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Solar Wind Helium Charge Exchange in the Martian Corona

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When the solar wind encounters the Martian hydrogen corona, charge-changing collisions between the solar wind ions and coronal neutrals successively alter the charge-state ratios of solar wind species. The solar wind H/H+ and He+/He+2 ratios increase as a function of the traversed neutral column density. This can be used to infer the column density from observed charge-state ratios (Simon Wedlund et al. [2016]). The charge-state evolution of the solar wind increases the precipitation of solar wind particles onto the Martian atmosphere, since less-charged particles penetrate the Martian magnetosphere more easily. Accordingly, Halekas et al. [2017] found that the solar wind hydrogen precipitation onto the Martian atmosphere correlates with the seasonal variability of the Martian corona.

In the present study, we aim to follow the charge-state evolution of the solar wind in the Martian corona. We focus on the charge states of solar wind helium ions, which we observe in data from ion sensors on Mars Express and MAVEN. We evaluate the solar wind He+/He+2 ratio within the Martian corona, upstream of the Martian bow shock. We then use these results to discuss the density profile of the Martian hydrogen corona and its spatial and temporal variation.

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Halekas, J. S. (2017), J. Geophys. Res. Planets, 122, 901–911, doi:10.1002/2017JE005306.