct path to Saturn, so the trip involved flybys and gravitational assists from Venus, the Earth and Jupiter. The two spacecraft arrived at Saturn and went into orbit around the giant planet on 1 July, 2004.

On 25 December Huygens separated from Cassini and on 14 January, 2005, after a high-speed entry into Titan's atmosphere, it deployed a parachute for a slow descent to the surface. It landed on a dry riverbed. On the way down Huygens photographed a landscape resembling the Canadian Arctic, with many lakes and rivers. However, since temperatures on Titan hover around -180 C the liquid in those lakes and rivers could not be water. It turned out to be a mixture of liquid hydrocarbons, such as propane and ethane.

Over the following years Cassini explored Saturn and its satellites. It used its thrusters to change its orbit as needed, to fly close to as many of Saturn's moons as possible, and in order to get a close look at Saturn from all angles. Among many discoveries, it revealed a strange hexagonal storm near Saturn's North Pole, and showed that Titan is not the only moon of Saturn that is not a deep-frozen ball of rock and ice. Enceladus is covered

with a thick layer of ice, but there is evidence that under the ice there is a deep, dark ocean of liquid water, heated by volcanism driven by Saturn's pulling Enceladus out of shape. This is also the situation with Europa, one of the moons of Jupiter. It is widely believed that Europa and Enceladus may be among the best places in the Solar System to look for life. On 19 July, 2013 Cassini recorded a montage of images showing Saturn, backlit by the Sun, many of its moons visible as dots, with three other dots: Venus, Earth and Mars.

Cassini is now running low on fuel, so that soon there will be no means to control its orbit. With Saturn and its moons' gravitational tugging there is a risk the spacecraft will crash into one of them, introducing contamination that could interfere with future searches for life. It would be disastrous to drill down through the ice on Enceladus only to find oceans loaded with Earthly bacteria. So Cassini is being directed to dive into Saturn's atmosphere, to be incinerated by friction, avoiding the risk of contaminating any of the moons. The spacecraft's last days will be used for high-risk but important observations, such as flying through Saturn's rings – huge but very thin belts of ice and rock particles.

Cassini has changed its highly elongated orbit so that when passing at its closest to Saturn it touches the top of the planet's atmosphere. Drag will slightly slow the spacecraft so that on the next pass it will dip in a little deeper. After several of these passes the spacecraft will dive in so deeply it will burn up. However, in the meantime it will be measuring the composition of Saturn's atmosphere and giving us the closest up data on the giant planet that we have ever had.

Jupiter is now getting lost in the sunset glow. Saturn lies low in the south. Venus rises in the early hours, shining more brilliantly than Jupiter. The Moon will reach First Quarter the 29<sup>th</sup>.

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