IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

Author: Dr. Ivan Di Stefano
Sapienza University of Rome, Italy

Prof. Luciano Iess
Sapienza University of Rome, Italy
Dr. Catia Benedetto
Agenzia Spaziale Italiana (ASI), Italy
Dr. Gaetano Di Achille
INAF, Italy
Prof. Antonio Genova
Sapienza University of Rome, Italy
Prof. Giuseppe Mitri
Università degli studi "Gabriele d'Annunzio", Italy
Dr. Barbara Negri
Italian Space Agency (ASI), Italy
Prof. Giacomo Tommei
University of Pisa, Italy
Dr. Marco Zannoni
Alma Mater Studiorum - University of Bologna, Italy

THE MERCURY ORBITER RADIOSCIENCE EXPERIMENT OF THE BEPICOLOMBO MISSION

Abstract

Mercury's intriguing characteristics have been partly unraveled by past missions, revealing a complex interior and active history. The Mercury Orbiter Radioscience Experiment (MORE) onboard the ESA/JAXA BepiColombo mission aims at advancing our understanding of the gravity field and rotational state of the planet, and at testing the general relativity theory. These scientific objectives are obtained thanks to accurate radiometric measurements (range and range-rate) processed by means of a precise orbit determination procedure. In-flight range-rate observables have shown an accuracy below 0.01 mm/s at 60 s of integration time, while range measurements reached an accuracy at centimeter level after a few seconds of integration time, thanks to the novel pseudo-noise wide-band ranging system at 24 Mcps. The unprecedented accuracy of the radiometric observables will enable a thorough insight into the subsurface and deep interior of Mercury. The static gravity field will be estimated to degree and order 45 allowing to constrain the properties of the crust and the lithosphere through a joint analysis with the topographic relief measured by laser altimetric data. The improved estimate of the time-varying gravity field and the rotational state will aid determining the thermal state and size of the liquid outer core and the solid inner core. An important objective of MORE is the investigation of the processes that led to the evolution of Mercury's interior by studying the the internal dynamics and the mineralogical composition of the crust and mantle. The morphogenetic processes of Mercury's surface will be characterized to correlate them with internal processes in the crust and mantle. Additionally, MORE seeks to precisely characterize the geological and tectonic features of specific geophysical-geodynamic areas of interest, with a focus on the southern hemisphere. Tests of fundamental physics will be performed by precisely measuring the parameters of the Parametrized Post-Newtonian formalism. This includes testing the equivalence principle,

the inverse square law of gravitation, and the precession of the planet's perihelia. Furthermore, radio tracking data collected during cruise superior solar conjunctions are currently under analysis to improve the classical relativistic test of time delay and frequency shift of radio signals. These experiments have the potential to enhance our understanding of gravity theories.