

B38 - Ionospheric Escape of H_3^+ from Jupiter's Polar Regions

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Abstract

Trihydrogen cations (H_3^+), a key diagnostic of atmospheric energy balance, are produced through ionization by solar radiation and particle impacts in hydrogen-rich planetary atmospheres. At Jupiter, H_3^+ is produced most efficiently in the auroral region through electron precipitation and plays a leading role in magnetosphere-ionosphere coupling by regulating ionospheric conductance. Previously, the properties of H_3^+ have been determined from remote sensing, with plasma parameters retrieved from its infrared emissions, although these measurements are limited by line-of-sight integration and restricted altitude resolution. Here, we report the unambiguous, direct in-situ detection of H_3^+ plasma in the auroral region. Unexpectedly, intermittent H_3^+ outflows are measured high above the ionosphere, with upward velocities exceeding Jupiter's escape speed, confirming atmospheric escape of H_3^+ . We propose that H_3^+ outflow originates in the auroral upward electric current region, initially triggered by plasma-wave interactions and subsequently accelerated by the electric potential structure above the ionosphere. This study reveals a new H_3^+ -mediated pathway for mass and energy transfer between the ionosphere and magnetosphere of Jupiter, constituting an important contribution to atmospheric escape with a loss rate of order $10^{26}/\text{s}$. Similar mechanisms may operate at other planets with infrared aurorae and strong magnetic fields.