Azimuthal variability of radial structure of Saturn's rings observed by Cassini radio occultations

E. Marouf (1), N. Rappaport (2), R. French (3), C. McGhee (3), A. Anabtawi (2)

(1) San Jose State University, California, USA, (2) Jet Propulsion Laboratory, California, USA, (3) Wellesley College, Massachusetts, USA

(emarouf@email.sjsu.edu / Fax: 001 408 924 3925 / Phone 001 408 924 3969)

Eight completed Cassini radio occultation observations of Saturn's rings have yielded high spatial resolution ($<$ 1 km) X-band (3.6 cm-wavelength) optical depth profiles at twelve distinct ring longitudes. The profiles provide a rich resource of information about radial ring structure and its azimuthal variability. Additional acquired Ka- and S-band (0.94 and 13 cm-wavelength) profiles yield important complementary information about the particle sizes populating the observed structure. Of particular interest here is the observed profile variability with observation longitude (azimuth). Well-known mechanisms responsible for the variability include resonant interaction with exterior satellites, gravitational interactions with ring-embedded satellites, and resonant forcing of ring edges and narrow ringlets. Streamline distortion caused by such mechanisms is clearly evident in the profiles in the form of a host of density waves, some bending waves, Pan's wake, sharp noncircular edges, and narrow eccentric ringlets. Although much of the observed structure correlates well with known forcing mechanisms, some structure does not. This includes width/profile variations of several narrow gaps and eccentric ringlets as well as several wave-like features. Much of the asymmetry is particularly prominent in features within Rings C, the Cassini Division, and Ring A. A different known mechanism responsible for profile asymmetry is related to the rings microstructure. Gravitational wakes developing within self-gravitating Keplerian disks result in spatial correlations of particle positions that are elongated and preferentially oriented. Different radio occultation cuts probing the wakes from different viewing geometry (relative to an Earth observer) yield asymmetric profiles. The asymmetry here is observation geometry related, however, and is not ring intrinsic. Evidence for this type asymmetry is prominent over most of Ring A. Somewhat surprising is the case of Ring B, where unique and remarkably rich radial structure observed across this broad and optically thick main ring feature appears to show much less variability with observation longitude. The exception being a prominent density wave in inner Ring B forced by resonance with the co-orbital satellites (Janus/Epimetheus), and the region interior to the outer edge of Ring B resonantly forced by Mimas. The emphasis here is on characterization of observed profile variability with longitude. Work is in progress to determine/constrain implied physical ring properties and to investigate related ring dynamics.