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The effect of Ganymede's exosphere on JUICE's determination of the moon's gravity field

A. Hickey (1), D. Durante (1), L. Iess (1), C. Plainaki (2), A. Mura (3), A. Milillo (3)

(1) Sapienza University of Rome, Department of Mechanical and Aerospace Engineering, Rome, Italy (anne.hickey@uniroma1.it)

(2) ASI – Italian Space Agency, Rome, Italy

(3) INAF-IAPS, Rome, Italy

Abstract

ESA's JUpiter ICy moons Explorer (JUICE) is planned to be launched in 2022 with arrival at Jupiter in 2029. The spacecraft will spend approximately 3 years observing the Jupiter System, performing flybys of the moons, ending the mission with a tour around Ganymede, the largest moon in our solar system.

One of the instruments on board the JUICE spacecraft is the 3GM experiment, devoted to reveiling the moons' gravity fields. An orbit determination code will use Doppler measurements to determine a spacecraft's position, velocity and dynamical model parameters that affect the spacecraft's trajectory, including gravity field coefficients which relate to the interior structure of a planetary body. Additionally, a spacecraft experiences the effect of drag in the presence of an atmosphere/exosphere.

Ganymede's exosphere consists of O_2 and H_2O which is generated by ongoing processes of sputtering, sublimation and radiolysis on the moon's icy surface. This generation of the exosphere is complicated by the fact that Ganymede has its own magnetic field which is imbedded within Jupiter's magnetosphere and results in preferred regions of ion precipitation on the moon's surface. Recently, a model of this complex interaction has been developed [1].

This work aims to incorporate this exospheric model for Ganymede in our orbit determination code, in order to simulate and assess the effect experienced by JUICE during the final phase around Ganymede and to determine the feasibility of using an onboard accelerometer to calibrate and estimate this effect.

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References

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