HeRS: A HERMEAN RADIOSCIENCES EXPERIMENT, TO STUDY THE DEEP INTERIOR AND THE LITHOSPHERE OF MERCURY. V. Dehant[1](PI), J.P Barriot[2](co-PI), M. Paetzold[3](co-PI) and the HeRS team, [1]Observatoire Royal de Belgique, Bruxelles, Belgique, Veronique.dehant@oma.be, [2]Observatoire Midi-Pyrénées/GRGS, Toulouse, France, Jean-pierre.barriot@cnes.fr, [3]Universitat zu Koln, Germany, Paetzold@geo.uni-koeln.de.

We propose a radio-science experiment in the frame of the European Space Agency Bepi Colombo mission to study the deep interior and subsurface of Mercury. The proposed experiment HeRS (**He**rmean **R**adio **S**cience experiment) will only use the nominal TT&C equipment onboard the Planetary Orbiter (MPO) and the ground segment without modifications and will be able to address fundamental questions regarding the physical characteristics of the innermost planet of our solar system, Mercury, by measuring its gravity field and the physical librations. The general objectives of the HeRS experiment are:

1. To study the orbital motion of the spacecraft to obtain the global gravity field of Mercury and the tidally driven gravity variations, to an accuracy required to constrain the structure of the mantle and crust/mantle interface, as well as the deep internal structure of the planet;

2. To measure the degree-2 gravity coefficients and the rotation state of Mercury, so as to constrain the size and physical state of the core of the planet.

We plan to establish a global gravity map with a resolution of about 300 km (harmonic degree 25) by means of a dynamical modeling of the MPO orbit. This gravity map will be supplemented with local maps in areas under the pericenter at a resolution of 200 km with line-of-sight inversions of the Doppler data. The geometry of the orbit, such as the eccentricity and the inclination, is fundamental in the determination of the gravity field precision that can be achieved by using HeRS data. As determined from simulations, the MPO orbit is appropriate to reach the ESA required precision on the gravity field by using the nominal radio-science configuration.

We propose the to use the gravity anomalies to investigate the crust and lithosphere of the planet. Gravity anomalies, in conjunction with the altimeter data, will allow us to estimate the thickness of the crust as well as its spatial variability. The lithospheric thickness can also be deduced from a combined analysis of gravity anomalies and topography, and will be used to determine the heat flow at the time of loading.

The low degree gravity coefficients J_2 and C_{22} will be used, in conjunction with libration and obliquity observations to determine the principal moments of inertia of the core, the mantle, and the whole planet. The amplitude of libration and the obliquity angle will be determined jointly with other BepiColombo instruments (the camera and the star-tracker). These measurements will benefit from Earth-based radar data. We expect a precision of 0.003 on the moment of inertia factor C/Mr^2 and a precision of 0.05 on the ratio between the moment of inertia of the part of the planet participating in the libration to the moment of inertia of the whole planet (C_m/C). In order to interpret libration in terms of the interior of the planet, a precise theory of the spin and orbital motions will be used. This theory, in addition to the classical 88 days libration, will allow accounting for the proper frequencies generated by the 3:2 spin-orbit resonance of Mercury.

The tidal variations of the gravity field will provide the value of the Love number k_2, which is very sensitive to the state and dimension of the liquid outer core and the solid inner core. The Love number, together with the moment of inertia values, can be interpreted in terms of physics of the interior of the planet. This study will therefore provide the best values for core parameters such as radius, density and composition. We will for instance be able to constrain the amount of sulfur in the iron alloy of the core and set limits on the temperature. This is also important for modeling a possible hydromagnetic dynamo.