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The radio waves & quasi thermal noise spectroscopy experiment (SORBET) on BEPICOLOMBO/MMO/PWI

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SORBET (*Spectroscopie des Ondes Radio & du Bruit Electrostatique Thermique*) is a radio HF spectrometer designed for the radio and Plasma Waves Instrument (PWI) onboard BepiColombo/Mercury Magnetospheric Orbiter (MMO), which performs remote and in-situ measurements of waves (electromagnetic and electrostatic). Technically, SORBET includes a plasma wave spectrometer, with two E-field inputs from the two perpendicular electric antennas and one B-field input from a search coil, in the range 2.5 kHz - 640 kHz. This frequency band includes the local gyrofrequency and plasma frequency expected on most part of the MMO orbits. SORBET also includes a higher frequency radio receiver for remote sensing in the range 500kHz-10.2MHz. Owing to its capabilities, SORBET will be able to address the following scientific objectives:

- High resolution mapping (30 km) of electron density and temperature in the solar wind and in the Hermean magnetosphere and exo-ionosphere, via the technique of Quasi-Thermal Noise (QTN) spectroscopy. The quasi-thermal noise is due to the thermal motions of the particles, which produce electrostatic fluctuations. This method is routinely used on Ulysses and Wind spacecraft in the solar wind or in planetary magnetospheres/ionospheres (Ulysses at Jupiter, Cassini at Venus, Earth and very recently at Saturn). This method has the advantage of being relatively immune to spacecraft potential and photoelectrons perturbations. These QTN measurements will be determinant for the dynamic modeling of the magnetosphere and will provide a fundamental input for the chemistry of cold ionized species (Na, K, O ...) in Mercury's environment.

- Detection and study of Hermean radio emissions, including possible cyclotron emissions (up to 10-20 kHz) from mildly energetic electrons in most highly magnetized (polar?) regions, and possible synchrotron radiation (up to a few MHz?) from more energetic electrons.
- Monitoring of solar radio emissions up to 10 MHz in order to create a solar activity index from the view point of Mercury, allowing to correlate it with the Hermean magnetospheric response.