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Radiative Transfer in Planetary Atmospheres

Department of Physics and Astronomy
University of Massachusetts
Amherst, MA 01003

F. Peter Schloerb

Strategy

This research effort covers a wide range of topics including: (1) the observational study of cometary comae via millimeter and radio spectroscopy; (2) observational and theoretical studies of planetary atmospheres at millimeter wavelengths; (3) application of theoretical models of the reflection of light from solid surfaces to the study of planetary regoliths and planetary rings.

Progress and Accomplishments

The focus of last year's effort was to take advantage of observational opportunities for cometary work as a part of our continuing effort to use the radio spectral region to probe of the physics and chemistry of the coma. Our most exciting results of 1990 were obtained at the Caltech Submillimeter Observatory (CSO) on Mauna Kea. Observations of both C/Austin and C/Levy were obtained, and in C/Levy we made several good detections of cometary molecules, including the first detections of submillimeter transitions of HCN, formaldehyde and methanol. In addition, the emission was so strong that, for the first time, it was possible to map these parent molecules in the coma. The HCN map revealed an asymmetric distribution of this molecule in the coma, with the strongest emission from the sunward side of the nucleus. Observations of the formaldehyde emission showed evidence of extended emission in our 20" beam. If real, this emission indicates that formaldehyde may be produced directly from a source in the coma, rather than from the nucleus alone. In a second project, observations of the 18-cm OH transitions were made at the NRAO 140-foot telescope in P/Brorsen-Metcalf, C/Okazaki-Levy-Rudenko, and C/Austin. All comets were detected and the OH line shapes are now being analyzed to deduce coma outflow speeds. Finally, we participated in a coordinated campaign to observe C/Austin in the HCN 1-0 line with the Five College Radio Astronomy Observatory (FCRAO) 14m telescope and the Berkeley-Illinois-Maryland millimeter array (BIMA) simultaneously. Unfortunately, no detections were made, but the experience obtained combining the data from these two instruments has prepared the collaboration partners to make sensitive use of these observatories when the next bright comet appears.

Projected Accomplishments

The work on the study of comets via their radio/millimeter emission will continue. We will complete reduction and analysis of data obtained during the last year and continue our theoretical investigations of the cometary coma, using the data provided by this effort over the last several years. When bright comets provide the opportunity to do radio work, new observations will be pursued, especially at the CSO facility in the submillimeter portion of the spectrum where we have arranged a commitment for observing time for cometary work. In addition, our continuing collaboration with K. Lumme on the study of radiative transfer in planetary and satellite regoliths will continue.

Publications

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