Cassini's Earthly Benefits

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BENEFITS OF INTERNATIONAL COOPERATION

The Cassini program is an international cooperative effort of NASA, the European Space Agency (ESA), the Italian Space Agency (ASI) and several separate European academic and industrial contributors.

The Cassini mission's goal is to perform close-up studies of **Saturn**, its rings, moons and magnetic environment. Satun's largest moon, Titan, is a target of special interest because of atmospheric and perhaps surface characteristics it shares with early Earth. An instrument-laden probe provided by ESA will descend via parachute to Titan's surface to directly sample the atmosphere and provide our first view of its surface.

Participation in the Cassini mission is a high priority for NASA's European partners and represents a foundation upon which future space science cooperation is being based. The Cassini program is an opportunity for spacefaring nations to share in both the investment and the science return of one of the most ambitious and challenging interplanetary explorations ever mounted.

Cassini's NASA/European partnership provides an example of an undertaking whose scope and cost would not likely be borne by any single nation, but is made possible through shared investment and participation.

The International Team

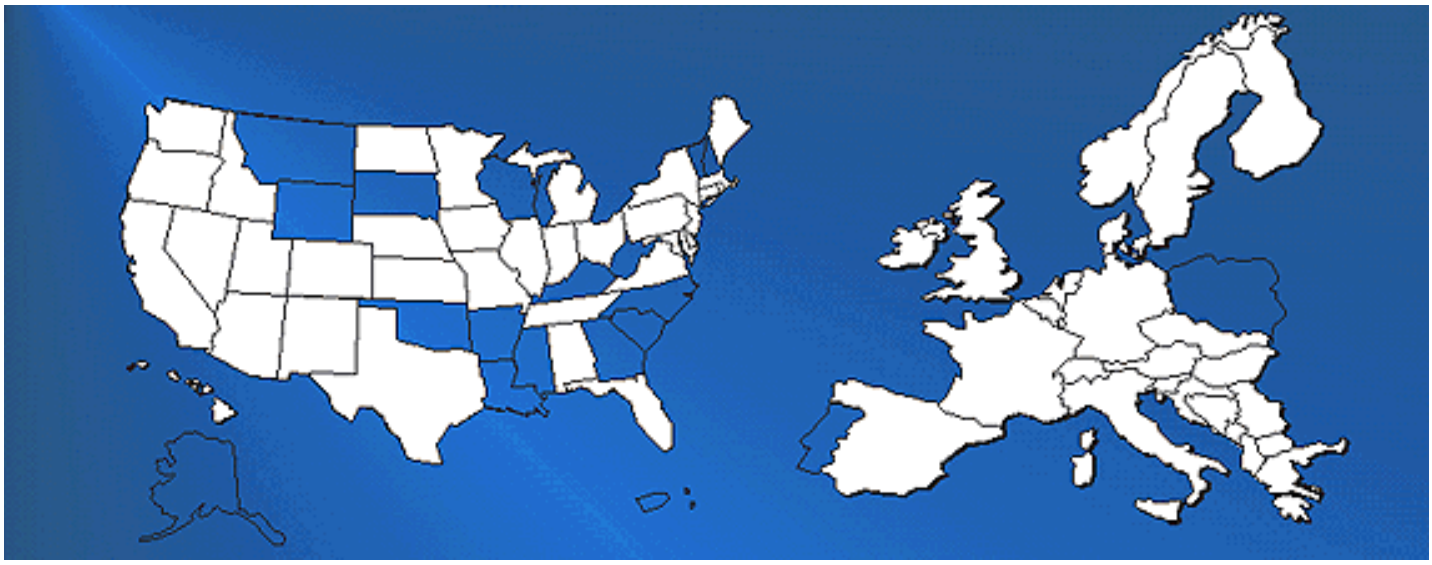
Hundreds of scientists and engineers from 16 European countries and 33 U.S. states make up the team designing, fabricating and preparing to fly the Cassini/Huygens spacecraft.

In the U.S., the mission is managed by NASA's Jet Propulsion Laboratory in Pasadena, California, where the Cassini orbiter is also being designed and assembled. Development of the Huygens Titan probe is managed by the European Space Technology and Research Center (ESTEC). ESTEC will use a prime contractor in southern France, with equipment supplied by many European countries; Huygens' batteries and two scientific instruments will come from the U.S. ASI is contributing the orbiter's dish-shaped high-gain antenna, as well as significant portions of three science instruments.

Communications with Cassini during the mission will be carried out through stations of NASA's Deep Space Network in California, Spain and Australia. Data from the Huygens probe will be forwarded to an operations complex in Darmstadt, Germany.

A unique research and development (R&D) effort, Cassini is the world's only science probe for exploring the outer planets currently in development. The mission is the next step in a highly productive, three-decade-old program of exploration of the solar system using robotic spacecraft.

The Cassini Mission's International Partners



The Cassini Mission represents the efforts of academic and industrial partners in 33 U.S. states and 16 European nations.

The Cassini program employs more than 3,000 individuals in science, technology, academia, business and industry in the United States. In Europe, 14 nations are participating in the technological development of the Huygens Titan probe, and scientists from 12 European nations are members of Cassini's scientific team.

