

>0.4 at a radial resolution of <100 m. The widest estimated egress width is 1.9 km, with ~80% of the material lying within the 1.0 km core. To ~10%, the optical depth of the ring at each cut is the same. The azimuthal asymmetry is substantial, implying dynamic forces on the 1986UIR ring material.

Voyager images never resolved the γ ring. The PPS data from the β -Per occultation provided two cuts 86° apart that also showed marked azimuthal asymmetry. The ingress cut is strongly condensed with O.D. >3.1 and a width of ~0.6 km. No internal structure was discernable. The egress cut is about 2.6 km wide, with half that width <3.1 O.D. Some internal structure is visible. The ring is not homogeneous in azimuthal extent and because of its thickness PPS cannot comment on the angular constancy of material. However, the extremely high measured O.D. implies that particles are piling up out of the orbital plane where the ring is narrowest. This situation is similar to that seen for the ϵ ring (2).

The η ring also exhibits this azimuthal inhomogeneity and may come closest to being an incomplete ring at observations of 1 km resolution.

- (1) B. A. Smith et al., (1986). *Science*, 233, 43-64.
- (2) A. L. Lane et al., (1986). *Science*, 233, 65-74.

23.17

Azimuthal Brightness Variation and Albedo Measurements of the Uranian Rings

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The recent Voyager encounter with Uranus has produced new insights and observational constraints on the structure, composition, and evolution of the Uranian rings. We have made careful measurements of the brightness variation as a function of longitude for the alpha, beta, gamma, delta, and epsilon rings. These measurements showed a substantial variation in azimuthal brightness because of the varying width of the rings. The single scattering albedo of the rings particles was found to be consistent with the pre-encounter estimates but highly dependent on assumptions about the phase function. The procedure also allows for the determination of the optical depth independent of the occultation measurement from the Earth or from the spacecraft. This value is the optical depth for reflected light whereas occultation data provide the forward scattering optical depth. The measured value is consistent with varying amount of mutual shadowing due to changing width of the ring along its orbit. We also tried to derive some constraints on the internal structure of the epsilon ring (so called zebra-pattern).

23.18

Meter-sized Particles in the Uranian Rings

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As we have previously demonstrated for the Voyager PPS Scan of Saturn's ring system, the statistical properties of the observed photon counts may be employed to constrain the size distribution of the largest ring particles (BAAS 18, 1986, p. 767). We have now applied a similar analysis to the two Voyager PPS scans of the Uranian ring system, involving occultations of the stars σ Sgr. and β Per. As before, our results are expressed in terms of the dimensionless parameter Q , defined by

$$Q \equiv \frac{\int (\pi r^2)^2 n(r) dr}{A \mu \int \pi r^2 n(r) dr} = \frac{\pi R_{\text{eff}}^2}{A \mu}$$

Here A is the effective sampling area for a single measurement, μ is the cosine of the incidence angle, and the size distribution $n(r)$ is defined such that $n(r)dr$ is the number of particles per unit ring area in the radius range from r to $r + dr$. R_{eff} is the equivalent particle radius for a delta-function size distribution, and is comparable to the upper size

cutoff for more realistic distributions. For Saturn's rings, values of R_{eff} range from $\lesssim 2$ m in the C Ring to ~ 9 m in the central A Ring.

Results from a preliminary survey of the Uranian PPS data are summarized in the table below. Note that significant constraints can be placed on Q using only five of the PPS ring cuts.

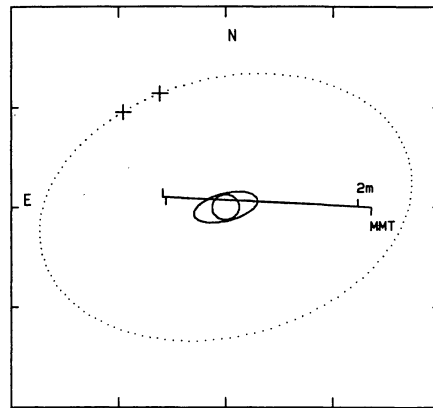
Ring	Occultation	Measured Q	A (m ²)	R_{eff} (m)
ϵ	σ Sgr. Ingress	0.029 ± 0.015	1746	3.8 ± 1.1
	σ Sgr. Egress	0.024 ± 0.025	1452	$3.1^{+1.4}_{-3.1}$
	β Per. Egress	0.039 ± 0.015	1298	3.6 ± 0.7
δ	σ Sgr. Ingress	0.010 ± 0.011	1635	$2.2^{+0.9}_{-2.2}$
	σ Sgr. Egress	0.028 ± 0.011	1527	3.5 ± 0.7

23.19

Coincidence Search for Neptunian Ring Arcs

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The figure shows the geometry of the occultation of a star (K-magnitude 11.3) by Neptune on 9 July 1987, as monitored from the Multiple Mirror Telescope on Mt. Hopkins and from the 2m Kitt Peak telescope. The projected separation of the tracks was about 50 km. Because a planetary occultation was observed, the tracks are accurately located with respect to Neptune. The figure also shows the orbit of Triton, positions of Triton during the interval, and the Roche limit for equatorial Neptune rings. No obvious ring occultations were observed; we discuss limits of detection and possible marginal events. Supported by NASA -- Planetary Astronomy.



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23.20

Two Recent Stellar Occultations by Neptune: Additional Matter near Triton?

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Occultations of infrared stars by Neptune have been observed on 22 June and 9 July 1987. Stellar K magnitudes, immersion times behind the planet, emersion times (in U.T.), apparent velocities, and observation sites were: 10.1, 3h 07mn 00s, 3h 19mn 25s, 24 km/s, 3.6-m European Southern Observatory telescope for the June event; 11.2, 8h 37mn 00s, 9h 05mn 35s, 23.5 km/s, 3.6-m Canada-France-Hawaii telescope for the July event.

Both atmospheric occultations show strong spikes. No secondary events were observed within the Roche limit of Neptune: prelimi-

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