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JUICE model rheometry and simulation for the calibration of the RWI antennas

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The scientific focus of the future JUICE (Jupiter Icy Moons Explorer) mission is to study the Galilean moons Ganymede, Callisto and Europa as potential habitable environments, and to study the Jupiter system as an archetype for gas giants. The so-called RPWI (Radio & Plasma Wave Investigation) onboard of JUICE will investigate the plasma environment and the rich Jovian radio spectrum. The latter will be done with the RWI (Radio Wave Instrument) which consists of three orthogonal dipole antennas of 2.5 m tip-to-tip length and a pre-amplifier mounted on the magnetometer boom plus corresponding radio receivers. The usage of three antennas allows the determination of the wave polarization and the incoming wave direction, but this is only possible with a well-calibrated antenna system.

In this presentation we report about the antenna calibration results from the experimental method of rheometry, in which a gold-plated, metallic scale model (1:40) of the JUICE spacecraft was immersed in a water-filled tank with a homogeneous electric field. By using at least two different suspensions of the model it was possible to derive the so-called effective length vector of each dipole, which describes the reception property of each antenna in the quasi-static frequency range. With the method of rheometry one can in principle measure the so-called open-port effective length vectors, which do not take the capacitve load (e.g. cable capacitance, input capacitance of pre-amplifier) on the antennas into account. The effective length vectors for loaded antennas can be calculated in case the antenna capacitances and the load capacitances are known. We have tested a new method to directly measure the effective length vectors for loaded ports with rheometry by introducing variable resistors, set up in parallel to each antenna port. We also compare the rheometry results with the results from numerical computer simulations with patch-grid models.