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Determination of Ganymede's exosphere and gravity field by JUICE

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Abstract

ESA's JUpiter ICy moons Explorer (JUICE) will be launched in 2022 and arrive at Jupiter in 2029. The mission's primary objectives are to investigate habitable worlds around gas giants and to establish if the Jupiter is an archetype for the giant planets of the Solar System. The spacecraft will spend approximately 3 years observing the Jupiter System and performing flybys of Europa and Callisto, before being placed into a circular orbit around Ganymede at an altitude of about 500 km for almost 4 months. In this phase of the mission, JUICE will investigate Ganymede's surface, magnetic field and exosphere.

JUICE comprises a suite of eleven instruments, one of which is 3GM (Geodesy and Geophysics of Jupiter and the Galilean Moons), a radioscience experiment devoted to revealing the moons' gravity fields. An orbit determination code will use Doppler measurements to determine the spacecraft's position, velocity and dynamical model parameters that perturb the spacecraft's trajectory. Such parameters include gravity field coefficients which are related to the interior structure of a planetary body as well as the effect of drag experienced by the spacecraft 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. The spatial distribution of the exosphere is complicated by the fact that sublimation occurs only on the dayside and also because of Ganymede's 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]. Figure 1 shows the acceleration due to drag induced by Ganymede's exosphere over a 24-hour period.

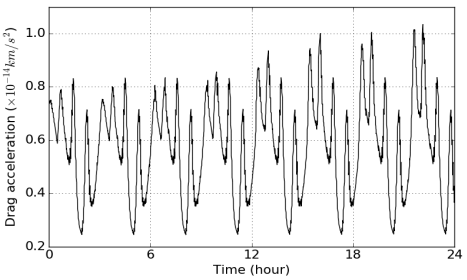

Figure 1: Drag-induced acceleration on JUICE owed to Ganymede's exosphere.

This work aims to include this exospheric model in an orbit determination code, to simulate and assess the effect on JUICE during the Ganymede circular orbit phase. We assess the possibility of determining the exospheric model parameters given their uncertainties.

Acknowledgements

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References

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