HYPERION, PHOEBE, AND IAPETUS: RELATIONSHIPS OF THE SATURNIAN SATELLITES. K. S. Jarvis[1] , F. Vilas[2] , S. M. Larson[3], M. J. Gaffey[4], and D. Domingue[5], [1]Lockheed-Martin Space Missions Systems & Service, 2400 NASA Rd 1, C23, Houston, TX, 77058-3799. Kandy.S.Jarvis1@jsc.nasa.gov, [2]NASA-JSC, [3]U. Arizona, [4]RPI, [5]Johns Hopkins Applied Physics Laboratory.

The mystery of the dichotomous Iapetus, a Saturnian satellite with a dark leading side and a bright trailing side, has intrigued astronomers for centuries. Theories about the source of the darkening agent of the Iapetus ice are greatly varied. One of the theories suggests remnants of Hyperion's precursor body are this darkening agent while another suggests Phoebe dust as the cause. Based upon spectral evidence, Hyperion's D-class spectrum appears more similar to spectra of Iapetus' leading side than does Phoebe's more C-class spectrum.

On July 18-19, 1996, visible and near-infrared (0.3936 - 0.7870 µm) CCD reflectance of S4 Hyperion and S9 Phoebe (dispersion = 7.40 Å/pixel) were taken at the University of Arizona Steward Observatory at Kitt Peak using the 2.25-m telescope with a cassegrain spectrograph. These spectra were ratioed to 16 Cyg B on both nights, extinction corrected, and scaled to 1.0 around 0.56 µm. The data display reasonable correlation with ECAS photometry[1]. The ECAS photometry of both Hyperion and Phoebe were converted so that the 0.550 µm reflectance (ν filter) is equal to 1.0. (Figure 1: Hyperion, Figure 2: Phoebe).

The new D-like spectrum of Hyperion is similar to many D-class asteroid spectra. Organic content is suggested by the increasing slope with increasing wavelength seen in this spectrum. Like many D-class asteroids [2], no opposition surge has been detected (down to an angle of 3 degrees) [3]. The visible spectral range lacks any significant absorption features, as shown by Fig. 3 where a straight line continuum has been removed from the Hyperion spectrum.

Wilson and Sagan[4] have suggested that the surface of Hyperion may be covered with an intimate mix of Iapetus dark and bright material. With the new, higher resolution spectrum of Hyperion, experimentation with mixing models was thought plausible. Bell et al.[5] and Vilas et al.[6] utilized a linear mixing model to extract the spectral signature of Iapetus' dark material from spectra of Iapetus' leading side. Voyager imagery suggest subtle mottling exists on Hyperion's surface and, while a linear mixing model may not be entirely appropriate, it should return preliminary results.

The first assumption made was that Hyperion's bright material was identical to Iapetus' bright material. Hyperion is known to have water ice absorptions in its spectra, though it lacks the 1.25 µm absorption. If Hyperion is native to the Saturnian system, and if it formed in the proximity of Iapetus, it is reasonable to assume a fair degree of similarity. If the surface of Hyperion is an intimate mix of Iapetus dark and bright material as Wilson and Sagan have suggested, subtracting the Iapetus bright material spectrum from Hyperion could result in a spectrum of Iapetus dark material. A secondary consideration would be to include Phoebe dust in the model. If Iapetus is coated with Phoebe dust, others have suggested some Phoebe dust would also reach Hyperion [7].

All spectra were smoothed by 300 Å. The Hyperion and Phoebe spectra were interpolated to match the wavelengths of the Iapetus data. All were scaled to 1.0 around 0.56 µm. A linear mixing model was then employed for a preliminary comparison. Varying percentages of the spectral signature of Iapetus bright material were subtracted from the Hyperion spectrum. A good match was not achieved. An improved match to the Iapetus dark material spectrum in the visible wavelengths was achieved when the Phoebe spectrum was included as a third component in the model. The 0.67 µm centered absorption feature seen in the Iapetus dark material spectrum was not replicated and the best spectral match achieved is still a poor one. Bell et al. were able to achieve an Iapetus dark material spectrum uncontaminated by the ice at the poles with their linear mixing model by finding a mixing ratio that removed most traces of water ice absorptions from the dark material spectrum. If the Hyperion spectrum represents a mix of Iapetus bright and dark material spectra, then a dark spectrum without water ice absorptions should be our goal in this preliminary investigation. Phoebe could not be utilized as a component in this part of the modeling as IR spectra of Phoebe are nonexistent. When the Iapetus bright material spectral signature was subtracted from the Hyperion spectrum, the water absorptions remained strong regardless of the ratios of materials. An intimate mixing model may improve results but better data need to be acquired of both Hyperion and Phoebe. [This work was supported by the NASA Planetary Astronomy Program.]

