Twelve Instruments, One Goal Archive Usable Science Data

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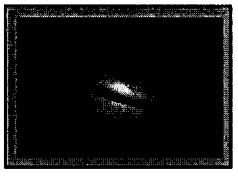
Cassini Mission to Saturn

NASA



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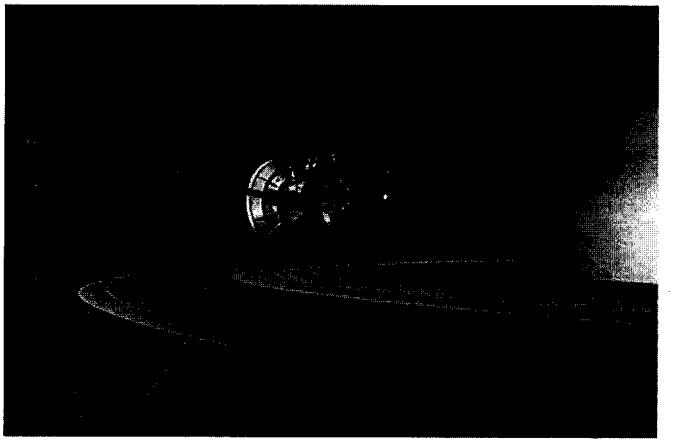
Tour Highlights

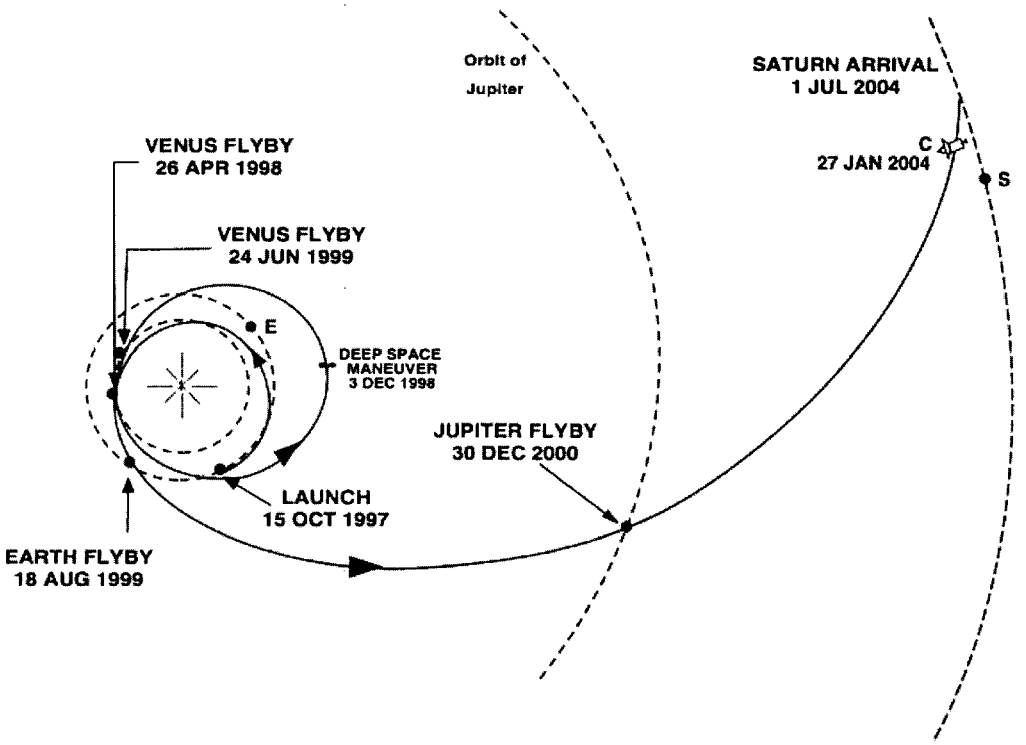
Cassini will spend 4 years orbiting the Saturn system. During that time, the spacecraft will make 75 orbits about the planet and 45 flybys of Titan.

