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Neutral Collisions Significantly Slow Down the Ions Returning to Titan

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Abstract

Our new simulations taking into account the elastic collisions between ions and the neutral gas at Titan show that above the exobase newly created (or escaping ionospheric) ions transfer most of their energy to the neutrals via ion neutral collisions. This is due to the extended nature of Titan's exosphere.

We used SRIM [1] cross sections for hydrogen and oxygen ions in nitrogen gas to calculate proper estimates for the cross sections for the five ions species used in the HYB-Titan hybrid model [2, see also 3], namely H^+, H_2^+, O^+, CH_4^+, and N_2^+. The N_2 density profile used was from INMS measurements over a dozen or so flybys.

We have made several comparative runs to establish the effect that collisions have both on the incident ions from the magnetospheric flow and on those ions escaping and then returning to Titan's atmosphere along field lines. The results indicate a decrease in the ion energies and fluxes for the ambient flow ions that reach Titan's exobase. The decreases are relatively larger for hydrogen ions than for oxygen ions; hydrogen ion energy deposit is decreased around 20 per cent due to the neutral collisions.

The effect on the returning ions of exospheric or ionospheric origin seems to exceed 80 per cent of their energy. For the exospheric H_2^+ the effect is considerably smaller, however, due to the large scale height. Results shown in Fig. 1 will be described as well as the implications of the ion-neutral collisions for the heating of Titan's neutral corona and atmospheric escape [4].

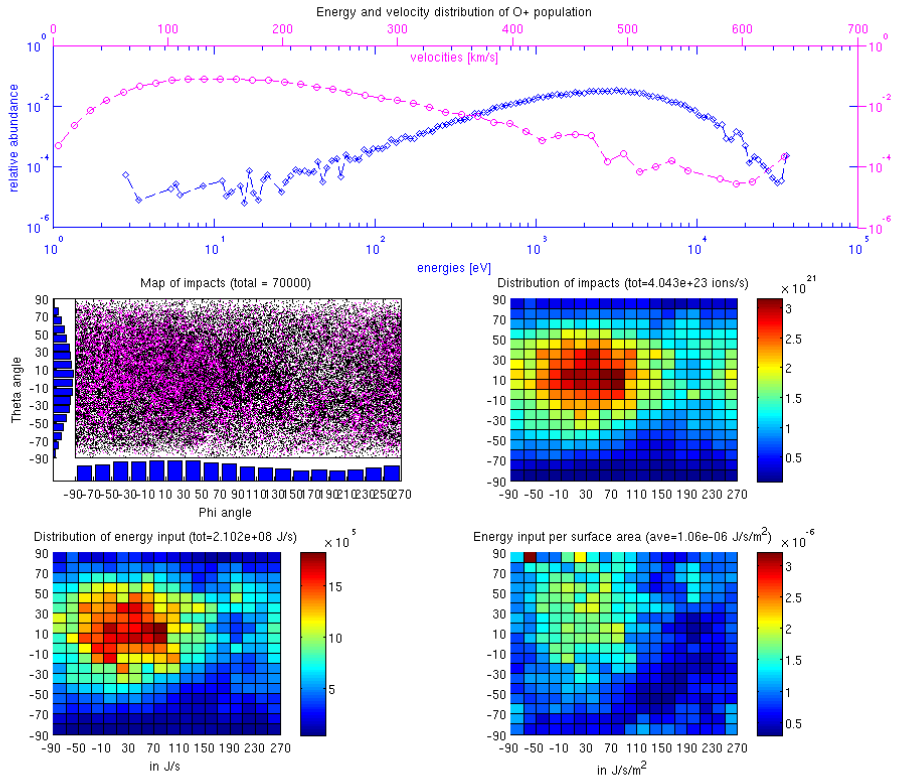

Figure 1: Preliminary run results on impacting O^+ ions onto Titan's exobase.

References

[1] Stopping and Range of Ions in Matter (SRIM), Monte Carlo software by James F. Ziegler (online at http://www.srim.org/)

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