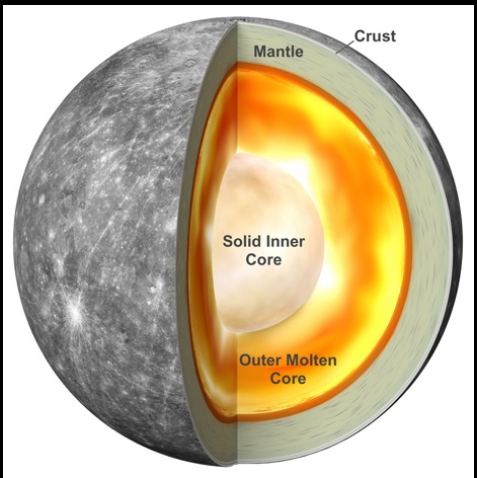
Constraining Internal Structures of Planets and Icy Moons through Geophysical Measurements



SUMMARY.
Geophysical measurements provide fundamental constraints on the internal structure of celestial bodies. Altimetry and imaging enable an accurate determination of the body's shape and surface roughness, the presence and properties of the magnetic field allow to characterize the deep interior or to demonstrate the existence of internal ocean, and gravity anomalies yield information on the internal mass distribution from the core by constraining the moment of inertia to the outer layers by retrieving short-wavelength features. The combination of these datasets is of paramount importance to fully address the scientific objectives of space missions devoted to the exploration of terrestrial planets (e.g., BepiColombo) and icy moons (e.g., JUICE, Europa Clipper).

OBJECTIVES

The main objective of this course is to provide the basic concepts of the following topics:

- Processing of altimetry and imaging data to generate Digital Elevation Model (DEM).
- Analysis of radio science data to map gravity anomalies and to determine planetary and satellite ephemerides.
- Markov Chain Monte Carlo (MCMC) simulations to constrain the interior structure of terrestrial planets and icy moons by using geophysical measurements.

PREREQUISITES

Basic knowledge of aerospace engineering and/or astronomy. Programming skills (e.g., Python) are necessary to achieve the main goal of the project.

THEORY

by A. Genova

The theoretical part of the course will be focused on the methods to determine DEM by using stereophotogrammetry, and to estimate gravity fields and planetary/satellite ephemerides through batch least-squares filters. To combine the geophysical measurements, the MCMC method will be studied and implemented for the science case considered in this project.

PROGRAM

by A. Genova

The course will consist of 3-h lecture-discussion every week on the main topic of the research activity that will be conducted by using the techniques and methods studied during the course.

MAIN PROGRESSION STEPS

The student will work on each task of the project to present the main progresses every week during the group meeting.

EVALUATION

The student will prepare a final report that summarizes the major results of the research activity. The evaluation will be based on the quality of the final report and the accomplishments of the intermediate goals.

BIBLIOGRAPHY & RESSOURCES

Reference
Link Genova et al. (2018): Planetary Ephemerides. Ruesch, Genova, et al. (2019): MCMC for subsurface brines detection. Genova et al. (2019): MCMC for planetary interiors

CONTACT

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