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Radio science investigations with the Proteus mission

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Proteus is a mission proposed in the framework of the NASA Discovery program dedicated to the exploration of Main Belt Comets (MBCs), a new class of volatile-rich bodies in the main asteroid belt. High precision isotopic measurements will be carried out using a state-of-the-art mass spectrometer to determine the relative abundances of key volatiles and shed light on the original formation of water and its delivery mechanisms towards the inner solar system. Global characterization will also be performed through imaging and radio science experiments, in order to determine the physical properties of the considered MBCs and give an indication on their formation process, as compared to comets and asteroids.

Numerical simulations of the radio science experiment were carried out using simulated Doppler and optical measurements to estimate the key properties of the target bodies, such as mass, pole orientation and higher order gravitational harmonics. The accuracy of the estimated parameters is computed for different mission profiles under reasonable assumptions for the dynamical environment. We show that the target objective of 10% accuracy in mass estimation, which is required for a correct evaluation of porosity and ice abundance in the MBCs interior, is met under all conditions.