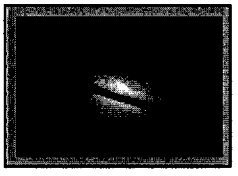
Some of the exciting events early in the Saturn tour include:

Phoebe encounter - 11 June 2004 (closest approach is 2,000 km, 1243 miles)
Saturn Orbit Insertion - 1 July 2004
Huygens Probe Release -
25 December 2004
Huygens Probe Mission -
14 January 2005



CASSINI MISSION CRUISE TRAJECTORY
Earth (E), Saturn (S), and Cassini (C) locations on 27 January 2004





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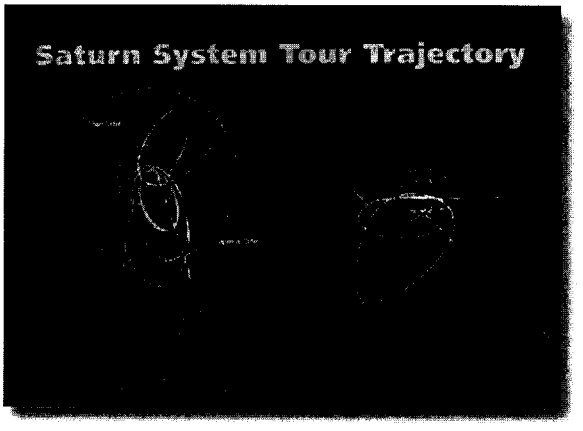
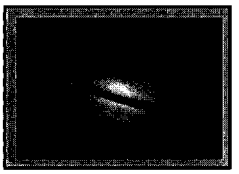
Touring Saturn

During the 4-year tour, Cassini will make 75 orbits of Saturn, using Titan to turn the spacecraft's orbit.

Orbits will range in length from 7 to 118 days.

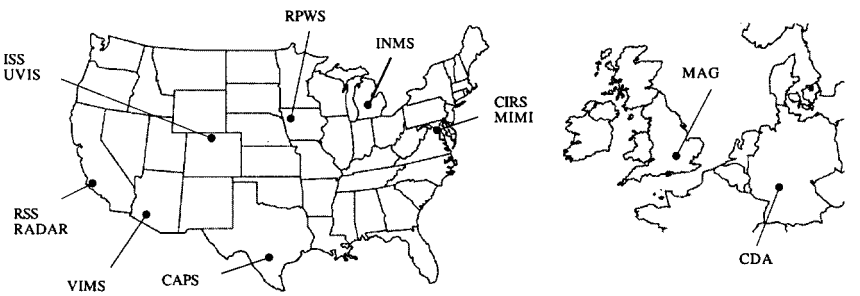
Cassini's orbital distance from Saturn will range from 156,858 km to 953,214 km (98,036- 592,422 miles). The spacecraft's orbit will change orientation from equatorial to an inclination of approximately 75°. This allows scientists to study Saturn's polar regions.



