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Variability in the loss of ions from the Martian atmosphere

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The MAVEN (Mars Atmosphere and Volatile EvolutioN) spacecraft has been making measurements of the upper atmosphere of Mars and its escape to space since November 2014. The loss of atmospheric particles (in neutral or charged state) is though to have played a role in the evolution of the Martian climate over the past ∼4 billion years. Charged particle escape at Mars may be significant due to the absence of a global dynamo magnetic field for most of its history, allowing more direct access of the solar wind to the Martian atmosphere. Among its many measurement capabilities, MAVEN can detect escaping planetary ions with high time cadence and high energy and mass resolution using the STATIC (SupraThermal and Thermal Ion Composition) instrument.

We present the results of an ongoing effort to compute the escape rate of ions from the Martian atmosphere over MAVEN's primary mission. We statistically map the measured fluxes of planetary ion to various surfaces near Mars, including a closed spherical shell surrounding the planet. We map both incoming and outgoing fluxes over different mass and energy ranges, and separate the fluxes by different drivers of escape measured by MAVEN, including solar wind pressure, Extreme Ultraviolet flux, and Interplanetary Magnetic Field strength. Next, we evaluate the relative importance of different drivers, and make a multi-parameter fit to the measured escape fluxes. Finally, we place our results in context with measurements of ion escape made by the Phobos 2 and Mars Express missions, and address the implications for atmospheric loss over the history of the planet.