OBSERVATIONS OF ENCELADUS AND DIONE AS SOURCES FOR SATURN'S NEUTRAL CLOUD. J. S. Leisner[1], K. K. Khurana[1], C. T. Russell[1], M. K. Dougherty[2], A. M. Persoon[3], X. Blanco-Cano[4], and R. J. Strangeway[1], [1]Institute of Geophysics and Planetary Physics, UCLA, Los Angeles, CA 90095-1567 (jleisner@ess.ucla.edu), [2]Department of Physics, Imperial College, London, SW7 2AZ United Kingdom, [3]Department of Physics and Astronomy, Univeristy of Iowa, Iowa City, IA 52242, [4]Instituto de Geofisica, UNAM, Ciudad Universitaria, Coyoacan, Mexico, DF 04510 Mexico.

Introduction: The neutral cloud of molecular water surrounding Saturn was first observed in 1993 [1]. Since then, models have indicated that most, if not all, of that material was provided by Enceladus [Johnson R. E., pers. comm.]. The first direct evidence of this relationship was provided by the magnetometer onboard the Cassini spacecraft. During the first close flyby of that moon, the magnetometer observed a deflection of magnetic field around Enceladus, similar to that seen at the jovian moon Io [2]. This draping pattern results when mass is added to the flowing magnetospheric plasma, and the flow near the moon is slowed. Two subsequent flybys confirmed the draping picture and showed that the source region was a plume located south of Enceladus.

Ion Cyclotron Waves: While in the inner magnetosphere, the Cassini magnetometer also has consistently observed ion cyclotron waves generated by the ionization of the neutral molecules near the equatorial plane [3]. Knowing the relationship between the energy carried by these waves and the amount of neutral material ionized below the spacecraft, we also calculate the ionization rates across the Cassini orbits to date. With these calculations, we construct an average radial profile for ionization of the neutral cloud. Between 3.5 and 6.5 Saturn radii, we find that over 8 kilograms of water molecules are ionized per second. We note that this figure is an underestimate of the total loss due to neutral particle losses to which our method is not sensitive.

Observations Near Icy Moons: When these calculated ionization rates are examined near the icy moons' orbits, we find that there is an enhancement close to Enceladus' position, indicating that the moon is a source of mass. We also find an enhancement near Dione, indicating that this moon also adds mass to the system, although the calculated ionization rate is much less there than near Enceladus [Fig. 1].

On the one close flyby of Dione, the magnetometer observed a deflection of the magnetic field, similar to that seen at Enceladus although smaller in magnitude [Fig. 2]. Modeling of the Enceladus signature shows that a mass-loading rate locally of over 2 kilograms per second is required. At Dione the amount needed to produce the observed signature is about 6 grams per second. This figure for Dione is an order of magnitude

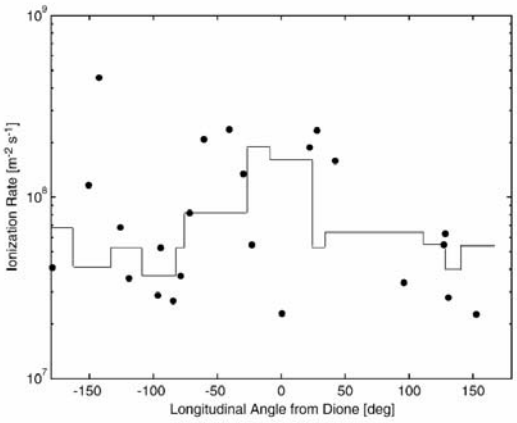

Figure 1. Calculated ionization rate near Dione's orbital path, versus longitudinal separation from the moon. The line is a running seven-point median. Positive longitudes are downstream of Dione and negative longitudes are upstream.

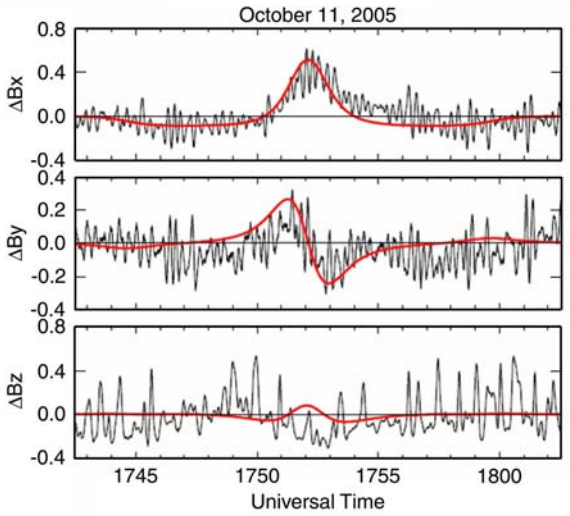

Figure 2. Detrended magnetic field vectors, in nT, during Dione flyby. The red lines mark the model fit of the Dione signature. The x direction is along corotation, the y direction is towards Saturn, and the z direction completes the right-hand system.

greater than can be accounted for through sputtering from that moon's surface alone.

Conclusions: We conclude that Enceladus is the dominant source of neutral material in the saturnian system. While introducing a much smaller amount than that, Dione also is found to be an active source of material in the magnetosphere. We have seen no evidence of mass-loading at Tethys, either in the draping signature or in the ion cyclotron waves.

References: [1] Shemansky D. E. *et al.* (1993) *Nature, 363,* 329-331. [2] Dougherty M. K. *et al.* (2006) *Science, 311,* 1406-1409. [3] Leisner J. S. *et al.* (2006) *GRL, 33,* L11101.