

Cassini-Huygens at Saturn — A Grand Exploration

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The Cassini-Huygens spacecraft entered Saturn orbit on June 30, 2004. By this time much had already been accomplished. The observational campaign during the flyby of Jupiter was very successful, as was the joint HST/Cassini campaign to observe Saturn's aurorae. Major discoveries started at Phoebe, which also was Cassini-Huygens' first "contact" with the Saturnian system. Phoebe dazzled us with its diverse morphology and compositionally variegated surface. Entry into the magnetosphere was several days sooner than expected because it was inflated compared to the size seen by the Voyager flybys. Cassini-Huygens passed through a gap in the rings, and fired an engine to achieve orbit. The closest observations of the rings and of the planet's magnetic field were then obtained. A new radiation belt was discovered between the innermost ring and the planet. Saturn has distinguished itself with a different magnetic rotation period than that recorded by Voyager. Large atmospheric storms are sources of immense lightening displays which correlate with observed EM emissions. The magnificent rings have not disappointed us. They show new structures and processes, and a range of composition that is baffling to explain. Satellites are of special interest because they record history, much of which can be deciphered from the impact crater record. Iapetus, in addition to its strange albedo distribution, has a unique geophysical signature which appears to constrain the age of the system. Morphologically Titan resembles the Earth's surface in many ways. But, where is the liquid that carved the "stream channels"? Recently, large surface changes have been seen that are thought to result from volcanic activity. Dust and magnetospheric plasma interactions with the satellite Enceladus are very interesting and material from that satellite appears to be loading the magnetosphere and also supplying the rings. A very significant South Polar thermal anomaly is suggestive of ongoing activity and higher internal temperatures. On the July 15, 2005 flyby Cassini flew through eruptive plume effluent. In situ composition measurements showed water vapor, molecular nitrogen (N_2), carbon dioxide (CO_2), methane (CH_4), propane (C_3H_8), acetylene (C_2H_2), and several other species. Many other species may be present. Highlights of the many discoveries in all aspects of the Saturnian system will be presented. Cassini-Huygens is a joint NASA-ESA program in cooperation with ASI. Part of this work was carried out at the Jet Propulsion Laboratory under contract to NASA.