1 NOVEMBER 1989
WEDNESDAY MORNING

Session 7: Planetary Rings I: Saturn, Mars, Theory (Moderator TBA)
8:30–12:00, Grand Ballroom

07.01
PRELIMINARY RESULTS from the OCCULTATION of 28 SGR by the SATURN SYSTEM: RINGS

C. Porco, W. Hubbard, D. Hunten, G. Rieke, M. Rieke, E. Asphaug, R. Clark, V. Haemmerle, J. Haller, J. Holberg, L. Lebofsky, R. Marcialis, D. McCarthy, B. McLeod (U. of Arizona), M. Buie (STSCI), J. Elias (CTIO), D. Jewitt (U. of Hawaii), E. Persson, T. Boroson, S. West (MWLCO)

University of Arizona observations of the 3 July 1989 UT occultation of 28 Sgr by Saturn, its ring system, and its satellite Titan were made from a network of observing sites distributed over the globe. The Saturn atmospheric observations will be reported in the talk given by Hubbard *et al.*; the Titan observations will be reported by Reitsema *et al.* Experimental parameters for observations of the Saturn disk and rings events from six major observatories are given in the table below. All experiments were successful. Typical S/N ratios for the MMT and CTIO aperture experiments were approximately 30/1 (3.17μ) and 50/1 (3.4μ), respectively, on the unocculted star. A prodigious amount of data were collected, in particular from the imaging experiments. Preliminary results on ring science obtained from the single aperture experiments, the data from which are most amenable to rapid reduction and analysis, will be presented. This work has been supported by NASA grants NAGW-1555, NAGW-960, and NSF grant AST-8715373.

Location	Telescope	$\lambda/\Delta\lambda$ (μ)	Scale	Sampling Rate (Hz)
		Imaging		
Las Campanas	DuPont 100"	2.12/.20[a]	0".5/pix	3
Kitt Peak	SO 90"	2.33/.07	0".6/pix	2
Mauna Kea	UKIRT 88"	3.08/.03[a]	0".6/pix	3
		Aperture		
Cerro Tololo	CTIO 4 m	3.40/.08	8"	18
Mt. Hopkins	MMT	3.17/.04	8"	10
Mt. Bigelow	Catalina 61"	3.40/.20	8"	10

[a] During the planetary occultations at Mauna Kea and Las Campanas, filter was switched to 2.3/.09μ.

07.02
The 3 July 1989 Occultation of 28 Sgr by Saturn and its Rings: Observations from McDonald Observatory

R. G. French, M. A. Clark (Wellesley College), E. Tollestrup, E. Robinson, P. Harvey, L. Heilman, R. Farr (U. of Texas), R. Stiening (Stanford U.)

The 3 July 1989 occultation of 28 Sgr by Saturn and its rings was successfully observed from McDonald Observatory using the 2.1 m and 2.7 m telescopes. The U. of Texas IR camera (58 x 62 pixels, at a plate scale of about 1"/px) was used on the 2.7 m telescope to record the occultation at a central wavelength of 2.1 μm (using a CVF), where the signal from the highly reddened star could be discriminated against the reflected solar signal from the planet and rings and where the background due to thermal radiation and absorption was relatively constant. Observations were made at a rate of 5 frames/sec for the time intervals 5:52 – 7:51 UT (spanning the ring system from just outside the F ring to the atmospheric immersion), 7:31 – 7:51 UT (covering the expected region for the central flash due to focussing of starlight around the limb of the oblate planet), and 8:18 – 9:34 UT (including atmospheric emersion and the ring system out to the F ring). Interpretation of the central flash is complicated by the presence of the broad rings, which partially block the light that would otherwise contribute more strongly to the total central flash intensity. Analysis of the nearly 40,000 individual frames has only just begun. These observations are expected to have high photometric accuracy, although somewhat restricted in resolution of ring structure due to the comparatively long integration time and the relatively large (~12 km) projected diameter of the occulted star. On the 2.1 m telescope, a 4-channel high speed aperture photometer was used with U, B, V, and R filters, along with a fifth channel that monitored the guide star intermittently throughout the observations. Data were recorded from 5:44 – 7:05 UT (covering ring and atmosphere ingress) with some data loss due to guiding errors, and from 8:13 – 9:41 UT (including atmospheric emersion and the entire ring system at egress) at an averaging interval of 50 ms for the B and R channels and at 100 ms for the U and V channels and the guide star monitor. Because of the large contribution of reflected light from Saturn and its rings, and differences in the albedo of the planet and rings at these wavelengths, color correction methods have been employed to extract the normalized stellar signal from the data. These observations will provide very accurate measurements of the locations of sharp ring edge features, complementing the IR camera observations. This work was supported by NASA Grant NAGW-656.

07.03
C – Ring Features and f – Mode Oscillations of Saturn

M. S. Marley, W. B. Hubbard, and C. C. Porco (Univ. of Arizona)

We have calculated the low degree fundamental (or f) mode oscillation spectra of Saturn to test the suggestion (Marley *et al.*, *BAAS* **19**, 1988) that resonances with oscillation modes of the planet may produce features in Saturn's rings. The calculated positions of the $m : m+1$ outer Lindblad resonances (OLR) for the sectoral ($m = \ell$) modes of the $\ell = 2, 3,$ and 4 oscillations lie near four previously unassociated C-ring features. These features are the Maxwell gap and three waves identified by Rosen (*Ph.D. thesis, Stanford Univ.*, 1989) as being forced at either OLR or inner vertical resonances (IVR). Two wave features lie near the 3:4 OLR; only one of the two features could be produced by the resonance. Rosen has derived limits on the azimuthal wave number of the forcing potential responsible for 6 unassociated waves (m_{obs} in table). The suggested planetary forcing (m_{OLR}) is consistent with these limits. Assuming approximate equipartition of energy among modes, modes of higher order ℓ should produce smaller C-ring torques. The proposed progression from gap to wave production with decreasing maximum wave amplitudes A (in units of radio science opacity τ) is consistent with this expectation. Planetary oscillation amplitudes of ~ 2 m are required for gap opening; wave amplitudes of ~ 10 cm are required for density wave production. Observations of wave and gap properties by Cassini should determine if the gap and waves are produced by planetary oscillations. If associated, significant constraints could be placed on Saturnian energy transport, differential rotation and core size. Supported by NASA grants NAGT-50049 & NAGW-960.

Proposed Ring Associations (*wave data from Rosen, 1989*)

Location (km)	Feature	m_{obs}	m_{OLR}	A (τ)
87620	Maxwell gap	—	2	—
82065	OLR/IVR	2–4	3	0.61
82211	OLR/IVR	2–5	3	0.38
80990	OLR/IVR	3–11	4	0.25

07.04
Characteristic Length Scales of Irregular Structure in Saturn's B Ring

L.J. Horn, J. Hui (JPL/CalTech), J.N. Cuzzi (NASA/Ames)

We have studied the spatial scales of the irregular structure seen in Saturn's B ring. Previous studies of this structure have not revealed any systematic quantitative information, because they have used Fourier techniques that require structure to remain coherent for many cycles before producing significant "power" at any particular spatial frequency. For instance, only density waves, which have phase coherence and relatively little wavelength variation over many cycles, have been detected by Fourier techniques. In contrast, we have used a non-linear analysis technique, Burg 2, on the data which has the advantage of not requiring more than one or two cycles to produce significant "detections." That is,