

N 9 2 - 1 2 8 2 1

## *Interiors and Atmospheres of the Outer Planets*

Lunar and Planetary Lab., University of Arizona

**W.B. Hubbard**

### ***Strategy***

This theoretical/observational project constrains structure of outer planets atmospheres and interiors through observational data. The primary observational tool is through observations of occultations of stars by outer solar system objects, which yield information about atmospheric temperatures and dynamics, and planetary dimensions and oblateness. The theoretical work relates the data to interior structures in a variety of ways.

### ***Progress and Accomplishments***

We continue analysis of the massive data set from the 1989 occultation of 28 Sgr by Saturn and Titan. Our 28 Sgr occultation data are competitive in precision with the Voyager RSS/PPS data. Unlike the Voyager measurements, we have nearly simultaneous cuts through the ring system from several stations at different distances from Saturn's center. From observations of ~15 sharp-edged fiducial ring edges from 5 stations, we have ~100 timings which constrain the solution. Our solution for the pole, radius scale, and Saturn's center is an essential first step for analysis of all the 28 Sgr data. The resulting astrometry should have an absolute accuracy ~10 km for the position of Saturn's ring center (= mass center) with respect to 28 Sgr, and a relative precision ~1-2 km for the position of ring features with respect to each other. During 1990 we successfully observed an asteroid occultation by Kleopatra, but lack of other observations may preclude a determination of Kleopatra's diameter from this event.

### ***Projected Accomplishments***

We plan to continue reducing and analyzing the prodigious amount of occultation data (~1 gigabyte) gathered during 1989. The analysis is yielding detailed information on the structure and shape of the upper atmospheres of Jupiter, Saturn, and Titan. The Titan data base has grown due to contributions from other observers in Europe and England. Our Neptune occultation data will be reanalyzed using the improved knowledge of Neptune's pole and ring system from the 1989 Voyager encounter.

### ***Publications***

Results for Titan's Atmosphere from its Occultation of 28 Sagittarii, W.B. Hubbard, D.M. Hunten, H.J. Reitsema, N. Brosch, Y. Nevo, E. Carreira, F. Rossi, and L.H. Wasserman, *Nature*, **343**, 353-355, 1990.

The Size and Shape of (2) Pallas From the 1983 Occultation of 1 Vulpeculae, D.W. Dunham, J.B. Dunham, R.P. Binzel, D.S. Evans, M. Freuh, G.W. Henry, M.F. A'Hearn, R.G. Schnurr, R. Betts, H. Haynes, R. Orcutt, E. Bowell, L.H. Wasserman, R.A. Nye, H.L. Giclas, C.R. Chapman, R.D. Dietz, C. Moncivais, W.T. Douglass, D.C. Parker, J.D. Beish, J.O. Martin, D.R. Monger, W.B. Hubbard, H.J. Reitsema, A.R. Klemola, P.D. Lee, B.R. McNamara, P.D. Maley, P. Manly, N.L. Markworth, R. Nolthenius, T.D. Oswald, J.A. Smith, E.F. Strother, H.R. Povenmire, R.D. Purrington, C. Trenary, G.H. Schneider, W.J. Schuster, M.A. Moreno, J. Guichard, G.R. Sanchez, G.E. Taylor, A.R. Upgren, and T.C. Van Flandern, *Astron. J.*, **99**, 1636-1662, 1990.