#92-5

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To: Holographers

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Subject: Inversion of the sun scan data

If we assume that the sun is a uniform disk of angular radius s and the antenna beam response is circularly symmetric.

$$R(x) = \int_0^{\pi} B(r) r\, F(r,s,x)\, dr$$

where

$R(x)$ is the sun scan response at distance x from the center of the sun

$B(r)$ is the beam response at angle r from the center of the beam

$$F = 2 \cos^{-1}\left((r^2 + x^2 - s^2)/(2\, x\, r)\right)$$

$$\text{for} \qquad s - x \le r \le x + s$$

$$F = 0 \qquad \text{for} \quad r > x + s$$

$$F = 2\pi \qquad \text{for} \quad r < s - x$$

Since the integral can be approximated by a sum

$$R(x) = \sum_{K=1}^{N} B_k r_k\, F(r,s,x)$$

we can use linear least squares to estimate the beam coefficients B_k. While the coefficients for a 20 parameter fit are noisy the fits are very good and the rms contribution to roughness scales smaller than seen by the holography can be estimated:

$$rms = \left(-Ln(1-A)\right)^{1/2}(\lambda/4\pi)$$

where

$$A = \sum_{M}^{N} B_k r_k / \sum_{1}^{N} B_k r_k$$

r_N = maximum extent of sunscan ($\approx 0.6°$)

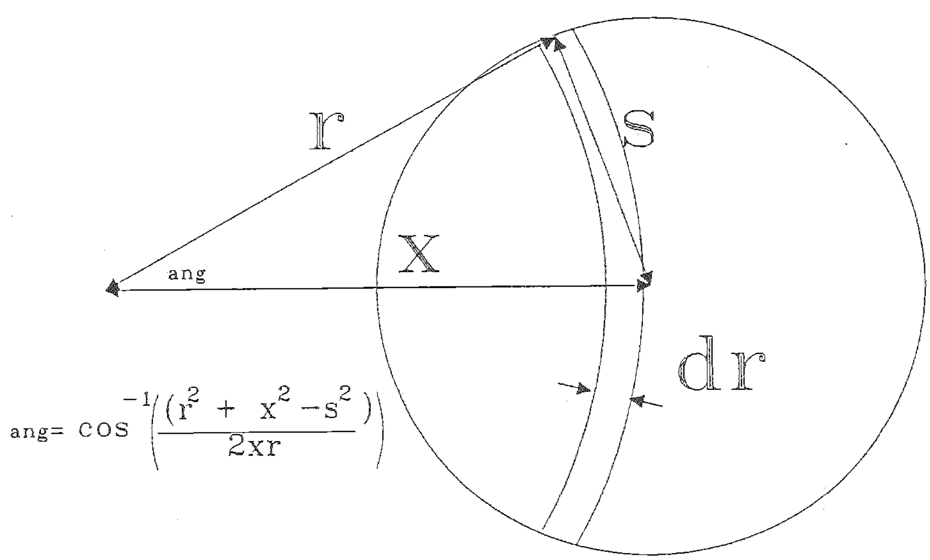
r_M = maximum extent of holography

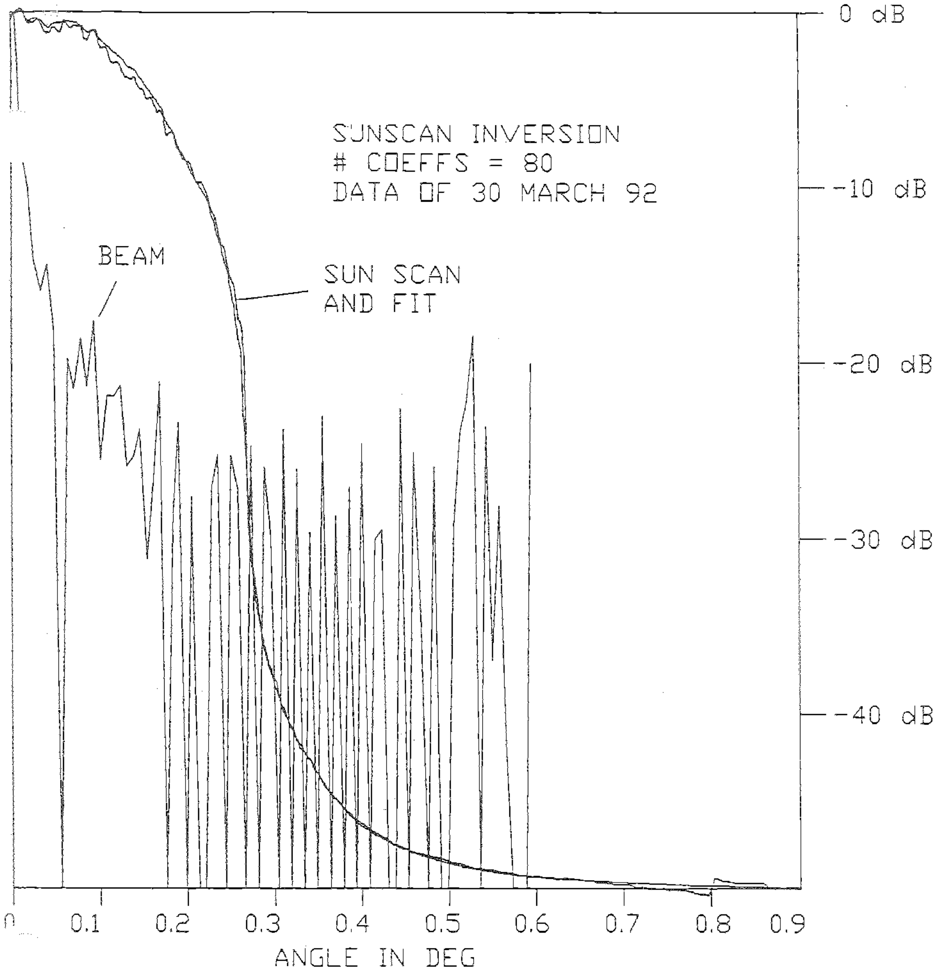
= (1.44 x 12/115 for 91 x 91, sunscan at 115 GHz)

