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Planetary Spectroscopy

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Strategy

Our effort is divided into instrumentation and observational research. In the area of instrumentation our primary objective is the maintenance and slow improvement of our CCD camera and data acquisition system for continuing use of any interested LPL user. The main goal of our observational research is CCD spectroscopic and imaging studies of the solar system in support of spacecraft investigations. Our studies include the physical behavior of comets, the atmospheres of the gaseous planets, and the solid surfaces of satellites and asteroids.

Progress and Accomplishments

During the past year we integrated a new CCD controller from Photometrics into our data acquisition system. This new controller will allow sub-array readout and binning. It has received very favorable comments from Dr. Hunten's group who have used it extensively. Users include: K. Wells, R. Kozlowski, A. Sprague, B. Rizk, K. Garlow, and H. Caudill. Our system was also used for an extended observing run on the asteroid/comet Chiron by M. Buie and K. Meech. Our own observation program last year involved spectroscopy of a representative sample of comets to determine differences in chemical composition. We observed Wild 4, P/Schwassmann-Wachmann 3, Austin, P/Peters-Hartley, Levy, P/Russell 3, P/Kopff, and P/Encke. P/Kopff is the target of the CRAF mission; comet Austin was the brightest comet last year. In addition we obtained a very high quality spectrum of Triton, as well as a spectrum of Pluto which we are monitoring every year for potential atmospheric changes since its perihelion 1989 Sept.

Our analysis efforts concentrated on continued analysis of comet P/Halley data. We completed a paper on "The production rate and spatial distribution of H_2O for comet P/Halley" *Ap J.*, **364,** 687-698, 1990. This paper derived a pre-perihelion fit to the H_2O production rate of $Q(H_2O) = 4.36 \times 10^{29} \times r^{-2.59}$. The post-perihelion data agreed roughly with this fit but gave an enhancement by a factor of ~1.8 and showed strong variations due to P/Halley's variability. We also completed a paper on "Composition comparison between P/Halley and P/Brorsen-Metcalf" *Icarus*, **91,** in press (1991). When compared to common H_2O production rates, the dust production rate of P/Brorsen-Metcalf was weaker than comet Halley by a factor of 20, NH_2 was down by 41, C_2 by 75, and CN by 70% indicating a significant difference in chemical composition between the two comets. In our new spectrum of Triton the 8900 Å methane ice band can be clearly seen for the first time and accurately measured. We set a methane ice grain size between 20 and 200 μm and concluded that methane ice is widely distributed on Triton's surface. We have expended a considerable effort in extracting spatial profiles from our P/Halley spectra. We have analyzed three pre-perihelion and three post-perihelion dates and have determined Haser model scale lengths for C_2, CN, NH_2, and OI. We found that good scale lengths could be determined for pre-perihelion dates but the post-perihelion data were severly affected by P/Halley's time varying production rate. This work is being submitted for publication.

Projected Accomplishments

We have begun a more complex analysis of our spatial profiles that includes time varying production and a CHON coma model. Following the determination of spatial profiles and scale lengths, we will begin the last major analysis program using our extensive P/Halley spectral library, i.e., the variation of the production rates of C_2, CN, NH_2 and the continuum with heliocentric distance. For our investigation of possible chemical differences among comets we will analyze spectra of a variety of comets taken within the last two years. Observationally we are planning to obtain further spectra of both periodic and new comets to extend our comet library searching for compositional differences. We also will try to obtain better SNR spectra of Triton and improve the data base and analysis for this intriguing object.