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New insights on the collisional escape of light neutrals from Mars

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Photodissociative recombination (PDR) of atmospheric molecules on Mars is a major mechanism of production of hot (suprathermal) atoms with sufficient kinetic energy to either directly escape to space or to eject other atmospheric species. This collisional ejection mechanism is important for evaluating the escape rates of all light neutrals that are too heavy to escape via Jeans escape. In particular, it plays a role in estimating the total volume of escaped water constituents ($i.e.$, O and H) from Mars, as well as influences evolution of the atmospheric [D]/[H] ratio[1].

We present revised estimates of total collisional escape rates of neutral light elements including H, He, and H_2, based on recent (years 2015-2016) atmospheric density profiles obtained from the NASA Mars Atmosphere and Volatile Evolution (MAVEN) mission. We also estimate the contribution to the collisional escape from Energetic Neutral Atoms (ENAs) produced in charge-exchange of solar wind H^+ and He^+ ions with atmospheric gases[2,3]. Scattering of hot oxygen and atmospheric species of interest is modeled using fully-quantum reactive scattering formalism[1,3]. The escape rates are evaluated using a 1D model of the atmosphere supplemented with MAVEN measurements of the neutrals. Finally, new estimates of contributions of these non-thermal mechanisms to the estimated PDR escape rates from young Mars[4] are presented.

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