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Jovian's plasma torus interaction with Europa. Effects of induced dipole moment: 3D hybrid kinetic simulation

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Abstract

The hybrid kinetic model approach supports comprehensive simulation of the interaction between different spatial and energetic elements of the Europa moon-magnetosphere system with respect to variable upstream magnetic field and flux or density distributions of plasma and energetic ions, electrons, and neutral atoms. This capability is critical to improved interpretation of the existing measurements for surface and atmospheric composition from previous missions and to planning of future missions. The simulations are based on recent models of the atmosphere of Europa [1,2]. The hybrid model allows us to take into account the finite gyroradius effect and to estimate correctly the ions velocity distribution and the fluxes along the magnetic field in opposite the MHD simulation with the Maxwellian velocity distribution for background and pickup ions. The hybrid model also allows us to investigate the effects of the electron pressure on plasma wake structure that was already done for Jovian torus Io interaction [3]. Photoionization, electron-impact ionization and charge exchange are included in our model. The temperature of the background electrons and pickup electrons was also included into the generalized Ohm's law. The background plasma contains O^{++}, S^{++} thermal ions and energetic ions [5]. The pickup ions were created from the atmosphere. The majority of O_2 atmosphere is thermal with an extended non-thermal population [1]. The moon is modeled in this initial work as a weakly conducting body. The first results of 3D hybrid kinetic simulation of Europa's environment in absence of the induced magnetic dipole moment were presented in [6]. In this report we discuss the results of the hybrid kinetic simulation of Europa's environment in presence of the induced magnetic dipole moment.

References

[1] Cassidy, T.A., R.E. Johnson, M.A. McGrath, M.C. Wong, J.F. Cooper, The spatial morphology of Europa's near-surface O_2 atmosphere, Icarus, 191, 755-764, 2007.

[2] Shematovich, V.I., R.E. Johnson, J.F. Cooper, M.C. Wong, Surface-bounded atmosphere of Europa, Icarus, 173, 480-498, 2005.

[3] Lipatov, A.S. and M.R. Combi, Effects of kinetic processes in shaping Io's global plasma environment: A 3D hybrid model, Icarus, 180, 412-427, 2006.

[4] Kabin, K., et al., On Europa's magnetospheric interaction: A MHD simulation of the E4 Flyby, JGR, 104, 19983-19992, 1999.

[5] Paterson, W.R. et al., Galileo plasma observations at Europa: Ion energy spectra and moments, JGR, 104, 22779-22791, 1999.

[6] Lipatov, A.S. et al., Jovian's plasma torus interaction with Europa: 3D Hybrid kinetic simulation. First results, PSS (submitted), 2009.