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A Continued Program of Planetary Study at the University of Texas McDonald Observatory

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Strategy

The program conducts solar system research in support of NASA missions and of general astronomical interest. Investigations of composition, physical characteristics and changes in solar system bodies are conducted primarily using the facilities of McDonald Observatory.

Progress and Accomplishments

We have monitored Io's 2.1253 μm feature, which we discovered last year, as a function of time and of subearth longitude on Io. We have also explored the rest of Io's K-band in search of other unidentified absorptions. None were found. In sharp contrast to Io's other known absorptions, the feature has not been observed to vary with time (over a 1.5 year interval) or with longitude on Io. Therefore, it can only indirectly be associated with Io's volcanos. With our collaborators at NASA-Ames, we have ruled out sources which are overtones or combinations of any of the molecular vibrations associated with species already identified on Io (SO_2, H_2S, H_2O) or from chemical complexes of these molecules. Laboratory experiments show that the most likely candidate is a multimer or "cluster" of CO_2 molecules. Our collected data show that very unusual periods of global scale auroral activity occurred during September and November of 1988. This would suggest that unusual periods of widespread magnetospheric dumping occur. This contrasts with the very weak activity seen a year later. There are long-term time scales for the Jovian auroral activity, and these are different for the H_2 and H_3^+ emissions. There have been times, as in 1986, when the H_3^+ was not detectable while the H_2 emission was clearly visible. During the global scale events, the H_2 and H_3^+ emissions remained confined to their unusual auroral zones but strong, unidentified emissions appeared in the vicinity of the H_2 quadrupole lines.

Projected Accomplishments

We will take advantage of the eclipses and occultations of Io to locate the source region on Io of the 2.1253 μm feature. We will also obtain high resolution FTS spectra at Kitt Peak of this feature to establish whether it is of gaseous or solid origin, and to enable more discriminating matches with laboratory spectra (useful for composition and state studies). We will also observe the eclipses of Galilean satellites by Io to study the Na atmosphere of Io. We will continue our spectroscopic study of the Jovian auroral emissions in an attempt to understand the excitation processes and connection with the plasma torus and Io volcanic activity. Pluto's post-perihelion changes will be monitored.

Publications

Published Papers:

1. "A Two-Component Volatile Atmosphere for Pluto I. The Bulk Hydrodynamic Escape Regime", L. Trafton, *Ap. J.* **359**, 512-523.

2. "Astrophysics from the Moon -- Composition and Structure of Planetary Atmospheres", L. Trafton in *Astrophysics from the Moon,* (M. J. Mumma and H. J. Smith, eds.), AIP Conference Proceedings **207**, 41-44.

3. "Origin and Evolution of Planetary and Satellite Atmospheres (S. K. Atreya, J. B. Pollack, and M. S. Matthews, Eds.), -- book review by L. Trafton, *Icarus* **86**, 574-575.

Submitted Papers:

1. "A New Class of Absorption Feature in Io's Near-Infrared Spectrum", L. M. Trafton, D. F. Lester, T. F. Ramseyer, F. Salama, S. A. Sandford, and L. J. Allamandola, *Icarus* **89**, 264-276, in press.

2. "Laboratory Studies of the Newly Discovered Infrared Band at 4705.2 cm^{-1} (2.1253 μm) in the Spectrum of Io: The Tentative Identification of CO_2", F. Salama, S. A. Sandford, L. J. Allamandola, L. M. Trafton, D. F. Lester, and T. F. Ramseyer, *Icarus*, in press.