



Observations of the Enceladus H₂O torus with Herschel / HIFI

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Observations of several water lines (557, 987, 1113 and 1670 GHz) at Saturn with Herschel / HIFI, performed in June 2009 and June 2010, have revealed that in addition to emission due to water in Saturn's stratosphere, these features include absorption cores, interpreted as due to absorption in the Enceladus H₂O torus produced by Enceladus plume activity (Lellouch et al. DPS 2010, Hartogh et al. DPS 2010). These absorptions were not observed in similar observations of the 557 GHZ line by SWAS in 1999, most probably a consequence of the different viewing geometry, with the ring / satellite system wide open in 1999 (sub-observer latitude $\beta \sim -25^\circ$) and almost edge-on in 2009-2010 ($\beta \sim 0^\circ$). These observations provide a new method to probe the physical conditions in the Enceladus torus, constraining the water column density, velocity dispersion, excitation conditions and torus vertical extent, and demonstrating the role of neutral-neutral collisions in shaping the torus. Comparing to the model of Cassidy and Johnson (Icarus, 2010), the 2009-2010 observations indicate an ejection rate of $\sim 0.75 \times 10^{28}$ H₂O molecules s⁻¹ from Enceladus, and a 7×10^5 cm⁻²s⁻¹ influx into Saturn, supporting the idea that Enceladus' plume activity is the source of water in Saturn's atmosphere. Additional observations with Herschel / HIFI were obtained on December 30-31, 2010, in an intermediate geometry ($\beta = 12.4^\circ$). These new data will be presented and interpreted in the context of the torus model.