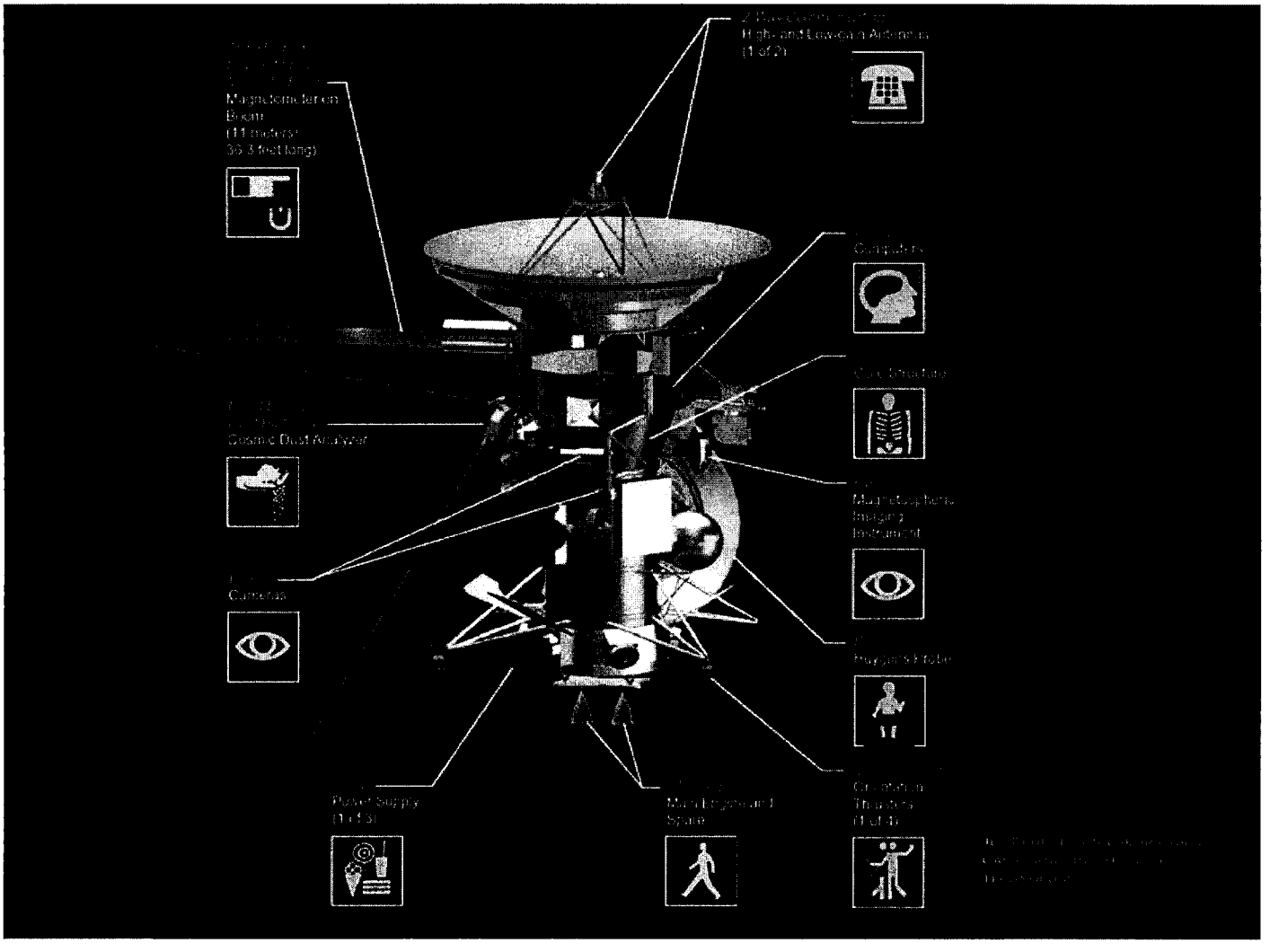


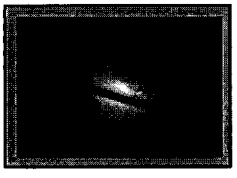
Introduction

- The Cassini mission is a complex undertaking.
  - Twelve instruments operated by teams around the world.
    http://saturn.jpl.nasa.gov



CAPS	Cassini Plasma Spectrometer, *Southwest Research Institute, San Antonio, USA*
CDA	Cosmic Dust Analyzer, *Max Plank Institute für Kemphysi, Heidelberg, Germany*
CIRS	Composite Infrared Spectrometer, *Goddard Space Flight Center, Greenbelt, USA*
ISS	Imaging Science Subsystem, *Space Science Institute, Boulder, USA*
INMS	Ion And Neutral Mass Spectrometer, *University of Michigan, Ann Arbor, USA*
MAG	Dual Technique Magnetometer, *Imperial College, London, UK*
MIMI	Magnetospheric Imaging Instrument, *John Hopkins University, Baltimore, USA*
RADAR	RADAR, *Jet Propulsion Laboratory, Pasadena, USA*
RPWS	Radio And Plasma Wave Spectrometer, *University of IOWA, USA*
RSS	Radio Science Subsystem, *Jet Propulsion Laboratory, Pasadena, USA*
UVIS	Ultraviolet Imaging Spectrograph, *University of Colorado, Boulder, USA*
VIMS	Visible And Infrared Mapping Spectrometer, *University of Arizona, Tucson, USA*


