Geophysical Research Abstracts
Vol. 12, EGU2010-4856-1, 2010
EGU General Assembly 2010

Final results of the Resonance spacecraft calibration effort

Manfred Sampl (1), Wolfgang Macher (1), Christian Gruber (1), Thomas Oswald (2), and Helmut O. Rucker (1)

(1) Austrian Academy of Sciences, Space Research Institute, Graz, Austria (manfred.sampl@oeaw.ac.at), (2) Thomas Oswald Aerospace Software, Weinitzen, Austria

We report our dedicated analyses of electrical field sensors onboard the Resonance spacecraft with a focus on the high-frequency electric antennas. The aim of the Resonance mission is to investigate wave-particle interactions and plasma dynamics in the inner magnetosphere of the Earth, with a focus on phenomena occurring along the same field line and within the same flux tube of the Earth's magnetic field. Four spacecraft will be launched, in the middle of the next decade, to perform these observations and measurements. Amongst a variety of instruments and probes several low- and high-frequency electric sensors will be carried which can be used for simultaneous remote sensing and in-situ measurements.

The high-frequency electric sensors consist of cylindrical antennas mounted on four booms extruded from the central body of the spacecraft. In addition, the boom rods themselves are used together with the these sensors for mutual impedance measurements. Due to the parasitic effects of the conducting spacecraft body the electrical antenna representations (effective length vector, capacitances) do not coincide with their physical representations. The analysis of the reception properties of these antennas is presented, along with a contribution to the understanding of their impairment by other objects; in particular the influence of large magnetic loop sensors is studied.

In order to analyse the antenna system, we applied experimental and numerical methods. The experimental method, called rheometry, is essentially an electrolytic tank measurement, where a scaled-down spacecraft model is immersed into an electrolytic medium (water) with corresponding measurements of voltages at the antennas. The numerical method consists of a numerical solution of the underlying field equations by means of computer programs, which are based on wire-grid and patch-grid models.

The experimental and numerical results show that parasitic effects of the antenna-spacecraft assembly alter the antenna properties significantly. The antenna directions and lengths, represented by the "effective length vector" are altered by up to 4 degree in direction and 50% in length, for the quasi-static range. High frequency analyses (up to 40 MHz) illustrate massive antenna pattern changes beyond the quasi-static frequency limit of approximately 1.5 MHz. In addition we found that the magnetic loop sensors tremendously increase the effective lengths and capacitances, depending on their placement on the booms. The antenna calibration results and loop placement findings are of great benefit to the Resonance mission. In particular, goniopolarimetry techniques like polarization analysis and direction finding depend crucially on the effective axes.