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Evidence of Hot Hydrogen in the Exosphere of Mars Resulting in Enhanced Water Loss

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The history of water escape from Mars has been a topic of intense interest among the scientific community. Water escape from Mars is generally studied by measuring the escape rate of atomic hydrogen from its exosphere and tracing it back in time to determine the total amount lost by the planet. However, the loss rates are estimated assuming thermal properties for the H atoms, and are therefore a lower limit. Past analyses of spacecraft observations presented indirect evidence for the existence of an energetic non-thermal H population. However, all these observations lacked a clear detection. Here we present the first unambiguous observational signature of non-thermal H at Mars, consistent with solar wind charge exchange as the primary driver for its production. The calculated non-thermal H escape rates reach as high as ~26% of the thermal escape rate near aphelion. An active Sun today would increase the present-day escape rate of H and a younger energetic Sun likely contributed towards a significant loss of water from Mars, thereby shortening the martian water escape history timeline.