ULTRAVIOLET SPECTRA OF ICY SATELLITES. K. S. Noll[1], [1]Space Telescope Science Institute (3700 San Martin Dr., Baltimore, MD 21218; noll@stsci.edu)

Introduction: The ultraviolet (UV) albedos of icy bodies feature unique diagnostics of composition, microphysical structure, and magnetospheric interaction. The ultraviolet opacity of the Earth's atmosphere, the rapidly dropping solar flux at shorter wavelengths, and detector limitations make obtaining high quality UV spectra an observational challenge. In this work I summarize the UV spectra of the satellites of Jupiter, Saturn, and Uranus obtained with the Hubble Space Telescope.

UV Spectra: The Hubble Space Telescope (HST) has obtained spectra of the three icy Galilean satellites of Jupiter [1,2,3], five of Saturn's icy satellites [4], and three satellites of Uranus [5]. A sample of these spectra is shown in Figure 1.

HST's UV satellite observations were made with two different instruments, the Faint Object Spectrograph (FOS) and the Space Telescope Imaging Spectrograph (STIS) between June 1995 and December 2000. The FOS was removed from HST in February 1997 and STIS suffered an electrical failure in August 2004. The Solar Blind Channel (SBC) of the Advanced Camera (ACS) remains in operation, but is only sensitive to wavelengths shorter than 170 nm where there is essentially no reflected flux from these objects. Upon successful completion of the planned servicing mission in 2008, HST will once again have the ability to obtain near UV spectra of icy satellites.

The icy satellite UV spectra obtained with HST come from six different general observer programs, each with somewhat different goals and observing strategies. For most satellites, leading and trailing hemisphere spectra were obtained in order to search for and characterize hemispheric dichotomies that can arise from magnetospheric interactions. For some satellites, there are marked differences between hemispheres, but for others there is little or no distinction. Spectra of objects differ in their wavelength coverage. In some cases, the spectra extend from 200-1000 nm. More frequently, however, only the near-UV and short wavelength visible portions of the spectrum are covered. In these cases, it is desirable to augment the HST spectra with ground-based visible and near-IR spectra when such are available. In Figure 1 the spectra of Rhea and Dione are composites of separately published UV and optical spectra [4,6].

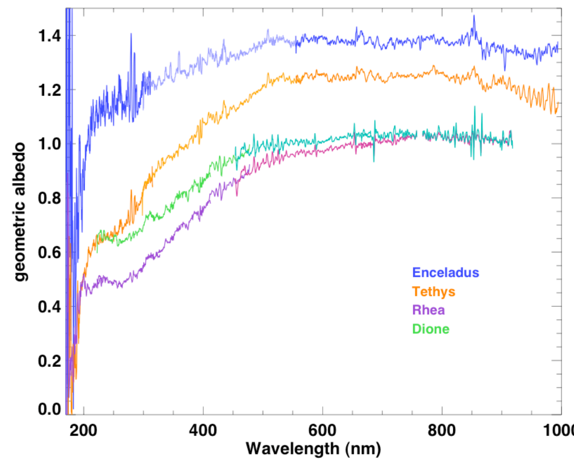

Figure 1. Albedo spectra of four of Saturn's satellites are compared in this figure. Spectra of Enceladus and Tethys were obtained with STIS. Spectra of Dione and Rhea shortward of 450 nm were obtained with the FOS[4], longward of that they are ground-based data[6]. Absolute albedos are calibrated by matching the spectra to albedos measured at low phase angles[7].

Spectral Features: As is evident from Figure 1, the ultraviolet region is not, at first glance, distinctly different from the longer wavelength optical and near-IR spectra of icy bodies. The specrtra can be broadly characterized as having a maximum albedo in the visible and near-IR and a decreasing albedo starting around 500 nm and continuing into the UV. On closer inspection, however, subtle differences can be seen. An absorption band centered at 260 nm is evident in the spectra Rhea and Dione. A weaker version of this band also appears in the spectrum of Tethys, but is not evident in the Enceladus spectrum. This band has been previously identified as possibly due to ozone trapped in ice [2,4]. Enceladus and Tethys spectra reach an apparent maximum albedo at 500 nm while Rhea and Dione albedos continue to increase, gradually, to approximately 700 nm. The cause for this subtle difference in unknown.

Spectral Modelling and Laboratory Data: UV absorption bands present difficulties to modelers for several reasons. UV bands are broad and generally weak so their identification and precise determination of band center in noisy data can be problematic. Band centers are known to shift depending on environmental factors, *e.g.* whether or not a constituent is adsorbed in water ice and the number of adsorbed constituents that are nearest neighbors. Often this depends on details of the sample preparation which, more frequently than not, are at temperatures and physical conditions that differ significantly from those on satellite surfaces. Simulating the effects of long-term ion irradiation for those satellites that are inside planetary magnetospheres is another challenge for laboratory measurement, yet is an important component of accurate spectral simulations.

References: [1] Noll K. S., Weaver H. A., Gonnella A. M. (1995) *JGR, 100,* 19057. [2] Noll K. S., Johnson R. E., Lane A. L., Domingue D. L., Weaver H. A. (1996) *Science, 273,* 341. [3] Noll K. S., Johnson R. E., McGrath M. A., Caldwell J. J. (1997) *GRL, 24,* 1139. [4] Noll K. S., Roush T. L., Cruikshank D. L., Johnson R. E., Pendleton Y. J. (1997) *Nature, 388,* 45. [5] Roush T. L., Noll K. S., Cruikshank D. P., Pendleton Y. P. (1998) *LPSC XXIX,* 1636R. [6] Buratti B. J., Hicks M. D., Tryka K. A., Sittig M. S., Newburn R. L. (2002) *Icarus, 155,* 375. [7] Verbiscer A., French R., Showalter M., Helfenstein P. (2007) *Science, 315,* 815.