CASSINI UVIS: A YEAR OF ICY SATELLITES. A. R. Hendrix[1] and C. J. Hansen[1], [1]Jet Propulsion Laboratory/California Institute of Technology, 4800 Oak Grove Dr., MS 230-250, Pasadena, CA, 91109, hendrix@jpl.nasa.gov.

Introduction: For the Cassini spacecraft, the year 2005 was marked by the close flybys of nearly all of the major icy satellites of Saturn. In fact, with the exception of Enceladus, Iapetus and Phoebe, the 2005 flybys were the closest to each of the moons planned for the entire mission. At this point all of the major icy moons of Saturn have been observed at close range, including Mimas, Enceladus, Tethys, Dione, Rhea and Hyperion. The closest flyby of Phoebe occurred in 2004. The second-closest flyby of Iapetus in the tour happened on December 31, 2004; the closest flyby of that moon will take place in 2007. A 100 km flyby of Enceladus is planned for 2008.

We present an overview of these intriguing moons as measured by the Cassini Ultraviolet Imaging Spectrograph (UVIS). In this analysis, we focus on surface composition through spectral modeling, and note that strides have been made in determination of upper limits on gases, as well as analysis of solar phase curves.

Flybys: The year 2005 began with the second-closest flyby of Iapetus in the tour, at 124,000 km on December 31-January 1. The Iapetus observations focused on the dark leading hemisphere. On January 16, the first good looks were obtained of Enceladus, Mimas and Rhea, from a distance of ~200,000 km. On February 17 came the first very close flyby of Enceladus, at 1100 km. It was on this flyby that the Magnetometer measurements [1] suggested an intriguing signature around Enceladus, but a stellar occulation by UVIS [2] showed no sign of an atmosphere. March 9 brought another close (500 km) flyby of Enceladus. The closest flyby yet of Enceladus was made on July 11, at 172 km; the original, more-distant flyby distance was decreased to allow for investigation of the curious Magnetometer signatures. During this flyby, a plume and associated hotspot were discovered [2][3]. On August 2, observations of Mimas were made from 62,000 km, the closest pass by this tiny moon in the tour. September brought Hyperion (Sept. 15) at 500 km and Tethys (Sept. 14) at 1500 km. On October 16, a 500 km pass by Dione was made and finally, on November 26, Cassini flew within 500 km of Rhea. In addition to these close flybys, numerous more distant observations were made, allowing for an extensive amount of analysis and intercomparison between the moons.

UVIS: The Cassini UVIS [4] uses two-dimensional CODACON detectors to provide simultaneous spectral and one-dimensional spatial images. Two spectrographic channels provide images and spectra in the EUV (563-1182Å) and FUV (1115-1912Å) ranges. The detector format is 1024 spectral pixels by 64 spatial pixels. Each spectral pixel is 0.25 mrad and each spatial pixel is 1 mrad projected on the sky. The UVIS has three selectable slits. The high-resolution slit is 0.75 mrad wide for the FUV channel (1.0 mrad for the EUV channel), the low-resolution slit is 1.5 mrad wide for the FUV channel (2.0 mrad wide for the EUV channel) and the occultation slit is 8.0 mrad wide for both the FUV and EUV channels. The high- and low-resolution slits have spectral widths of 2.75Å and 4.8Å, respectively, in both the FUV and EUV channels.

Spectral Modeling: In this analysis, we focus on the data from the FUV channel. In the FUV, water ice is characterized by a very strong absorption feature at ~165 nm. At wavelengths shortward of ~165 nm, water ice is extremely dark and spectrally gray. The exact wavelength at which the H_2O ice absorption occurs is dependent on grain size as shown in Fig. 1 [5]. Thus, spectral models of the icy satellites can estimate grain sizes comprising the optically active surface.

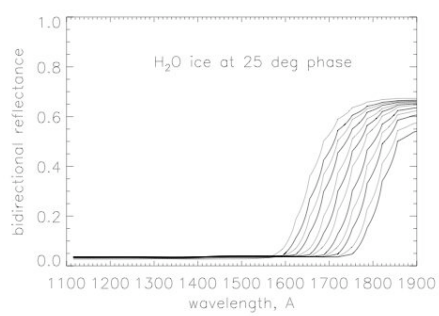

Figure 1. Reflectance of pure water ice at 25 degrees phase angle for several grain sizes (0.2 um – 1mm).

Near-UV spectra taken by the Hubble Space Telescope [6] show that something other than water ice is present and spectrally active on these moons. The FUV spectra are consistent with this idea; the very strong water ice absorption feature at 165 nm dominates the spectra of each of the icy moons. However, the match between pure H_2O ice and the icy satellites is far from perfect. We explore the

possibilities of other candidate materials and their effect on these FUV spectra. We use an intimate mixture model (after [7]) to model the spectra using water ice and various non-water-ice materials (such as ice tholin [8]) to fit the data.

Results: Spectral modeling results are used to compare between Phoebe, Iapetus and Hyperion, to investigate the properties of the dark material in the Saturn system at UV wavlengths. The spectral model results from the inner icy satellites are used to investigate water ice grain sizes and other composition. The presence of non-water ice species on the icy satellites has possible implications for transport of material throughout the Saturn system (e.g. [9]).

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