Magnetometers
Boom
(11 meters/
36.8 feet long)
Cosmic Dust Analyzer
Cameras
Power Supply
(1 of 3)
Computers
Ultraviolet
Spectrometer
Magnetospheric
Imaging
Instrument
Plasma Science
Cosmic Ray
Instrument
Low-Energy
Charged
Particle
Instrument



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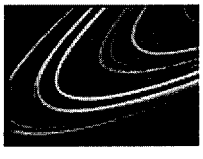
Science Targets

Cassini's 5 groups of science objectives at Saturn are:

Saturn - the planet and its atmosphere

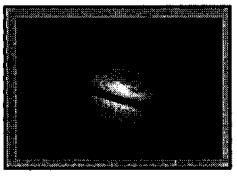


Saturn's extensive Rings

Titan

Magnetosphere

Icy Satellites



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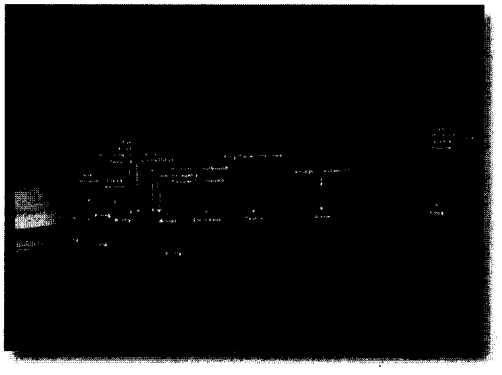
Saturn System of Satellites

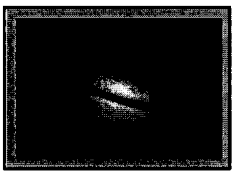
The order of the rings and moons, starting with the closest to Saturn, is:

Saturn
D-Ring
C-Ring
B-Ring
Cassini Division
A-Ring
Encke Division
Pan
Atlas
Prometheus
Pandora
F-Ring
Epimetheus
Janus
G-Ring
Mimas
E-Ring
Enceladus
Tethys
Telesto
Calypso
Dione
Helene
Rhea
Titan
Hyperion
Iapetus
Phoebe
New Discoveries



May 2004

Diane Conner



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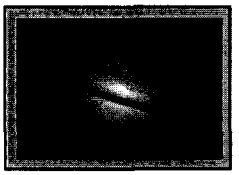
The Cassini Legacy

- Lessons learned from the Galileo Mission to Jupiter are a large driver behind the Cassini archive design
  - Diverse data sets make it a challenge to support collaborative science analysis
  - Large data sets make it a challenge to
    - validate data for science content and format
    - Distribute data
    - Track data production at a program level
  - It is always a challenge to compile the right level of documentation.



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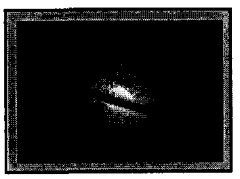
The Cassini Legacy

- Cassini is archiving science data with the Planetary Data System (PDS) http://pds.jpl.nasa.gov
- A reliable Cassini archive will
  - Support a Saturn data analysis program
  - Allow comparisons of the Saturnian system with the Jovian system (the Galileo and Jupiter Icy Moons Orbiter (JIMO) missions)
  - Provide a basis for future mission planning.



