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Effects of Neutral Collisions and Charge Exchange to Titan Plasma Interaction

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Our new hybrid simulations for Titan, which take into account the elastic collisions between ions and the neutral gas at Titan, show that even 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.

The results indicate a decrease in both the ion energies and fluxes for the ambient flow ions that reach Titan's exobase often by about a third. Results from the simulations with the elastic collisions will be described in detail as well as the implications of the ion-neutral collisions for the heating of Titan's neutral corona and atmospheric escape [4].

In addition, we are studying the effect the charge exchange reactions for O^+ has together and without the neutral collision scheme. We model three reactions

A) $O^+ + N_2 \rightarrow O + N_2^+$ Charge Exchange or CT (O^+ destroyed, N_2^+ created)

B) $O^+ + N_2 \rightarrow O + N^+ + N$ Dissociative CT (O^+ destroyed, N^+ created)

C) $O^+ + N_2 \rightarrow O^+ + N^+$ N^+ Ionization (N^+ created, no effect on direction or energy of O^+)

All reaction cross sections have energy dependence. Neutral particles are not created, but the total ENA energy is recorded as well as the resulting reaction rates. We expect to present first results of modeling these reactions.

References

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