MODELING OF THE INTERACTION OF ENCELADUS WITH THE MAGNETOSPHERE OF SATURN.
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Introduction: The numerical modeling of the interaction between the atmosphere of Enceladus and the Kronian magnetosphere is a complex problem due to the diversity of the physical and chemical mechanisms involved in shaping the environment of this icy moon. The Kronian magnetosphere at the orbital distance of Enceladus can be seen as a supersonic, sub-Alvenic plasma co-rotating with Saturn and embedded in the strong magnetic field of the planet. The water vapor released from the south pole terrain adds to the neutral atoms and molecules that are sputtered from the surface of Enceladus by energetic ions, photons and through meteoroid bombardment to form a tenuous supersonic expanding neutral atmosphere. The released neutral gas is partially ionized and dissociated by EUV radiation, charge exchange and electron impact ionization. The created ions are picked up and a weak "mass loading" phenomenon forms in which mass, momentum, and energy are exchanged between the Kronian plasma and the original atmosphere of Enceladus.

In this paper we present the latest results of the three-dimensional multi-fluid model of the interaction between Enceladus and the magnetosphere of Saturn. This model is based on the numerical code initially developed to simulate cometary atmospheres. It is designed to use the capabilities of highly parallel supercluster computers [1].

Modeling of Enceladus' Atmosphere: Our new model uses a two-fluid approach where ions and neutrals are considered as separate interacting fluids. The kinetic equations relative to these three fluids are solved using an adaptive Cartesian grid that is refined or relaxed as needed. The multi-fluid approach we chose leads to a more accurate representation of the atmosphere of Enceladus since the dynamics of ions and neutrals are computed separately and in a self-consistent way (Figure 1).

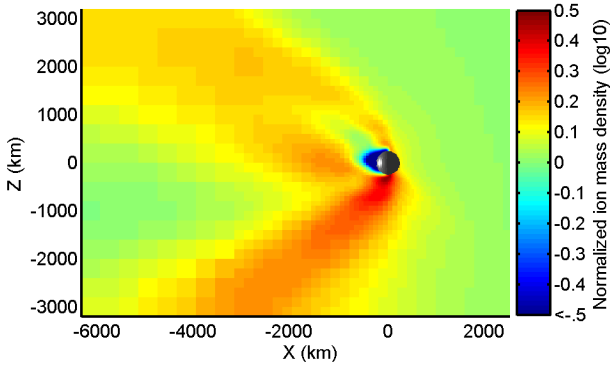

Figure-1: Modeled ion density (normalized to the density of the co-rotating magnetospheric ions).

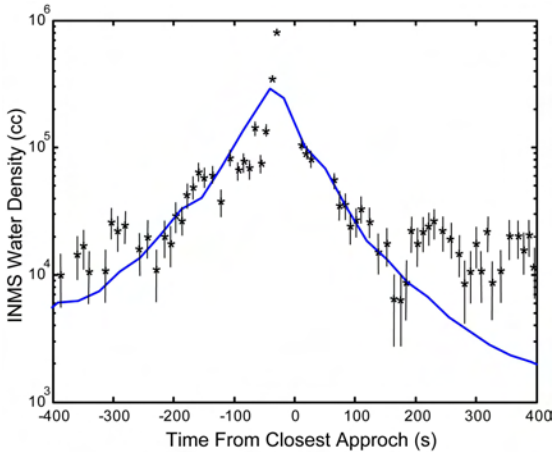

Figure-2: Modeled water density profile and comparison with the INMS data recorded along the Cassini trajectory near its closest approach of Enceladus. The data are derived from [2].

In the current simulation we investigate more precisely the structure of Enceladus' tenuous atmosphere in the light of the recent data gathered by the Cassini spacecraft during its flybys of this icy moon. The model takes into account a neutral plume emission from the southern polar terrain as an explanation of the density peaks detected by the Ion Neutral Mass spectrometer (INMS) and the Dust analyzer (CDA) instruments (Figure 2).

References:

[1] Benna M. et al. (2004) *ApJ, 617*, 1, 656-666.

[2] Waite J.H., et al. (2006) *Science, 311*, 1419-1422.