

AN OVERVIEW OF CASSINI UVIS ICY SATELLITE RESULTS SO FAR. A. R. Hendrix¹ and C. J. Hansen¹, ¹Jet Propulsion Laboratory/California Institute of Technology, 4800 Oak Grove Dr., MS 230-250, Pasadena, CA, 91109, hendrix@jpl.nasa.gov.

Introduction: The icy satellites of the Saturn system exhibit a remarkable amount of variability. From dark, battered Phoebe orbiting at 200 R_S to black-and-white Iapetus, the wispy streaks of Dione, heavily cratered Tethys and Mimas, to potentially geologically active Enceladus, the extent of geological phenomena exhibited by these bodies is tremendous. Phoebe, Iapetus and Hyperion all orbit outside Saturn's magnetosphere, while Mimas, Enceladus, Dione Tethys and Rhea all orbit within the magnetosphere. Furthermore, Mimas, Enceladus, Tethys and Dione all orbit within the E-ring – so the extent of exogenic effects on these icy satellites is wide-ranging. After 9 months in orbit around Saturn, we present UV results so far from Phoebe, Tethys, Dione, Iapetus, Mimas, Enceladus and Rhea. We expect that the UV signatures of these icy satellites are strongly influenced not only by their composition, but by external effects and magnetospheric environments.

UVIS: The Cassini Ultraviolet Imaging Spectrograph (UVIS) [1] 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.

Observations: We present results from Cassini's December 31, 2004 flyby of Iapetus and the June 11, 2004 flyby of Phoebe. The range to Phoebe (radius=107 km) at closest-approach was 2068 km, while the Iapetus closest-approach distance was 124,000 km. We also have an observation of Tethys (radius=530 km) performed on October 28, 2004 at a range of 255,000 km, as well as an observation of Dione (radius=560 km) from December 15, 2004 at a range of 73,000 km. On January 16, 2005 we plan to obtain observations of Mimas, Enceladus and Rhea.

On February 17, 2005 Cassini will perform the first close flyby with Enceladus and on March 9, Cassini will fly by Enceladus at a range of 500 km.

Results: 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 ~160 nm. At wavelengths shortward of ~160 nm, water ice is extremely dark and spectrally gray. As shown in Figure 1, the water ice absorption feature dominates the spectra of Dione and Phoebe: Dione is ~6 times brighter than Phoebe at a similar phase angle, and has a steeper spectral slope at longer wavelengths. Furthermore, the signal from Dione at Lyman-alpha (1216 Å) is muted compared to Phoebe, due to the presence of water ice which is very dark at the short FUV wavelengths. The water ice absorption feature also dominates the spectra of the other icy satellites, but spectral differences exist that reveal compositional variations among the satellites.

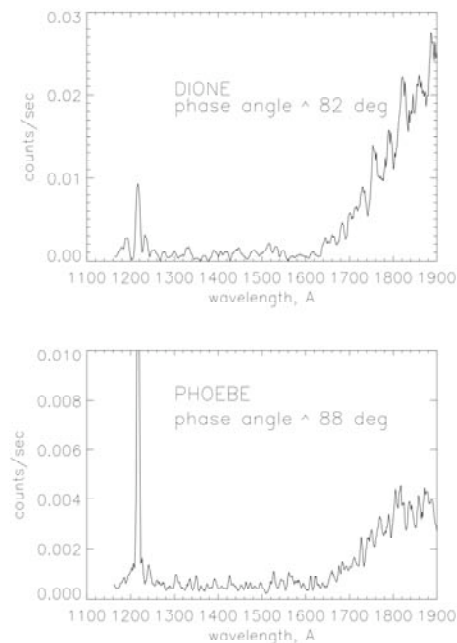


Fig. 1 Raw FUV spectra of Dione (upper) and Phoebe (lower) at similar phase angles. The Dione spectrum is consistent with higher amounts of pure water ice.

We model the surface spectra using water ice and a non-ice material and present model results to investigate compositional variations. We present UV images of each of the icy satellites (where resolution

allows). We present solar phase curves for each of the satellites. We investigate each of the datasets to look for emissions indicative of tenuous atmospheres.

Interpretation: We expect that the FUV data from UVIS will provide insight into the exogenic processes occurring at the icy satellites, in addition to providing compositional information. All of these satellites are orbitally locked, so that one hemisphere faces Saturn at all times. The Saturn-facing hemisphere is centered on 0°W longitude, with the leading hemisphere (facing the direction of orbital motion) centered on 90°W , and the trailing hemisphere centered on 270°W . The primary surface component of the saturnian satellites is water ice, possibly in mixtures with methane or ammonia. Additional effects on the spectral behavior of the satellite are from magnetospheric bombardment, meteoritic bombardment and potential endogenic material similar to carbonaceous chondrites (dark, red material).

It has been shown [2] that the relative velocities between the E-ring particles and the icy satellites may explain the large-scale longitudinal albedo patterns on the icy satellites that are seen at visible-near IR wavelengths. Mimas and Enceladus are both slightly darker on the leading hemispheres than on the trailing hemispheres at visible wavelengths, possibly because the E-ring particles sweep by the trailing hemispheres, brightening them. Conversely, the leading hemispheres of Tethys and Dione are brighter than the trailing hemispheres, because their leading hemispheres sweep by the E-ring particles. We investigate the UVIS data to see if such a pattern holds up in the FUV, and whether associated grain size variations are detected.

References: [1]Esposito, L. *et al.*, (2004) *Space Science Rev.* [2] Hamilton, D. (2001) *Nature*, 412, 132.