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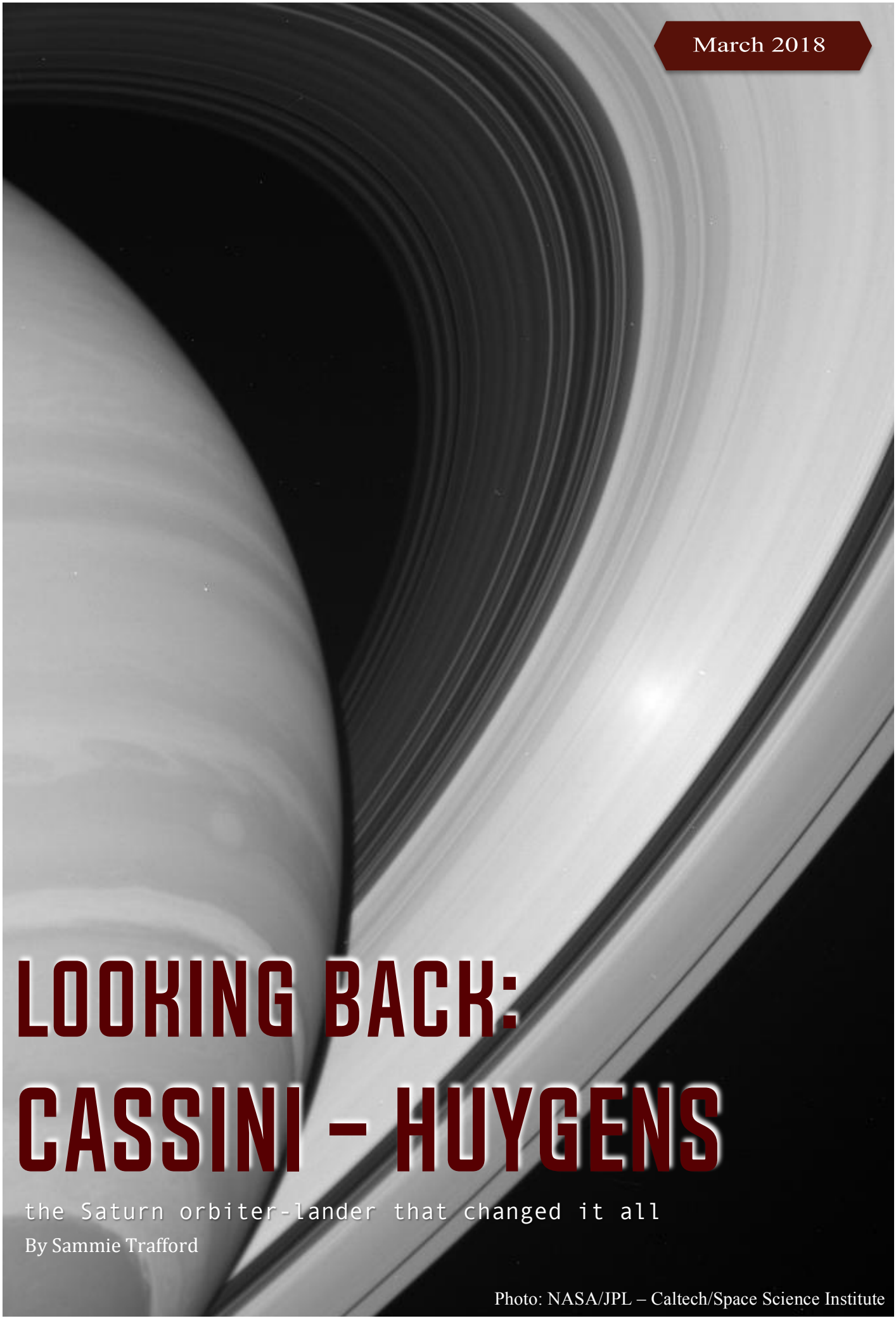
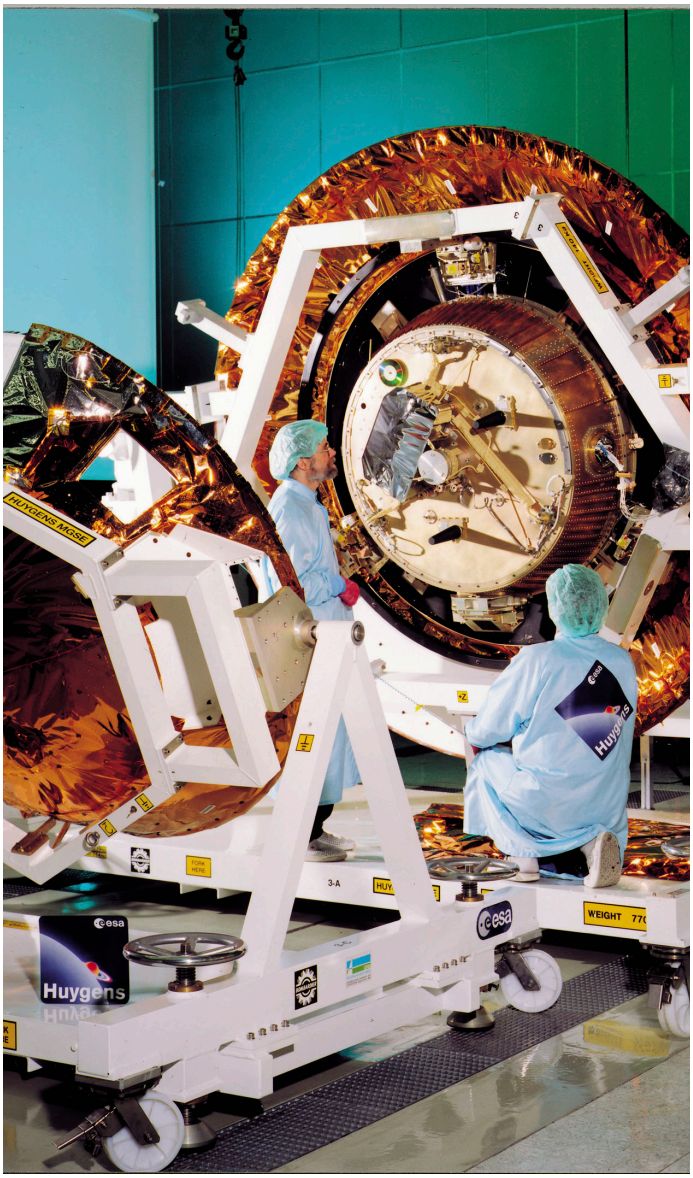


