Chemistry in Titan's ionosphere: contribution of dissociative recombination to an ion- neutral coupled model

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Chemistry in Titan's ionosphere: contribution of dissociative recombination to an ion-neutral coupled model

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Modelling the chemical composition of Titan's ionosphere is a very challenging issue. Latest works perform either inversion of CASSINI's INMS mass spectra (neutral[1] or ion[2]), or design coupled ion-neutral chemistry models[3].

Coupling ionic and neutral chemistry has been reported to be an essential feature of accurate modelling[3]. Electron Dissociative Recombination (EDR), where free electrons recombine with positive ions to produce neutral species, is a key component of ion-neutral coupling.

Experimental databases of EDR are incomplete. Indeed, for heavy hydrocarbon ions ($C_nH_y^+, n \geq 3$), final neutral molecules distribution is unknown. Data are available only over the carbon composition of fragments, which leaves a deterministic approach irrelevant.

Thanks to a novel stochastic description of the EDR chemical reactions, we were able to calculate neutral species fluxes du to EDR processes and compare them to fluxes du to neutral chemistry processes.

Some species' fluxes, like nitrile molecules, are mainly described by EDR processes (Fig. 1). Although hydrocarbon fluxes are dominated by the neutral chemistry contribution, EDR contribution grows with the molecules' mass (Fig. 2) and is therefore of importance for heavy molecules coupling.

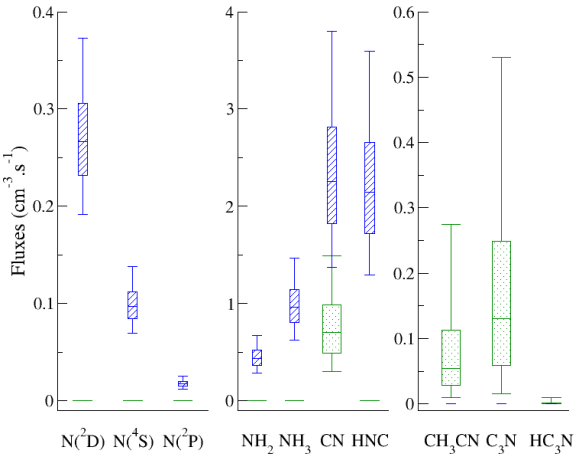

Figure 1: Nitrile species fluxes; blue: EDR processes flux; green: neutral chemistry processes fluxes

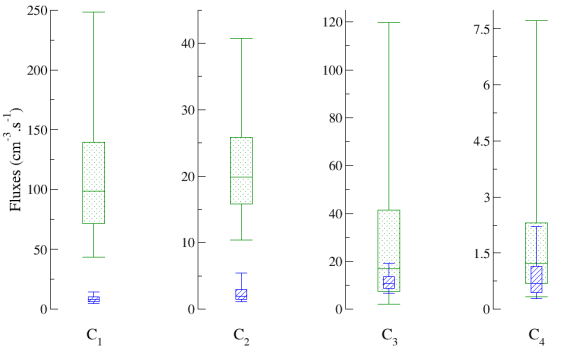

Figure 2: Global fluxes for hydrocarbon molecules, sorted by mass; blue: EDR processes flux; green: neutral chemistry processes fluxes

References

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