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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Radiative Transfer in Planetary Atmospheres

PERFORMING ORGANIZATION

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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. Theoretical techniques and observations at millimeter wavelengths are combined to study the atmosphere of planets and comets, planetary and satellite regoliths, and planetary rings.

b. Analysis continued of the very high quality data on the 18cm OH line observed in recent comets. The high spectral resolution and high signal-to-noise make these lines ideal for study of the kinematics in cometary comae. A model of the collisional quenching of the inversion of the lambda doublet responsible for the OH radio emission has been developed by P. Schloerb. For conditions appropriate to Halley's Comet, collisional quenching should lead radio observers to systematically underestimate the OH parent production rate by a factor of approximately 3 relative to its actual value, which is very consistent with differences observed between radio and ultraviolet-derived production rates. Modeling is likewise continuing for the line profiles observed in the lowest rotational transition of HCN in Comet Halley in order to better estimate the excitation and hence the abundance of HCN, as well as the kinematics of parent molecules in the coma. A collaborative program to combine data from the FCRAO 14m antenna with interferometric data obtained at the Hat Creek Radio Observatory is allowing aperture synthesis mapping of Venus in the CO J=1-0 line. Graduate student Swade completed his analysis of observations of molecular emission from the nearby interstellar cloud L134N. Chemical gradients have been demonstrated which may be related to variations in the depletion of oxygen onto interstellar grains in the form of water-ice.

c. Modeling of the OH line profiles and production rate for Comets Halley, Giacobini-Zinner, Thiele, Hartley-Good, and Wilson will continue. Study of the thermodynamics and excitation of HCN in the coma of Comet Halley will also continue. The question of whether cometary HCN is a parent molecule or originates in a distributed source in the coma is being investigated. Multiple frequency carbon monoxide observations for Venus and Mars will take place, and analysis will be carried out for the aperture synthesis observations of Venus. The study of radiative transfer in planetary and satellite regoliths or cometary nuclei will be extended with particular reference to analyzing data obtained on the Phobos Mission concerning the structure and composition of the regolith of Phobos.

d. During the past year 8 articles have been published in scientific journals or conference proceedings (see attached list) and another two have appeared as abstracts.

Bibliography

Claussen, M.J. and F.P. Schloerb: Radio OH Observations of P/Halley with the NRAO 43m Telescope, in Cometary Radio Astronomy, ed. Irvine, W.M., Schloerb, F.P., and Tacconi-Garman, L. (NRAO Workshop #17, Green Bank, WV), 135-142, 1987.

Schloerb, F.P., W.M. Kinzel, D.A. Swade, and W.M. Irvine: HCN Observations at FCRAO, in Cometary Radio Astronomy, ed. Irvine, W.M., Schloerb, F.P., and Tacconi-Garman, L. (NRAO Workshop #17, Green Bank, WV), 65-74, 1987.

Schloerb, F.P., Kinzel, W.M., Swade, D.A., and Irvine, W.M.: HCN Production from Comet Halley. Astron. Astrophys. 187, 475, 1987.

Schloerb, F.P., Kinzel, W.M., Swade, D.A., and Irvine, W.M.: HCN Production from Comet Halley. 20th ESLAB Symposium on the Exploration of Halley's Comet, ESA SP-250, 577-581, 1987.

Schloerb, F.P., Claussen, M.J., and Tacconi-Garman, L.: OH Radio Observations of Comet Halley. Astron. Astrophys. 187, 469, 1987.

Schloerb, F.P., Claussen, M.J., and Tacconi-Garman, L.: OH Radio Observations of Comet Halley, 20th ESLAB Symposium on the Exploration of Halley's Comet, ESA SP-250, 583-587, 1987.

Swade, D.A., Schloerb, F.P., Kinzel, W.M., and Irvine, W.M.: Search for Parent Molecules in Comet Halley at Millimeter Wavelength, in Cometary Radio Astronomy, ed. Irvine, W.M., Schloerb, F.P., and Tacconi-Garman, L. (NRAO Workshop #17, Green Bank, WV), 79-84, 1987.

Tacconi-Garman, L. and Schloerb, F.P.: Models of the OH 18cm Line Profiles of Comet Halley, in Cometary Radio Astronomy, ed. Irvine, W.M., Schloerb, F.P., and Tacconi-Garman, L. (NRAO Workshop #17, Green Bank, WV), 143-148, 1987.