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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Research in Planetary Astronomy and Operation of the Mauna Kea Observatory

PERFORMING ORGANIZATION

NASA Ames Research Center — Formerly the PI was at the Institute for Astronomy University of Hawaii, Honolulu, where much of this work was performed

INVESTIGATOR'S NAME

Dr. Dale P. Cruikshank

DESCRIPTION *(a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)*

Strategy: Spectroscopic studies with ground-based telescopes at low resolution can give compositional information on the surfaces and atmospheres of planets, satellites, asteroids, and comets. Solid state absorptions in ices and minerals are measurable by the low-resolution spectrophotometric technique. This program includes spectroscopy of distant comets, asteroids of particular interest in various contexts (planet crossers, outer main belt, trojans, etc.), Pluto and Charon, and planetary satellites of particular interest (Iapetus, Io, Uranian satellites, etc.). In the case of planets, satellites, and comets, emphasis is placed on volatiles (ices and organics), while for asteroids the stress is on mineralogy and the connection with the meteorites.

Accomplishments: **Triton:** New spectra show that the IR signature of the satellite has changed since 1980, in that the methane bands are significantly weaker. Spectral evidence for the presence of molecular nitrogen remains convincing. Also, the brightness of Triton throughout its orbital cycle was measured to higher precision than before and found to be constant to better than 0.02 mag. **Asteroids:** Suggestive spectral evidence was found for the presence of the C-H stretching mode band in diffuse reflection on asteroid 130 Elektra. The planet-crossing asteroid 3551 (1983RD) was found to have a Vesta-like spectrum, and may be a piece of the parent body of the (differentiated) eucritic meteorites. Asteroid 2060 Chiron was found to exhibit an anomalous brightening (by 0.6 mag) indicating some kind of comet-like activity at 12 AU from the sun. **Io:** Spectra were taken in eclipse to study sulfur dioxide in the volcanic plumes. **Comets:** VJHK photometry was obtained of Comet P/Halley at distance ~8 AU showing different colors from those observed before and during perihelion. Several other comets were observed with the same technique.

Anticipated Accomplishments: New data will be obtained for Triton at shorter wavelengths to test for other hydrocarbons (e.g. ethylene) and to discriminate between gas and ice of methane. New VJHK photometry and near IR spectra of comets will be obtained to search for diagnostic spectral features in 2-um region. Asteroids will be observed in study of the connection to certain meteorite types and in pursuit of the problem of the origin of the ordinary chondrites. Additional data will be obtained on the organic band in asteroids and the dark hemisphere of Iapetus. New spectra of Io for the study of the volcanoes will be obtained. Collaboration with laboratory scientists at NASA Ames will continue in connection with these planetary problems.

Refereed Publications, 1987-1988

H. B. Hammel, C. M. Telesco, H. Campins, R. Decher, A. D. Storrs, and D. P. Cruikshank. "Albedo Maps of Comets P/Halley and P/Giacobini-Zinner." **Astron. Astrophys. 187**, 665-668, 1987.

M. W. Buie, D. P. Cruikshank, L. A. Lebofsky, and E. F. Tedesco. "Water Frost on Charon." **Nature 329**, 522-523, 1987.

D. P. Cruikshank and R. H. Brown. "Organic Matter on Asteroid 130 Elektra." **Science 238**, 183-185, 1987.

W. K. Hartmann, D. J. Tholen, J. Goguen, R. P. Binzel, and D. P. Cruikshank. "Trojan and Hilda Asteroid Lightcurves. 1: Anomalously Elongated Shapes Among Trojans (and Hildas?)." **Icarus 73**, 487-498, 1988.

D. J. Tholen, W. K. Hartmann, and D. P. Cruikshank. "(2060) Chiron." **IAU Circ. 4554 (1988 February 1)**.

D. P. Cruikshank, R. H. Brown, A. T. Tokunaga, R. G. Smith, and J. R. Piscitelli. "Volatiles on Triton: The Infrared Spectral Evidence, 2.0-2.5 Micrometers." **Icarus** (in press), 1988.

J. R. Piscitelli, D. P. Cruikshank, and J. F. Bell. "Laboratory Studies of Irradiated Nitrogen-Methane Mixtures: Applications to Triton." **Icarus** (in press, 1988).

M. W. Buie, D. P. Cruikshank, L. A. Lebofsky, and E. F. Tedesco. "Water Frost on Charon." **Nature, 329**, 522-523, 1987.

N. L. Lark, H. B. Hammel, D. P. Cruikshank, D. J. Tholen, and M. A. Rigler. "The Brightness and Light Curve of Triton in 1987." **Icarus** (submitted 1988)

A. T. Tokunaga, K.-W. Hodapp, E. E. Becklin, M. A. Rigler, R. H. Brown, and D. P. Cruikshank. "The Infrared Spectrum and Image of G29-38." **Astrophys. J. Lett.** (in press, 1988)

D. P. Cruikshank. "SIRTF and Solar System Studies." **Astrophys. Lett.** (in press, 1988)

J. R. Cronin, S. Pizzarello, and D. P. Cruikshank. "Organic Matter in Carbonaceous Chondrites, Planetary Satellites, Asteroids, and Comets." In **Meteorites and the Early Solar System**, J. Kerridge and M. S. Matthews, Eds., Univ. Arizona Press (in press 1988)

R. H. Brown, D. P. Cruikshank, A. T. Tokunaga, R. G. Smith, and R. N. Clark. "Search for Volatiles on Icy Satellites I: Europa." **Icarus 74**, 262-271, 1988.

B. Zellner, E. N. Wells, C. R. Chapman, and D. P. Cruikshank. "Asteroid Observations with Space Telescope and SIRTF." In **Asteroids II**, T. Gehrels, Ed., Univ. Arizona Press. (in press)

D. P. Cruikshank. "Infrared Studies of Solar System Bodies." In **Comets to Cosmology**, (Lecture Notes in Physics series), A. Lawrence, Ed., pp 73-77. Springer-Verlag, Berlin, 1988.