

Extended H₂ distribution in Titan's upper atmosphere

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The global averaged H₂ density profile throughout Titan's upper atmosphere between 1,150 and 7,600 km is extracted from the Ion and Neutral Mass Spectrometer (INMS) observations of 10 different low altitude Titan flybys of the Cassini orbiter. In Titan's thermosphere between 1,150 km and the exobase level at 1,360 km, the observed H₂ distribution can be described by the diffusion model with a best-fit upward flux of $3.6 \times 10^9 \text{ cm}^{-2}\text{s}^{-1}$, referred to the exobase. Throughout Titan's exosphere, the H₂ density profile can be described by a collisionless model including only ballistic and escaping particles, with a best-fit exospheric H₂ temperature of 133 K. This temperature is lower than Titan's thermospheric temperature of 144 K, derived from the N₂ distribution below the exobase. This may be interpreted as the outcome of energy continuity in the transition layer between the collision-dominated thermosphere and collision-free exosphere. The derived exospheric H₂ temperature corresponds to a Jeans escape flux of $1.2 \times 10^9 \text{ cm}^{-2}\text{s}^{-1}$ at the exobase. A comparison with the upward flux estimated from the diffusion theory implies that either nonthermal processes or Saturn's gravitational field may play an important role in the enhanced escape of H₂ from Titan.