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Understanding the interaction between Ganymede's and Jupiter's magnetospheres through multi-fluid simulations and observations

C. Paty and R. M. Winglee

Dept. of Earth and Space Sciences, University of Washington, Seattle, WA 98195-1310 USA (carol@ess.washington.edu, winglee@ess.washington.edu)

The Galilean moon Ganymede provides a unique case study in furthering our understanding of how space plasmas interact with planetary magnetospheres. Ganymede is the largest of Jupiter's moons and the only one to have its own magnetosphere, which is embedded within the large Jovian magnetosphere. In order to understand the complex interactions in this system, we have implemented a novel three-dimensional modeling technique that represents different ion sources as collisionless fluids that interact via electric and magnetic fields. The results from this multi-fluid treatment are well correlated with observations of aurora and magnetic fields, and demonstrate the important role heavy ions and their gyromotion play in governing the shape and dynamics of Ganymede's magnetosphere. The multi-fluid nature of the simulations also allows one to track the differential acceleration of heavy and light mass ions sourced from Ganymede's ionosphere and the Jovian magnetosphere. Thus, sampling the simulated ion energies, temperatures and densities for each ion species along Galileo's trajectory permits the representation of simulated data in a way directly comparable to ion energy spectrograms from Galileo.