THE BEPI-COLOMBO MISSION

SUMMARY.
The Bepi-Colombo mission is an ESA large mission of exploration of Mercury. Its main goal is the characterization of the internal structure of the closest to the sun planets together with the tests of general relativity. In this METEOR, we will firstly see how the solar system can be a very efficient tool for testing general relativity. We will then focus on Mercury and see how the Bepi-Colombo mission can contribute in testing alternative theories of gravity.

OBJECTIVES

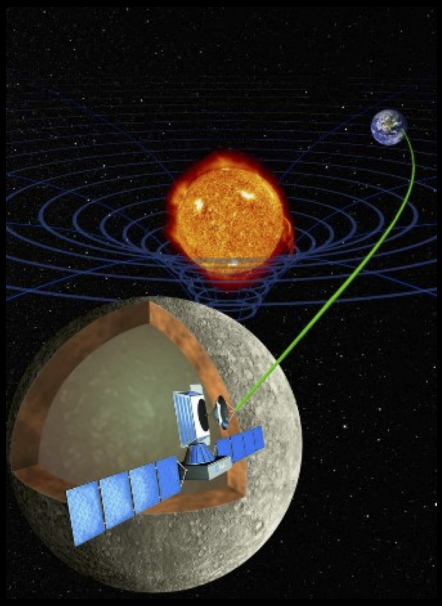
There 2 main objectives:

- to learn how, in the solar system, the law of gravity ruled by General Relativity can be studied and how alternative theories of gravity can be also tested in the low gravitational regime of the solar system.

- to understand how spacecraft are navigated and how radio science measurements can be used from constraining the motion of the major bodies of the solar system and how the knowledge can be used for benchmarking laws of gravity.

PREREQUISITES

Dynamics and Planetology; Numerical methods; General Relativity, Extragalactics and Cosmology; Maths/Stat Interesting complementarity with the METEOR JUICE.



THEORY

by A. Fienga (O. Minazzoli)

We will introduce different theories of gravity starting from the fondation of general relativity with the definition of the metrics, the geodesics and the different time-scales to tensor-scalar theories and phenomenological approaches such as MOND theory. We will see how these diverse models impact the modelization of the light path and the equations of motion for spacecraft and solar system objects.

APPLICATIONS

by A. Fienga

The pratical works will be done in the frame of the mission of Mercury exploration, Bepi-Colombo and of the instrumental experiment MORE. This experiment of radio science aims at constraining the accuracy on the s/c orbit and the Mercury orbit. Simulations will be done considering different alternative theories of gravity to measure if the MORE experiment will be sensitive to the modifications induced by the studied alternative theories.

MAIN PROGRESSION STEPS

- First part of the first half of the period : theoretical courses introducing the construction of the equation of motions with GR lagrangian and generalization in considering alternative theories.

- Second part of the first half of the period : lectures introducing the

navigation of a spacecraft and the MORE experiment.

- Second half of the period : Each student has a different theory to implement in the equations of motion and in the simluation of the MORE measurements (distances between Earth and the spacecraft or Earth and Mercury).

- Last week : preparation of the final oral presentation.

EVALUATION

- Type of examinations: written (40%), project (60%).

- The written examination is a concise but detailed report on a chosen article.

- The student's performances will be evaluated based on the achievement of the project and on the code developed by the student to reach the goals(second half of the METEOR) .

Reference

- Bepi-Colombo mission overview

- Testing GR with the Bepi-Colombo mission

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