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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

A Continued Program of Planetary Study

PERFORMING ORGANIZATION

McDonald Observatory
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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)*

a. This program conducts solar system research in support of NASA missions and of general astronomical interest. Investigations of the composition, physical characteristics, and changes in solar system bodies are conducted primarily utilizing facilities of McDonald Observatory, but also utilizing various space vehicles where appropriate.

b. We have made the *first* detection of 2μm H_2 emission from Jupiter's southern auroral zone, and we have confirmed our previous detection of northern auroral emission from Jupiter's H_2 S(1) quadrupole line at 2.12μm. Unlike the previously known 8μm aurorae, this phenomenon can not be thermal in origin. Analysis of Raman scattering in the blue and ultraviolet spectrum of Uranus (2000–5000Å) shows that there must be absorbing aerosol particles in the upper 10 mbar region of the atmosphere. We have obtained spectra of Pluto-Charon in and out of eclipse in the red and near IR. These data confirm that CH_4 is confined to Pluto and absent on Charon. We have predicted that there will be prominent changes in the albedo of Pluto near perihelion as the surface frost layer vanishes and the planet darkens, and later as it reforms and the planet brightens. The fact that this darkening has not yet occurred sets a lower limit on Pluto's atmospheric bulk. The mole fraction of CH_4 in Pluto's surface volatiles near perihelion should be the same as that of the bulk volatile ice. Therefore, the present spectral observations may indicate that CH_4 is the dominant constituent in Pluto's volatile ices and atmosphere. We have completed a study of low-activity comets and have shown that these comets are intrinsically different from normal comets, and that no obvious parameter exists to explain the differences. We have reduced our long-slit CCD observations of Comet Halley and find that the scale lengths for the molecular species CN, C_2, and CH differ with direction within the coma, but the scale lengths of C_3 are symmetric with direction. The non-equilibrium comet chemistry model is almost completely converted from a 1-D Lagrangian to a 1-D Eulerian formulation. Analysis of the rotational structure of the 3360Å NH emission feature in Comet Halley indicates that resonance fluorescence is the dominant physical process in band formation, and that the role of collisions is negligible. This implies that the NH is formed at greater than 3×10^4 km from the nucleus, and that NH_3 is not the direct parent of NH. We have submitted a large body of Giacobini-Zinner and Halley spectroscopic data to the IHW archive. We have started a systematic survey to discover extra-solar planetary systems by searching for periodic radial velocity variations of the central star. We are able to achieve radial velocity precision of 10-20 m s^{-1}, which is sufficient to detect a Jovian planet around a solar type star.

c. The Faint Comet Survey will continue to monitor all comets brighter than 19.5 mag available from McDonald Observatory. Some comets will be available for a second apparition, allowing us to examine their long-term evolution. We will continue mapping the H_2 quadrupole auroral emission from Jupiter and will attempt to discriminate between a fluorescence source and impact ionization. The lingering Pluto-Charon partial eclipses will provide us with additional opportunity to measure the radial extent of the CH_4 atmosphere of Pluto. We will continue our survey for extra-solar planetary systems, and will develop instrumentation to significantly improve our measurement precision.

d) Summary Bibliography

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