The results were as follows:

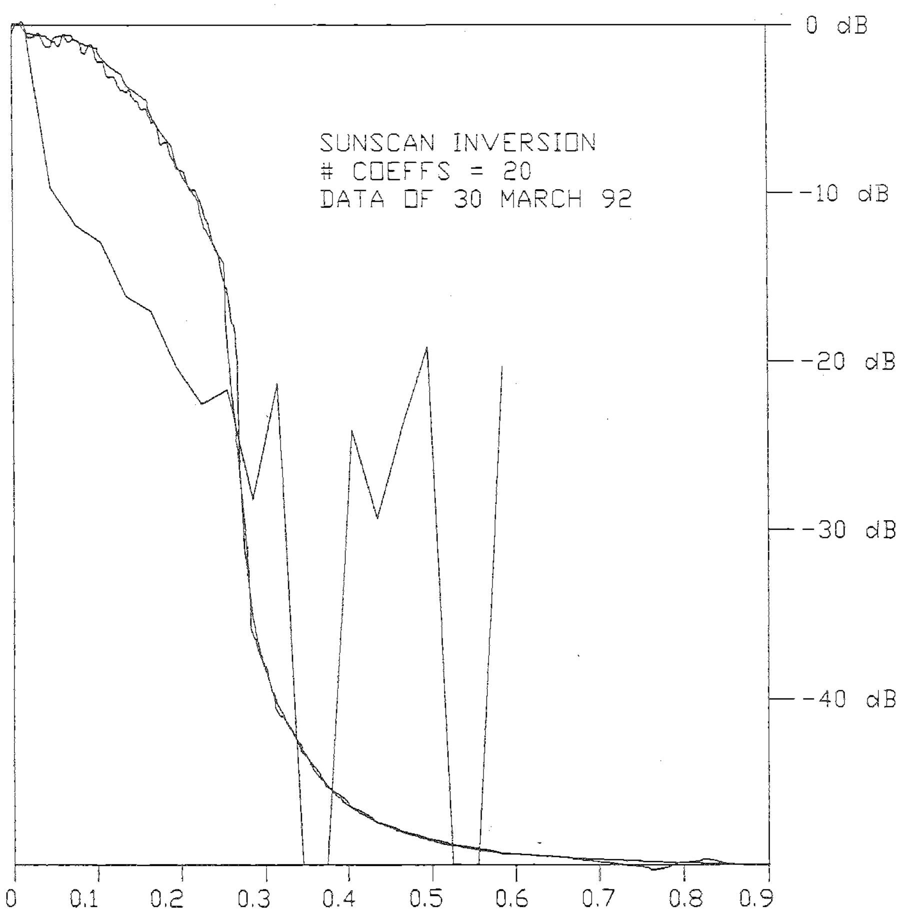
Sunscan Date	Scan #	Small scale rms mils
2 March 1992	1 & 2	5.4
2 March 1992	3 & 4	5.6
30 March 1992	1	4.9
30 March 1992	2	5.0

The attached figure shows sample inversions using 20 and 80 coefficients for the beam.





SUNSCAN INVERSION
COEFFS = 80
DATA OF 30 MARCH 92
BEAM
SUN SCAN
AND FIT
0 dB
-10 dB
-20 dB
-30 dB
-40 dB
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
ANGLE IN DEG



SUNSCAN INVERSION
COEFFS = 20
DATA OF 30 MARCH 92
0 dB
-10 dB
-20 dB
-30 dB
-40 dB
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9