**IR Spectroscopic Monitoring of Pluto with IRTF/SpeX:**
**Recent results**

**W.M. Grundy and M.W. Buie (Lowell Ob s.)**

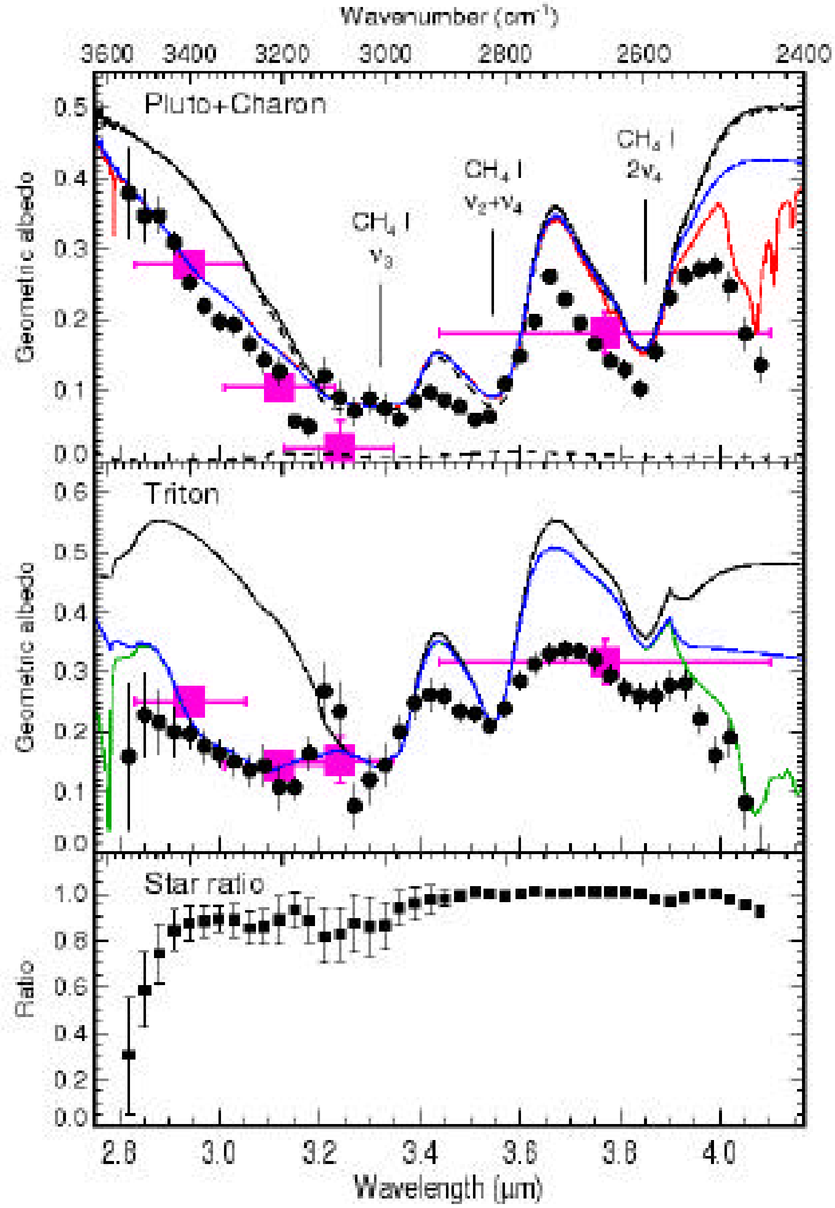
Pluto's infrared reflectance spectrum changes over time in 3 ways. First, as Pluto spins with a 6.4 day period, different longitudes rotate into and out of view, revealing regions having distinct compositions and albedos. Second, Pluto's obliquity is high, so as it moves about the sun with a 250 year period, different latitudes become visible. Currently, the northern hemisphere is coming into view as the southern hemisphere disappears into winter darkness. Finally, Pluto's surface ice inventory (consisting of at least nitrogen, methane, and carbon monoxide ices, all in vapor-pressure equilibrium with a thin atmosphere) is expected to migrate around Pluto's surface driven by seasonally varying patterns of illumination by the sun.

Infrared spectroscopy is a powerful tool for probing Pluto's surface ices, since different ice species each have characteristic patterns of spectral absorption. But to disentangle the different causes of spectral variations, it is essential to sample the spectrum over a broad range of time scales. We have been using various infrared instruments to monitor Pluto's infrared spectrum since 1994. Beginning in 2000, IRTF/SpeX has proven to be a particularly valuable tool for this purpose, producing top-quality JHK spectra within two to three hours. SpeX has also allowed us to extended our survey into the L band, an under-explored region where the fundamental vibrational transitions of many ice species are located.

The SpeX data revealed unexpected absorptions around 3 and 4 microns. Models can be made to match the 3 micron absorption reasonably well by adding a combination of water ice and tholin (a laboratory carbonaceous material) to volatile-rich regions of the model surfaces. Likewise, the addition of $CO_2$ or $SO_2$ ices to volatile-rich regions improves the fits near 4 microns.

That non-volatile components are required in volatile-rich regions challenges the traditional picture of volatile ices seasonally migrating on a static, non-volatile substrate. These new data appear to require non-volatile surface constituents to also be mobile, in order to keep up with the seasonally mobile volatile ices. The most plausible explanation may be that non-volatile grains are blown about the surfaces of Triton and Pluto in the form of fine dust.

Reference:
Grundy, W.M., and M.W. Buie 2002. Spectroscopy of Pluto and Triton at 3-4 microns: Possible evidence for wide distribution of non-volatile solids. Astron. J. (in press).




New data from SpeX [black points] compared with models extrapolated from recent publications [black curves (dashed curves are separate contributions of Pluto and Charon)] and with earlier IRTF observations by Spencer et al. (1990) [pink squares]. The extrapolated models agree reasonably well with the three methane absorptions between 3.2 and 3.9 microns, but show too much reflectance near 3.0 and 4.0 microns.

Models having additional water ice added to nitrogen and methane-rich regions [blue curves] match the 3 micron region much better, but still fail to absorb sufficiently beyond 4 microns. For Triton, the models can be helped by adding additional $CO_2$ ice to $N_2$-rich regions [green curve], but $CO_2$ is excluded on Pluto by the absence of absorption bands near 2 microns. Adding $SO_2$ ice improves the fit [red curve]