Afternoon Session 5
Pluto
(D. Cruikshank, Moderator)
5:30–6:00 p.m.

5.1

Methane Frost on Pluto: Model Implications from Spectrophotometry

M. W. Buie and U. Fink (LPL/U. Arizona)

Last year we presented evidence that the strength of the methane bands in Pluto's spectrum varies with rotational phase. Furthermore, the minimum absorption was shown to be correlated with the minimum in Pluto's lightcurve. This was shown to be clear evidence that the observed absorption is not due primarily to an atmosphere.

A model for the surface of Pluto was constructed using the spot parameters determined by R. Marcialis. The absorption due to methane was calculated using the approach of B. Hapke (1980). Synthetic spectra were generated using the imaginary indicies measured for liquid methane. With this approach it is possible to reproduce the observed spectrum of Pluto without the need of any overlying gas.

Further studies are necessary to resolve the question of an atmosphere. According to the studies done by Trafton and Stern, a global atmosphere can exist with only 3 cm-agt of methane, an amount which would not be detectable with our current instrumentation. Direct information regarding the surface temperature would yield a direct knowledge of the atmosphere, but it is difficult to make a model-independent measurement at this point. Perhaps a stronger constraint would come from noting that a stable albedo pattern on Pluto has persisted for 30 years against any evaporation and redeposition that would be occurring in the presence of an atmosphere.

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5.2

A Two Spot Model for the Surface of Pluto

R. L. Marcialis (LPL/U. Arizona)

A computer program has been developed to generate synthetic light curves of an unevenly bright, rotating sphere. Application to the Pluto-Charon system shows that two dark circular spots (46° and 28° in radius, both at latitude -23°, separated by 134° in longitude) with limb darkening coefficient x = 0.5 and half the albedo of the surrounding terrain can accurately reproduce six available photoelectric light curves from 1953 to 1982.

The model has been used to redetermine the phase coefficient (a weighted mean of β = 0.031 ± 0.006 mag/deg) based on individual analysis of the 1980, 1981, and 1982 light curves, bound external errors of the photometric data, and determine the zero point error in the 1955 observations.

In order to explain the secular dimming of Pluto, band and polar cap models were examined. Many potential solutions were found, but discrimination among them was not possible due to the short time base of available observations. An alternate explanation invoking an overall decrease in the surface albedo is equally plausible based on the results of this study.

The model can be used to predict the long term amplitude behavior of Pluto's light variation, and to estimate the out-of-eclipse variability during the impending season of mutual events. Knowledge of the latter is essential for accurate extraction of radii, albedos, oblatenesses, and limb darkening for both Pluto and Charon, as well as orbital elements for the system, using standard Russell-Merrill techniques. Once these parameters become known, refinement of the working model becomes possible. This in turn should result in second-order corrections to the parameters.

5.3

A Constraint on Pluto's Origin

T. Owen (ESS/SUNY Stony Brook, N. Y. 11794)

As an ice-rich body smaller than the moon, Pluto should have a reservoir of trapped volatiles similar to that of Triton, Titan, and the comets. The existence of CO and N_2 in Pluto's atmosphere and/or on its surface therefore offers a constraint on its origin. Production of clathrate hydrates is strongly dependent on local temperature and pressure. Both of these parameters will be lower in the solar nebula itself than in a protoplanetary nebula, e.g., about Neptune. If N_2 is absent from Pluto, an independent origin of the planet is indicated. The presence of N_2 would be less definitive.

Evening Session 6
Space Station
7:30–8:00 p.m.

6.1

Planetary Science Experiments Aboard Space Station: Workshop Report

R. Greeley (Arizona State U.)

A workshop (unsponsored) was held to consider experiments that could be conducted in an earth orbital environment to shed light on various planetary processes. The 22 participants represented a cross section of university, institution, and NASA Center investigators and included aerospace industry and Headquarters representatives. Many planetary processes (e.g. impact cratering, particle formation and interaction, crystal settling and magma evolution) are currently being studied through laboratory experiments. Although gravity is a critical term in many of these experiments, there is no suitable means for physically modelling reduced gravity in experiments conducted on Earth. Because most planetary environments involve low gravity conditions, workshop participants concluded that such experiments could be profitably carried out on a Space Station to gain fundamental knowledge of a wide variety of planetary processes. A developmental program could include feasibility experiments involving both the KC-135 aircraft (which provides microgravity conditions up to ~40 seconds duration) and shuttle. Such experiments would provide critical design information for the space station experiments and may yield significant science results as well. In addition, it was suggested that a second workshop be held to consider the full range of planetary investigations that could be conducted on Space Station.