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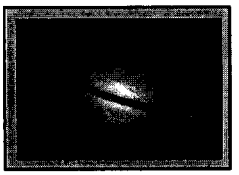
Timeline

Oct 1997 Launch	
	1998 Downlink Working Group formed
Dec 2000 Jupiter Flyby	2000 Archive Plan for Science Data, Ops Concept published
	2001 Science Archived Working Group formed
	2003 Archive Design Reviews of team archive plans
Jan 2004 Saturn Approach	2004 Data Products Defined, Peer Reviews held, Cassini Archive tracking system (CATS) developed.
Jul 2004 SOI	
	2005 July is the first delivery of data to the PDS. Includes all data collected up to Saturn Orbit Insertion (SOI).
Jul 2008 End of prime mission	



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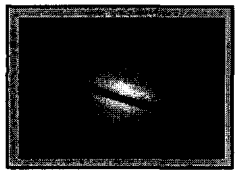
Ingredients of a Useable Archive

- ***DOCUMENTATION*** of the mission, spacecraft, instruments and datasets - a detailed history of the mission and full description of the capabilities is required,
- ***STANDARDIZATION*** of data formats - to assure long-term access, data formats should be as simple as possible,
- ***PRESERVATION*** of navigation and calibration - retrieval of pointing information and calibration should be planned early and accomplished in a monitored incremental process,
- ***VALIDATION*** of data products – data validation is best accomplished by distributing products to the science team in their archive form.
- ***OPTIMIZATION*** for correlative studies - coordination among experiments to ensure correlative studies are supported by defining standards for data products and documentation.



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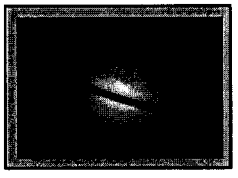
Documentation

- Mission Events and science objectives
- Spacecraft and instrument design and operations
- Interface Agreements
  - Describe who is delivering what to whom and how
  - Template developed for new missions
- Data
  - Formats and parameter descriptions
  - Calibration algorithms
  - Usage restrictions
  - Coordinate system



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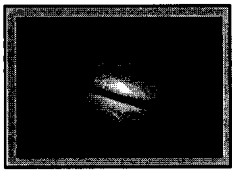
Standardization

- Data formats
  - Simple ASCII preferred for non-imaging instrument data.
- Consistent time representation
  - file and directory names
  - keywords
  - Internal to data
- Coordinate systems
  - Planetocentric or planetographic - use international standard IAU
  - East or west longitude - consistent on given planet



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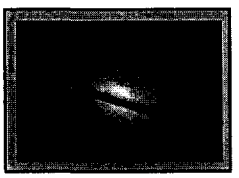
Preservation

- PDS Navigation Ancillary Information Facility SPICE formatted data files
  - Spacecraft pointing geometry
  - Trajectories of spacecraft and satellites
  - Instrument boresights and FOV descriptions
  - Mission events
    - Boresights used for pointing s/c as a function of time
    - Primary target for observation
    - Various spacecraft and instrument configurations
- Calibration algorithm as a function of time



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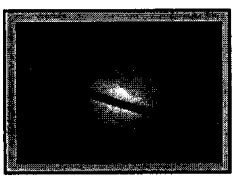
Validation

- Design review of planned data formats and volume contents
  - Identify areas that need to most work
- Peer review of sample volume
  - Put data formats, documentation, and software to the test
- Through Scientific use
  - Members of the science teams use same products as go into the archive.



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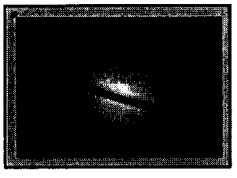
Optimization

- Correlative studies within scientific disciplines
  - Atmospheres
  - Surfaces
  - Physics
- Search parameters
- Temporal & spatial resolution
- Similar formats (cohesive)



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Summary

- Cassini is a mission that presents many challenges for archiving data
  - Distributed ops
  - Large diverse data sets
  - Complex mission plan with a variety of scientific objectives and science targets
- The Cassini legacy will be the archived data. When the mission has collected the last data, the only challenge remaining will be to analyze and interpret that data.