THE CASSINI-HUYGENS MISSION

Orbiter In Situ Investigations

Volume 2

Edited by

CHRISTOPHER T. RUSSELL
University of California, California, U.S.A.

KLUWER ACADEMIC PUBLISHERS
DORDRECHT / BOSTON / LONDON

A.C.I.P. Catalogue record for this book is available
from the Library of Congress

ISBN: 1-4020-2773-7

Published by Kluwer Academic Publishers
P.O. Box 17, 3300 AA Dordrecht, The Netherlands

Sold and distributed in North, Central and South America
by Kluwer Academic Publishers,
101 Philip Drive, Norwell, MA 02061, U.S.A.

In all other countries, sold and distributed
by Kluwer Academic Publishers,
P.O. Box 322, 3300 AH Dordrecht, The Netherlands

Printed on acid-free paper

Cover illustration: Courtesy of ESA

Printed in the Netherlands

TABLE OF CONTENTS

The Cassini-Huygens Mission

Orbiter In Situ Investigations

Editor: C.T. Russell

Springer

Foreword

Planetary exploration is generally conducted with one of five different techniques. In order of increasing complexity these are: remote sensing from 1 Astronomical Unit (AU), observations from a spacecraft flying by the planet, orbital observations, atmospheric and/or landing probes, and sample return missions. For the Moon, Mars and Vesta for which meteorites are available, samples literally fall in our laps, but for most of the planets, and in particular for the Saturnian system, we must visit them in order to obtain detailed understanding.

Despite its great distance from the Sun, almost 10 AU, Saturn's great size and extended ring system, has enabled Saturn to be studied for centuries using the first of these techniques. Nevertheless Saturn's atmosphere, unlike Jupiter's has a veil of haze that cloaks the planet, keeping much of the dynamics of that atmosphere hidden from view. While scientists have learned much about the Saturnian system from remote sensing from the vicinity of Earth, this knowledge has generally fueled our fascination, rather than deepened our understanding.

The first glimmering of understanding arose over two decades ago from technique number two with three flyby missions to Saturn in quick succession: Pioneer 11, Voyager 1 and Voyager 2. However, the time spent at Saturn by these three missions is numbered only in days. The time needed to obtain understanding of the dynamics of the atmosphere, the structure in the rings, the properties of the moons, the harmonics of the magnetic and gravitational fields and the dynamics of the magnetospheric plasma requires years of observation, not days. An orbiting spacecraft is required to provide long-term, in situ observations. The Cassini orbiter answers that need.

As described in Volume 1 of this three-volume set, Cassini is a comprehensive attack on the nature of the Saturnian system, using techniques three and four on our list, measurements with the Cassini orbiter and the Huygens atmospheric probe/lander. Volume 1 described the Huygens probe in detail, the overall scientific objectives of the mission, and the mission and spacecraft design. In this volume we describe the in situ investigations carried by the orbiter: plasma and neutral particles, energetic electrons, ions and neutrals, the magnetic field, radio and plasma waves, and dust particles. Volume 3 will be devoted to the remote sensing instruments.

As with Volume 1, this compilation is due to the efforts of many individuals, especially the referees and authors who have contributed to producing a very readable and complete description of the investigations. We especially wish to

Space Science Reviews **114:** vii–viii, 2004.

thank Anne McGlynn who assisted me in the initial stages of the assembly of this volume and Marjorie Sowmendran who completed the effort upon Anne's retirement.

C. T. Russell
University of California Los Angeles
January, 2004

The Cassini-Huygens Mission

Orbiter In Situ Investigations

Editor: C.T. Russell

The joint NASA-ESA Cassini-Huygens mission promises to return four (and possibly more) years of unparallel scientific data from the solar system's most exotic planet, the ringed, gas giant, Saturn. Larger than Galileo with a much greater communication bandwidth, Cassini can accomplish in a single flyby what Galileo returned in a series of passes. Cassini explores the Saturn environment in three dimensions, using gravity assists to climb out of the equatorial plane to look down on the rings from above, to image the aurora and to study polar magnetospheric processes such as field-aligned currents. Since the radiation belt particle fluxes are much more benign than those at Jupiter, Cassini can more safely explore the inner regions of the magnetosphere. The spacecraft approaches the planet closer than Galileo could, and explores the inner moons and the rings much more thoroughly than was possible at Jupiter.

This book is the second volume, in a three volume set, that describes the Cassini-Huygens mission. This volume describes the in-situ investigations on the Cassini orbiter: plasma spectrometer, ion and neutral mass spectrometer, energetic charged and neutral particle spectrometer, magnetometer, radio and plasma wave spectrometer and the cosmic dust analyzer. This book is of interest to all potential users of the Cassini-Huygens data, to those who wish to learn about the planned scientific return from the Cassini-Huygens mission and those curious about the processes occurring on this most fascinating planet. A third volume describes the remote sensing investigations on the orbiter.

Reprinted from *Space Science Reviews*, volume 114, nos. 1-4, 2004.

ISBN 1-4020-2773-7

9 781402 027734

springeronline.com