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Test particle simulation of Ganymede's plasma environment

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So far, Ganymede's nearby plasma environment has been in part characterized only during a few flybys of the moon by the Galileo spacecraft at the end of the 1990s and through a few remote observations of auroral emissions by the Hubble Space Telescope. Our knowledge of the plasma composition, density and dynamics in Ganymede's magnetosphere remains therefore limited. The JUICE spacecraft will characterize in detail the exosphere, ionosphere and particle environment around the moon. Prior to arrival, models have been developed to predict these regions and their interaction with the background Jovian particles and magnetic field.

We have developed the first 3D test particle model of Ganymede's ionosphere. The model is driven by: (1) the number densities of neutral species from the exospheric model of Leblanc et al. (Icarus, 2017), (2) solar extreme ultraviolet radiation (Woods et al. 2005), (3) electron fluxes coming from the Jovian plasma around the moon (Mauk et al., 2004) and (4) the electromagnetic field from the hybrid model of Leclercq et al. (PSS, in revision). In the simulation, the ionospheric ions are produced via photoionization and electron-impact ionization of the neutral exosphere. The test particles move under the influence of the magnetic and electric fields derived from the hybrid model.

We will present the first three-dimensional maps of number densities and bulk speeds of the main ion species produced in Ganymede's ionosphere. We will show and interpret our derived ion-impact 2D maps at the surface for both ionospheric ions and Jovian ions (coming from the Jovian plasma sheet), and provide sputtering rates of neutral molecule production resulting from these impacts. We will also quantify the importance of the charge-exchange process between the ions and exospheric species in terms of production of energetic neutrals, which is relevant for exospheric models. Finally, we will assess the variability of the ionosphere over a revolution of Ganymede around Jupiter, driven by the change in the neutral exosphere (Leblanc et al., 2017) and in the angle Sun-moon direction. We will evaluate its potential implications on the variability of Ganymede's magnetic environment.