CONTRIBUTIONS TO EDUCATION

The Cassini project is developing, and will distribute, supplementary curricula and educational materials relating to the Cassini mission and the Saturnian system to enhance classroom science teaching from kindergarten through high school. The project's educational outreach approach emphasizes the development of "user-friendly" materials that will supplement the standard curricula and can be readily used by teachersÑincluding those with little or no science background. The interdisciplinary aspects of Cassini are being explored to help make the mission's science, math and engineering more attractive subjects **to teachers and students** who are not necessarily technically oriented. Efforts also are underway to present materials in multiple languages to meet the large demand for instructional media for non English-speaking students.

TECHNOLOGY UTILIZATION BENEFITS

Challenging scientific enterprises routinely generate technological advances which are applicable to other, unrelated fields. Program planning and preliminary R&D activities for the Cassini mission already have resulted in several significant innovations of direct benefit to government agencies, industry, business, and to the field of environmental regulation.

Technology developed and qualified for spaceflight by or for the Cassini project is being adopted by new space science programs, in some cases at a discounted cost directly attributable to Cassini, enabling the development of a new class of low-cost, high-efficiency spacecraft.

Solid-State Recorder

One innovation developed for Cassini is a solid-state data recorder that has no moving parts. The recorder has great potential for use in a variety of fields, from aerospace to the entertainment industry, and is expected eventually to find wide applicability in consumer electronics.

NASA's Advanced X-ray Astrophysics Facility (AXAF), another major space science mission that will provide new insights into the mysteries of the universe, will use a solid-state recorder from the production line established for the Cassini mission.

Powerful New Computer Chips

The main on-board computer that will direct the operations of the Cassini orbiter uses a novel design that draws upon new families of electronic chips.

Cassini's educational approach will enhance standard curricula.

Among them are Very High Speed Integrated Circuits (VHSIC) developed under a U.S. govemment/industry R&D initiative for dual-use technology. The Cassini application GVSC 1750A computer is the first civilian spacecraft application of this technology.

Powerful new radiation-hardened, Application-Specific Integrated Circuits (ASIC) have also been developed for the Cassini project. Each ASIC replaces one hundred or more traditional chips, allowing the development of a data system for Cassini 10 times more efficient than earlier spacecraft designs (e.g., Galileo and Magellan), but at less than one-third the mass and volume. Two of NASA's new Discovery-class missions, Mars Pathfinder and Near Earth Asteroid Rendezvous (NEAR), are planning to use these chips directly off the Cassini production line.

Micro-Miniature Radio Transponder

The Cassini program has developed a low mass, low power, radiation-hardened X-band radio transponder (a combined receiver and exciter). This innovation will enable the NEAR and Mars Pathfinder missions to meet their performance requirements. Both of these Discovery missions will have their radio transponders built on the Cassini mission's production line.

Solid-State Power Switch

The Cassini program combined the switching attributes of the Metal-Oxide Semiconductor Field-Effect Transistor (MOS FET) with an ASIC design to create an advanced solid-state power switch that eliminates the rapid fluctuations (called transients) usually found in circuits utilizing conventional power switches. This design should result in significantly improved component lifetime and efficiency, and is widely applicable to both industrial and consumer electric and electronic products.

Gyros

The inertial reference units to be used on Cassini represent the first space version of a revolutionary new gyro developed and produced by Delco/Hughes, called the Hemispherical Resonator Gyroscope. Gyros commonly used in spacecraft, aircraft and ships are large, mechanical devices whose many moving parts make them susceptible to failure. This new gyro, which eventually may be used on other spacecraft, promises greater reliability and less vulnerability to mechanical failure because it uses no moving parts. The NEAR mission will use the robust Cassini gyro with a minimum amount of modification.
Resource Trading System

A "Cassini Resource Exchange" was developed by the Cassini project to help balance the conflicting mass, electrical power, data rate and fixed-price cost demands of the spacecraft's science instruments and other subsystems. The electronically based trading tool has been utilized by California's South Coast Air Quality Management District (AQMD) in its implementation of a new, marketbased approach to regulating air pollution in the Los Angeles basin.

Cassini's resource exchange system was adapted by the AQMD for its RECLAIM program to facilitate the buying and selling of emissions allowances by regulated facilities to help achieve U.S. Government-mandated reductions in air pollution. The State of Illinois is similarly adapting the Cassini Resource Exchange to manage volatile organic waste, and Vancouver, British Columbia, Canada, is seeking to adapt the system to help that city manage its air pollution.

The National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC) have contracted with the California Institute of Technology (Caltech) to demonstrate various methods of auctioning off wavelengths of the electromagnetic spectrum to personal communications industries; the Cassini system's algorithms and communications protocols served as the backbone for the Caltech demonstrations .

BENEFITS SUMMARY

Aside from the multiple benefits already being derived from Cassini's technology, the mission's greatest possible return is new and unique scientific knowledge.

The Cassini mission is a challenging and innovative examination of another world. The detailed observations of the Saturnian system it will radio back to Earth are bound to inspire young and old alike to learn more about science, engineering and technology, and will provide insights on profound issues ranging from the origin of the planets to the beginning of life on

Earth.

For more information on the Cassini mission, please contact:
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