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Vaisala on Board for the Saturn Tour

When the Cassini spacecraft entered orbit around Saturn in July 2004, it had eight Vaisala BAROCAP® sensors on board, as part of an instrument designed by the Finnish Meteorological Institute and Helsinki University of Technology. Cassini is just one part of the Cassini-Huygens space mission designed to explore the distant planet, its mysterious moons and stunning rings.

Cassini is a robotic spacecraft that will orbit the planet for four years gathering as much information as possible about the planet, its rings, and its moons. The Huygens Probe separated from Cassini in December 2004 and started its flight to Titan, which is the largest of Saturn's 30 or so known moons. If successful, it will descend through Titan's atmosphere to its surface in January, 2005.

Astronomers are interested in Titan because of its rare atmosphere. Titan is already known to have a curious orange atmosphere, rich in nitrogen, methane and other organic compounds. In 1998, the European Space Agency's (ESA) Infrared Space Observatory also identified the presence of water vapor in Titan's atmosphere. Basically, Titan exhibits many similarities to conditions that may well once have prevailed on Earth.

The Saturn system offers more variety in scientific targets for study than any other planet in our solar system. Cassini's four-year mission, and the studies of Titan by the Huygens probe, are expected to enrich our understanding of phenomena in fields such as biology, atmospheric chemistry and physics, climatology, volcanism, tectonics, the physics of disc systems such as galaxies and solar systems in formation.

As the probe breaks through the cloud deck, a camera will capture pictures of Titan, surface properties will be studied, and about 1,000 images of the clouds and surface will be taken. In the final moments of descent, a spotlight will illuminate the surface for the imaging instrument onboard. If the probe survives landing at a fairly low speed of about 25 kilometers per hour (15 miles per hour), it can possibly

return data from Titan's surface, where the atmospheric pressure is 1.6 times that on Earth.

The probe could touch down on solid ground, ice or even splash down in a lake of ethane or methane. Throughout its mission, Huygens will radio data collected to the Cassini orbiter to be stored and then relayed to Earth. If it lands in liquid ethane, Huygens will not be able to return data for long because the extremely low temperature of this liquid, about –180 degrees Celsius (–290 degrees Fahrenheit), would prevent the batteries from operating and it is estimated that there would only be 30 minutes in which to send back data before failure occurred.

The on-board Huygens Atmosphere Structure Instrument (HASI) comprises sensors for measuring the physical and electrical properties of the atmosphere and an on-board microphone that will send back sounds from Titan.

Sensor for pressure readings

Vaisala's contribution to the instrumentation is a series of Vaisala BAROCAP® sensors. This is a capacitive absolute pressure device manufactured by silicon micro-machining. The sensor has excellent hysteresis and repeatability characteristics and outstanding temperature and long-term stability. When the pressure changes, the silicon diaphragm bends and changes the height of the vacuum gap in the sensor. This alters the sensor's capacitance, which is measured and converted into a pressure reading. The sensor's structure gives it a wide dynamic range and a built-in overpressure blocking mechanism. The design combines two powerful techniques: the use of single crystal silicon as sensor material and the capacitive measurement principle. Silicon offers good elasticity, low hysteresis, excellent repeatability, small temperature dependence and superior long-term stability.

International collaboration

The Cassini-Huygens mission is an international collaboration of three space agencies: NASA, ESA and the Italian Space Agency. The Cassini orbiter was built and is managed by NASA's Jet Propulsion Laboratory. The Huygens Probe was built by ESA. The Italian Space Agency provided Cassini's high-gain antenna. In addition, seventeen countries have made scientific contributions to the mission at the time of launch. More than 250 scientists worldwide are involved in studying the data coming in from the Saturn system.

The total cost of the Cassini-Huygens mission 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 U.S. contributed $2.6 billion, ESA $500 million and the Italian Space Agency $160 million. The spacecraft and probe carry a wide range of scientific equipment that will be used to explore the Saturn system over the next four years.

The Cassini-Huygens mission started with a launch on October 15, 1997, on a Titan 4 rocket from Cape Canaveral, Florida. Cassini has also flown past other planets on its way to Saturn – once each by Earth and Jupiter, twice by Venus. This was necessary in order to borrow sufficient gravitational energy to speed the craft on its way. During the Saturn Tour, Cassini will complete 74 orbits of the ringed planet, 44 close flybys of Titan, and numerous flybys of Saturn's other icy moons. Already scientists have been gathering new images and information about one of the most intriguing planets in the solar system.

The next crucial phase for the mission begun on December 25, 2004, when the Huygens probe separated from the Cassini orbiter and begun its 21-day journey to Titan. On January 14, 2005, Huygens begins its descent through Titan's cloudy atmosphere, where, if successful, it lands on the surface about two and half hours later. Then scientists will finally learn what Titan is really made of. ●

The Saturn System

Saturn, the most distant planet that could be seen by ancient astronomers, had appeared for centuries only like a bright star in the night sky. The invention of the telescope at the beginning of the 17th century finally confirmed that this celestial body was actually a planet.

Italian astronomer Galileo was the first to look at Saturn through a crude telescope in 1609 and 1610 and mistakenly thought that the rings around the planet were moons. It was in 1655 that the Dutch scientist Christiaan Huygens saw that the two "moons" first identified by Galileo were in fact a thin flat ring surrounding the planet. It later became clear that this ring was really a system of rings. Then the Italian astronomer Jean-Dominique Cassini discovered in 1675 that the "ring" consisted of an outer ring and an inner ring, separated by a darker band, now known as the "Cassini Division". Nearly two centuries later, the Scottish physicist James Clerk Maxwell proved that the rings had to consist of many small particles, all orbiting Saturn like individual moons.

When the first space missions flew past Saturn at the end of the 1970s, very little was known about this mysterious and beautiful world. Ground observations had shown Saturn itself to be a large ball of hydrogen and helium, flattened at the poles due to its rapid rotation. Occasionally, light and dark spots could be seen in the vague bands of cloud running parallel to the equator. Virtually nothing was known about the moons, except for their orbits, orbital periods and rough sizes. ●

Titan

Huygens discovered Titan in 1655. Four more moons were first observed by Cassini and, thanks to better telescopes, nine more moons were known by the beginning of the 20th century. On August 17th, the mission revealed two more small moons, bringing the current total to 33. Dutch-born astronomer Gerard Kuiper discovered in 1944 that Titan has an atmosphere that contains methane. This makes it unusual. A relatively thin atmosphere has only ever been found on two other large moons, Jupiter's Io and Neptune's Triton.

Titan offers a tantalizing mix of an Earth-like, nitrogen-based atmosphere and a surface that many scientists believe probably features chilled lakes of ethane and a surface coated with sticky brown organic condensate that has rained down from the atmosphere. Because Titan and Earth share such similarities in atmospheric composition, Titan is thought to hold clues to how Earth evolved from its primitive beginnings into a life-bearing planet. ●