MARS RADAR REFLECTIVITY IMAGES FROM 1988 AND 1990 CW SPECTRA; M. A. Slade[1], R. S. Hudson[2], T. C. O'Brien[3], and R. F. Jurgens[1] [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109 [2]Washington State University, Pullman, WA 99164 [3]University of California at Berkeley, Berkeley, CA 94720

Whole-disk dual-polarization CW observations of Mars at 4 cm were performed during the 1988 and 1990 oppositions. 69 round-trip accumulations were made on 7 days between October 1988 and January 1989. 76 round-trip CW measurements were made on 12 days between August 1990 and December 31, 1990. In all observations, a right-circularly polarized CW wave was transmitted and both Opposite-sense Circular ("OC") and Same-sense Circular ("SC") polarizations were recorded through independent receivers. The two modes of received polarization are due to different combinations of scattering mechanisms. The strength of the OC returns usually is dominated by information about the scattering properties around the sub-Earth point out to about 30° angle of incidence. The strength of the SC returns usually is controlled by the amount of near-surface material whose size-scale is within a factor of 3 of the radar wavelength. These new observations therefore contain primarily *new* information about 4 cm whole-disk roughness from the SC returns. This information complements similar radar spectra at 13 cm wavelength made at Arecibo Observatory during 1988 and 1990, as well as 1990 delay-Doppler imaging of the whole disk at Arecibo [1,2]. A joint effort to explore the large combined data set is underway.

We discuss here primarily maps made from the SC spectra at 4 cm from 1988 and 1990 radar observations using a **direct inversion** technique [3]. Such maps are complementary to those obtained by forward modeling (e.g., Thompson and Moore [4]). Since most of these spectra were obtained at non-equatorial latitudes, the resulting images are unambiguous between north and south. Briefly, the planet's reflectivity distribution is expanded in a truncated spherical harmonic series. The coefficients are estimated from the observed spectra by least-squares fitting solved using singular value decomposition. The angular scattering law of the surface is assumed to follow

$$\sigma_0(\gamma) = \rho \cos^n \gamma$$

where γ is the angle of incidence and ρ is the solved-for reflectivity. The dependence of the solution on the assumed value of n is explored by performing solutions with several different values of n. Note that the assumed scattering law is valid only for the SC echos and for the diffuse component of the OC echos. The surface resolution of such maps is limited by the Nyquist sampling theorem; thus the degree of the spherical harmonic series can be no larger than half the effective number of Doppler spectra available at each subradar latitude. A spherical harmonic series of degree L has $(L+1)^2$ coefficients, which is equal to the maximum number of independent resolution cells on the surface. Current solutions have L=15, leading to 256 resolution cells. Two values for n have been examined thus far: n=1.0 and 1.5. For the 4 cm data, the (marginal) best fit is n=1.0. Since the 1988 and 1990 oppositions are predominantly southerly views of Mars, the fidelity of the solution for reflectivity decreases as the latitude becomes more northerly. Much of the northern hemisphere is viewed with a very limited range of angles of incidence. The north polar regions are not viewed at all.

Figure 1 below shows a view of the solution for the SC surface reflectivity as seen from 25° S. at a longitude of 147° W. using just the 1988 spectra. In the greyscale version, white is most reflective and black is least reflective. In the color versions to be shown, red is most reflective going to blue through black as reflectivity decreases. The brightest features are: (center) a region south of Arsia Mons in Daedalia Planum and extending up over the Tharsis region (bottom) the south residual ice cap. The dark region to the west of Tharsis is the "Stealth" feature first observed in SC

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System

MARS CW RADAR IMAGES—1988 AND 1990: Slade, M.A., *et al.*

Goldstone/VLAradar images (Muhleman *et al.* [5]), as shown in Figure 2. This Goldstone/VLA image is shown for comparison to provide some "ground-truth" for the inversion technique. The resolution of the CW map should improve when the 1990 spectra are added; however the main features of the inversion maps are clearly real. The CW spectra also provide reflectivity for parts of Mars not imaged by the VLA in 1988. In particular, the bright feature associated with the Elysium volcanic complex can be seen to be south of Elysium Mons, and also a bright feature exists just south of Orcus Patera.

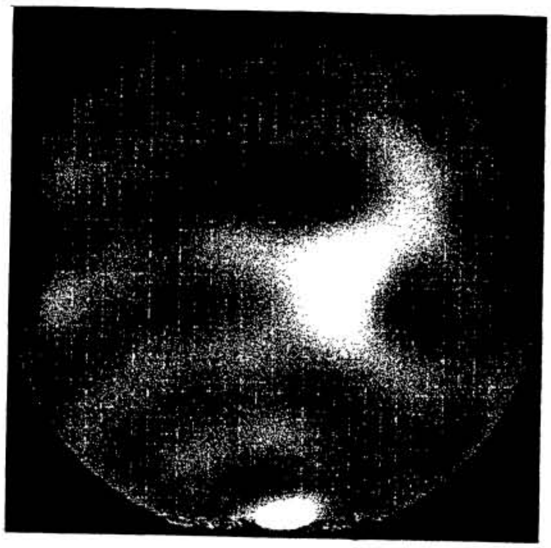

Fig. 1

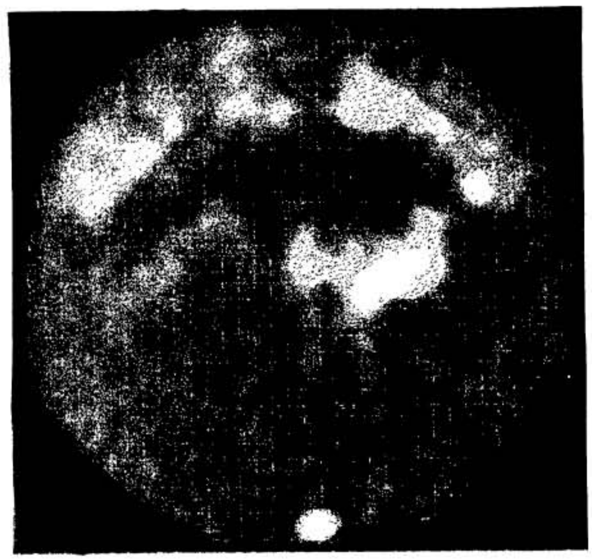

Fig.2

REFERENCES: [1] Harmon, J.K. (1988), LPSC XX, 371-372 (abstract). [2] Harmon, J.K. (1990), personal communication . [3] Hudson, R.S. and Ostro, S.J. (1990), JGR, 95 B7, 10947-10963. [4] Muhleman, D.O., Butler, B., Grossman, A.W., Slade, M., and Jurgens, R. (1989), Fourth International Conference on Mars, Jan. 10-13, Tucson,Arizona (abstract). [5]Thompson, T.W. and Moore, H.J. (1989), Proceedings of the 19th Lunar and Planetary Science Conference, 409-422.

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System