LOOKING BACK: CASSINI – HUYGENS

the Saturn orbiter-lander that changed it all

By Sammie Trafford

Photo: NASA/JPL – Caltech/Space Science Institute



Cassini-Huygens mission scientists work on the Huygens' Descent Module and Front Shield
Photo: European Space Agency

Little more than six months ago a lone spacecraft began the final stage of its impressive journey through space. After a mission run time of 19 years and 11 months, ending on September 15th, 2017, we look back at the success that was the Cassini-Huygens space probe.

Launched from Cape Canaveral, Florida, USA on October 15th, 1997, the Cassini-Huygens mission was a collaborative task between NASA (National Aeronautics and Space Administration), the ESA (European Space Agency), and the ASI (Agenzia Spaziale Italiana or Italian Space Agency). The primary aim of the mission was to further our understanding of Saturn through an orbiting spacecraft and lander, studying the surrounding moons, rings, and planet itself. The NASA-built spacecraft was named after Giovanni Cassini, the astronomer who discovered four of Saturn's moons, as well as the space between two of Saturn's rings, now called the Cassini Division, whilst the ESA-built lander was named after Christiaan Huygens, a Dutch astronomer who discovered one of Saturn's moons, Titan. Fittingly, the Huygens lander safely touched down on Titan on January 14th, 2005. Over the course of its near two-decade run time, Cassini-Huygens had two mission extensions, the first being in June 2008, called the Cassini Equinox Mission, and the second in September 2010, called the Cassini Solstice Mission, each designed to observe Saturn's equinox and solstice respectively.

The significance of this distant exploration lies in the way that the information collected during Cassini-Huygens' mission fundamentally changed our understanding of Saturn, its rings, and Titan. Cassini built upon a curiosity created by the Voyager missions, most notably collecting information about the storm and weather patterns of Saturn, performing studies on one of Saturn's moons, Enceladus, and making many new discoveries regarding the formation, behaviour, and composition of the rings of Saturn. The Huygens lander allowed for a much more in-depth study of Titan to take place, revealing the nature of the haze that seems to surround the moon, supplying evidence that there are liquid methane and liquid ethane oceans on the surface of Titan, and collecting data measuring the density of the atmosphere.

In terms of how this impacts us here on Earth and spaceflight in general, as a result of the Cassini-Huygens mission there are now many more possibilities for future interplanetary endeavours.

Throughout the mission the Cassini spacecraft completed a multitude of gravity assists, in which spacecrafts flyby an astronomical object, typically a planet, and use the gravity of the object to alter speed or direction. This allows for fuel to be conserved, enabling further travel and lowering

mission costs. Gravity assists also require careful and precise planning, making the four accomplished by the Cassini-Huygens team all the more impressive. This achievement broadens the possibilities of further and longer missions whilst also suggesting a more fuel-efficient and cost-effective way to power spacecraft.

The discoveries made regarding the moon Enceladus are also of great significance as, stated by Linda Spilker, a Cassini project scientist,