References: [1]Tholen and Zellner, **Icarus** *53*, p. 341, 1983; [2]French, **Icarus** *72*, p. 325, 1987; [3]Thomas and Veverka, **Icarus** *64*, p. 414, 1985; [4]Wilson and Sagan, **Icarus** *122*, p. 92, 1996; [5]Bell *et al*., **Icarus** *61*, p.192, 1985; [6]Vilas *et al*., **Icarus** *124*, p. 262, 1996; [7]Cruikshank *et al*., **Icarus** *53*, p. 90, 1983.

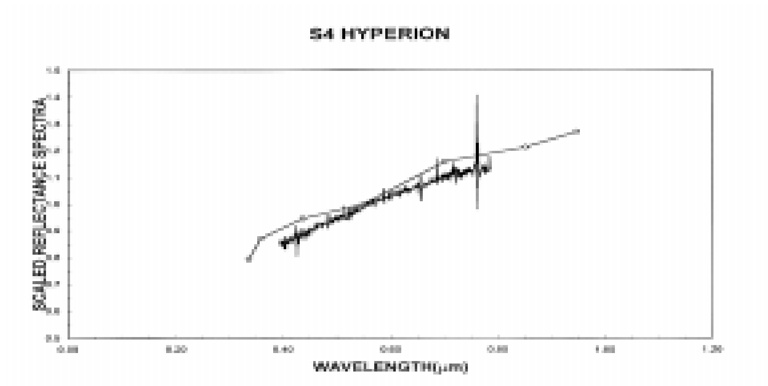

Figure 1: The Hyperion spectrum acquired July 19, 1996 compared to the ECAS[1] of Hyperion acquired in March, 1982.

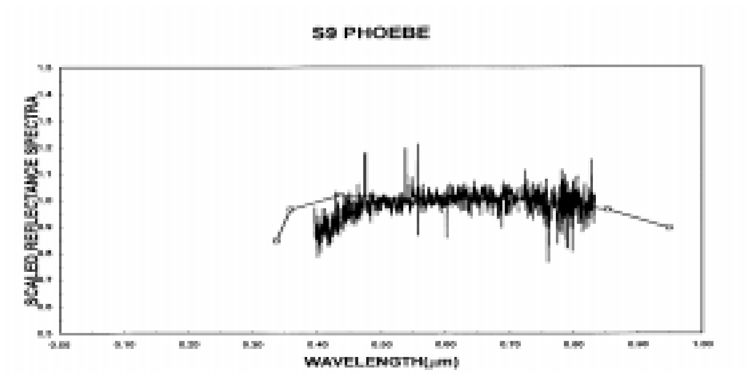

Figure 2: The Phoebe spectrum acquired July 18, 1996 compared to the ECAS[1] of Phoebe acquired in March, 1982.

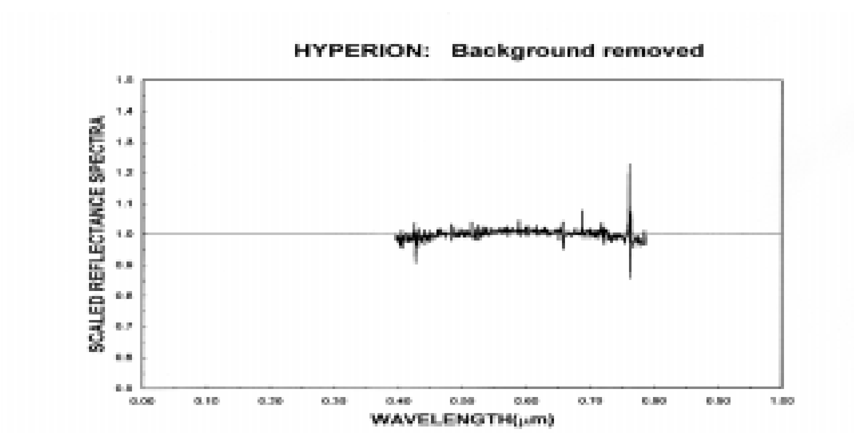

Figure 3: The Hyperion spectrum with the background continuum removed.