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Collisional dissociative recombination of H_3^+ ions with electrons

RAINER JOHNSEN, University of Pittsburgh — Plasma afterglow measurements have consistently yielded either much lower (by factors of 10 or more) or higher (by factors of 3 to 4) electron-H_3^+ recombination coefficients then those observed in ion storage rings, and calculated by *ab-initio* theory. The origin of this long-standing discrepancy has not been clearly identified. I will show here that "collisional dissociative recombination" in conjunction with angular momentum l-mixing can account for the observed increase of recombination rates in plasma experiments at higher neutral densities. In this model, the enhancement of the recombination results from three-body electron capture into Rydberg states of high angular momentum l, followed by l-reducing collisions with neutral atoms that induce predissociation. Hence, while there is no true "discrepancy" between afterglow and storage ring H_3^+ recombination coefficients, recombination in a plasma is not a purely binary process. The same may be true for other ions that recombine by the "indirect process." I also propose that the very low values obtained in some afterglows at low concentrations of neutral hydrogen are flawed by the presence of ion species other than H_3^+, rather than being due to different spin modifications, or vibrational excitation of H_3^+, as has been suggested.

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