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Saturn Ring Rain:
New Observations and Estimates of Water Influx

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Abstract

We estimate the maximum rates of water influx from Saturn's rings based on ionospheric model reproductions of derived H_3^+ column densities. On 17 April 2011 over two hours of near-infrared spectral data were obtained of Saturn using the Near InfraRed Spectrograph (NIRSPEC) instrument on the 10-m Keck II telescope. Two bright H_3^+ rotational-vibrational emission lines were visible nearly from pole to pole, allowing low-latitude ionospheric emissions to be studied for the first time, and revealing significant latitudinal structure, with local extrema in one hemisphere being mirrored at magnetically conjugate latitudes in the opposite hemisphere. In addition, those minima and maxima mapped to latitudes of increased or decreased density, respectively, in Saturn's rings, implying a direct ring-atmosphere connection in which charged water group particles from the rings are guided by magnetic field lines as they "rain" down upon the atmosphere. Water products act to quench the local ionosphere, and therefore modify the H_3^+ densities and their observed emissions.

Using the Saturn Thermosphere Ionosphere Model (STIM), a 3-D model of Saturn's upper atmosphere, we derive the maximum rates of water influx required from the rings in order to reproduce the H_3^+ column densities observed on 17 April 2011. We estimate the globally averaged maximum ring-derived water influx to be (1.6-12)x10^5 cm^{-2} sec^{-1}, which represents a maximum total global influx of water from Saturn's rings to its atmosphere of (1.0-6.8)x10^{26} sec^{-1}.

We will also present the initial findings of Keck ring rain observing campaigns from April 2013 and May 2014.