1987BAAS...19..859M

13.04

The Separate Spectra of Pluto and Its Satellite Charon

U. Fink, M. A. DiSanti (U. Arizona)

The occultation of Charon by Pluto 1987 March 03 was observed by us spectroscopically from 5400 to 10200 Å at a resolution of 12 Å. The midpoint of the event occurred at 11:06 UT, close to the emphemeris prediction. The depth of the event at 6800 Å was 0.162 magnitudes. A spectrum of Pluto alone during the totality of the event was obtained and, by subtraction from the spectra before the occultation, a spectrum of Charon.

The resulting spectrum of Charon is completely featureless and almost perfectly flat. Both the red slope and the CH_4 absorption features so prominent in the combined Pluto/Charon spectra can be attributed solely to Pluto. The depth of the 8900 Å CH_4 band on Charon is at most one tenth of that of Pluto. This implies an upper limit to any CH_4 atmosphere on Charon of 0.3 m-amagat and an absence of CH_4 surface ice covering or at most a very sparse and fine grained frost.

The spectra of Pluto and Charon 1987 March 04 can be compared to data taken at almost the same phase four years earlier by Buie and Fink (1987). While the absorptions in the 8900 Å CH_4 band are identical to a remarkable degree, the new data show the 7200 Å band to be considerably weaker. This decrease in absorption strength is difficult to interpret, but probably is most plausibly explained by a change in atmospheric CH_4.

13.05

CCD Spectrophotometry of Pluto-Charon Mutual Events

S.R. Sawyer, E.S. Barker, A.L. Cochran and W.D. Cochran (Univ. Texas)

Time resolved spectrophotometry of the 3 March 1987 and 4 April 1987 mutual events of Pluto and its satellite Charon were obtained with spectral coverage from 5000 to 10,000 Å with 25 Å spectral resolution. Since both events were occultations of Charon by Pluto, spectra were obtained of the anti-Charon hemisphere of Pluto, with no contribution from Charon during totality. On 4 April, a combined spectrum of Pluto and Charon was also obtained immediately before first contact. A spectrum of the Pluto-facing hemisphere of Charon was extracted by differencing the pre-event and totality spectra, and the spectra were reduced to reflectances by ratioing them to spectra of solar analog stars. Charon has a featureless, flat reflectance spectrum, with no evidence of methane absorption. Charon's reflectance appears grey with respect to the sun, and corresponds to a geometric albedo of ~ 0.41 at 6000 Å. Pluto's reflectance spectrum displays methane absorption bands at 7300, 7900, 8400, 8600 and 8900 Å, and is clearly red in color. The signal-to-noise ratios of the eclipse spectra were not high enough to unambiguously identify the weaker methane band at 6200 Å. These data provide improved constraints on models of methane frost and gas absorption in the Pluto-Charon system. The results of the model calculations are presented, and their implications concerning a possible methane atmosphere on Pluto are discussed.

13.06

Hemispherical Color Asymmetry on Charon?

R.P. Binzel (Planetary Science Institute)

Analysis of 1986 Pluto-Charon mutual event lightcurves by Tholen, Buie, Binzel, and Frueh (1987, Science 237, 512-514) shows evidence for B-V color changes during superior events. Because no significant color changes were observed during 1986 inferior events, these authors interpreted the results as evidence for a possible color asymmetry between the Pluto-facing and anti-Pluto hemispheres of Charon. Multi-color photometry observations of 1987 superior and inferior events were obtained using the University of Texas McDonald Observatory 2.7-m and 2.1-m telescopes. These observations confirm the previously noted color changes during superior events which show a greater depth in blue (Johnson B). In addition, a significant color change was also observed during the May 22 inferior event which showed a greater depth in red light (Johnson V). These results are qualitatively consistent with Charon being a uniform neutral-colored body. Results of a detailed quantitative analysis will be presented which will address the possible extent of a hemispherical color asymmetry on Charon.

13.07

The Surface Composition of Charon: Tentative Identification of Water Ice

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

The 3 March 1987 Charon occultation by Pluto was observed in the infrared at 1.5, 1.7, 2.0, and 2.35 micrometers. Subtraction of fluxes measured between second and third contacts from measurements made before and after the event has yielded individual spectral signatures for each body. Charon's surface appears extremely depleted in methane relative to Pluto. Constancy of flux at 2.0 micrometers throughout the event shows that Charon is effectively black at this wavelength, which is centered on a very strong water absorption band. Thus, the measurements suggest the existence of water ice on Pluto's moon. Other ices may be excluded by comparison of our data to laboratory spectra. These include CH_4 (Pluto spectrum shows its signature), CO_2 (2.0 μm absorption too shallow, no absorption at 2.35 μm); H_2S (2.35 μm absorption too shallow); NH_4HS (2.0 and 2.35 μm depths reversed); and NH_3 (1.5 and 1.7 μm depths reversed, 2.0 and 2.35 μm absorptions too deep.)

Presumably, both Pluto and Charon have resided at the same place in the solar system since their formation. Why, then, should such compositional dichotomy exist? Since the root-mean-square thermal velocity of methane is ~half escape velocity from Charon to infinity, and an even greater fraction for transfer through the inner Lagrange point onto Pluto, it can be shown that Charon's inventory of methane would be lost via hydrodynamic blowoff on a timescale short compared to the age of the solar system.

The details of methane partitioning between escape to infinity and transfer onto Pluto currently under study. After shedding several kilometers of methane, the surface of Charon might be expected to resemble a global moraine, with the residuum composed of (cosmically abundant) water ice and a "slag" of darker carbonaceous and/or silicaceous impurities. This process could explain both the compositional difference and also why Charon's visual albedo is significantly less than that of Pluto.

13.08

Pluto and Charon: Radii, Density, and Orbital Elements from Mutual Event Photometry through 1987

D. J. Tholen, M. W. Buie (Inst. for Astronomy, Univ. of Hawaii)

Favorable weather conditions have permitted us to observe another 16 Pluto-Charon mutual events in 1987 (as of July 28). We now have sufficient data to compute different sets of model parameters based on different assumptions. The one particular set of model parameters that we adopted for computing the mutual event circumstances in 1988 is shown below. The formal 1σ uncertainties in the radii are now impressively small; however, a different set of model parameters based on a different set of assumptions yields radii that differ by much more than the stated uncertainties. Clearly, the accuracy of the model parameters is now being limited by the assumptions used to generate the model, although the indicated accuracy should eventually be obtainable as more generalized modeling code is used to fit the data. A more realistic estimate of the uncertainty in the radii is about 20 km. Even with this inflated uncertainty, the accuracy of the actual radii is being limited by the uncertainty in the semimajor axis of the satellite, which sets the linear scale for the

THURSDAY

© American Astronomical Society • Provided by the NASA Astrophysics Data System