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A calculation of heating rate due to dissociative recombination in the Martian thermosphere

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Dissociative recombination of molecular ions is one of the most exothermic reactions in the Martian thermosphere. The heating efficiencies in the terrestrial planet were calculated by several authors and they show dissociative recombination of O_2^+ is major heat source in the upper thermosphere. Recently, the energy relaxation rate of hot oxygen atoms in collisions with atmospheric oxygen gas was evaluated using realistic differential cross section, in which all the electronic energy curves of O_2 separating to the atomic ground states was incorporated. The escape probabilities of hot O due to dissociative recombination of O_2^+ for several production altitudes calculated using this realistic differential cross section show the bulk of the escape O arises from far below the exobase where it was previously believed that fast particles were thermalized immediately.

In this paper, I evaluate heating rate due to dissociative recombination using Direct Simulation Monte Carlo model. Because we do not have all the potential of the excited levels of all species, I use the Lennard-Jones potential for interaction between two molecules.