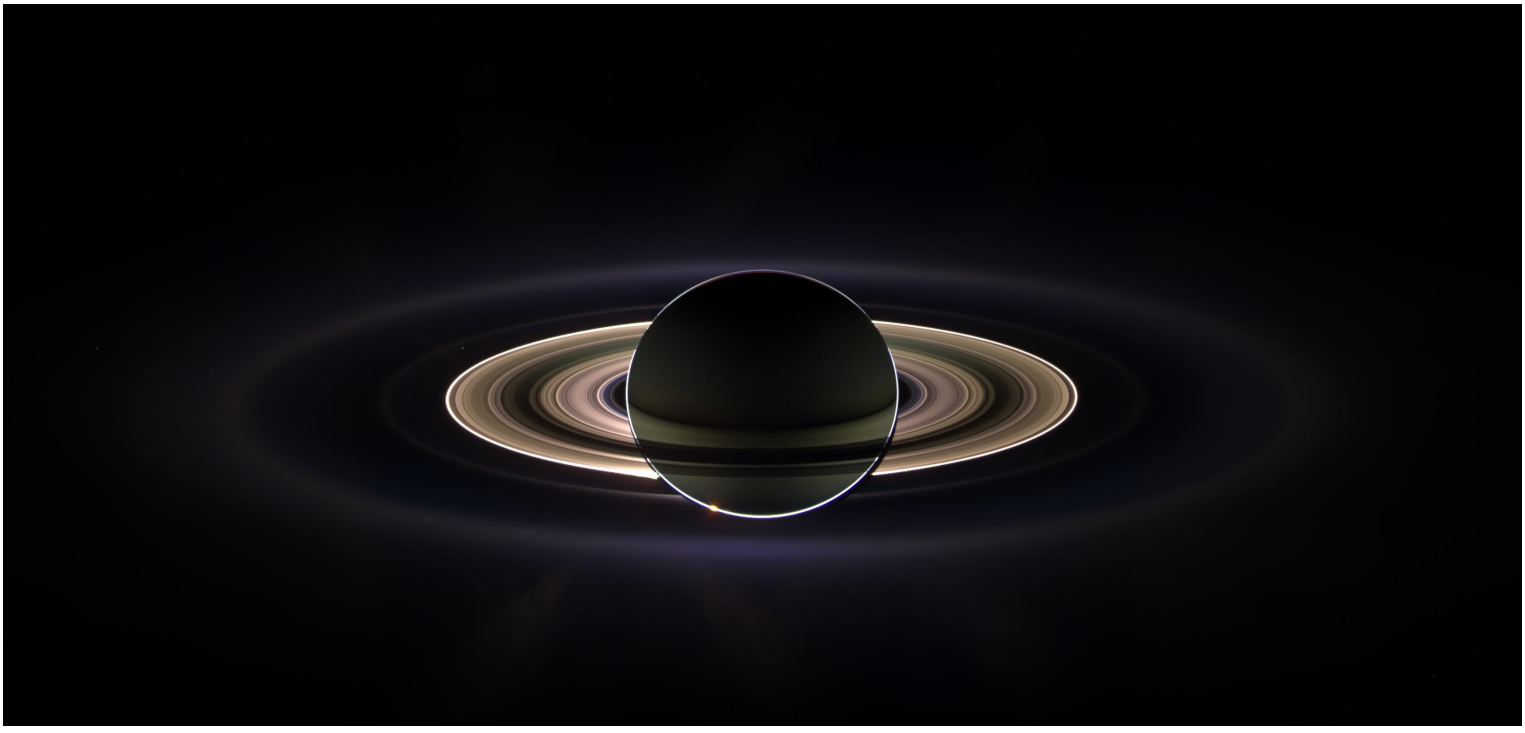
"Planetary scientists now have Enceladus to consider as a possible habitat for life."

(Spilker, as cited by Dunford et al, 2018). A global ocean is present underneath Enceladus' crust, comprised of liquid salt water with hydrothermal vents situated on the seafloor. This is a system similar to Earth's, and suggests that life may be found on Enceladus. The discovery of the ocean and the vents also assist in our understanding of Saturn's rings, with plumes of icy particles from the ocean erupting and entering orbit around Saturn, forming Saturn's E ring.

However, it should be noted that despite the remarkable discoveries and advancements in understanding made during Cassini-Huygens, the initial operation and planning of the mission was severely criticised. Conceptualised in 1982 as a joint task between NASA and the ESA as a way to bring the two closer together, the idea was delayed due to the recent economic recession in the USA, creating a reluctance to spend a large amount of money on the mission. Regardless, the mission was approved in 1989, costing US 3.3 billion dollars at the time, the extreme expense typical of flagship missions and heavily critiqued by many. The cost was defended by statements explaining how the ESA was paying for some of the mission, as well as by using newly developed technologies designed for the mission in other, smaller expeditions. Cassini-Huygens was also challenged by environmentalists before launch, opposing the mission's Environmental Impact Statement, objecting to the use of the radioisotope thermoelectric generator and the flyby of Earth. This attempt to prevent the mission from occurring was rejected however.

The success of Cassini-Huygens was immense, and has since created many more exciting possibilities for future expeditions regarding the further exploration of Saturn and it's moons, as well as interplanetary exploration as a whole. In order to prevent jeopardizing the discoveries made regarding foreign life in space, the Cassini spacecraft descended into Saturn's atmosphere on September 15th, 2017, collecting and sending data till the end, and ultimately burned away to nothing. This was done to prevent any bacteria from Earth present on the spacecraft from harming anyone or anything, as the bacteria may be toxic to extra-terrestrial life. Overall, despite its eventual destruction, the legacy and advancements that the Cassini-Huygens mission has left will forever be remembered.

A panoramic view of Saturn and its rings, combining 165 images taken by Cassini – Huygens
Photo: NASA/JPL/Space Science Institute



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