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To: Holographers

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Subject: What information can we get from a sun scan?

In principle it should be possible to use a sun scan to get the aperture efficiency, beam efficiency, and distribution of surface rms with scale size. However, all these parameters can only be determined if the sun scan is accurately calibrated and we assume:

1. The sun is a uniform 6000°K disk with perfectly sharp limb.
2. The beam pattern has circular symmetry.

In practice I feel that the only information we can get from existing sun scan data is an estimate of the contribution to the surface rms from roughness unresolved by the holography. The small scale roughness can be estimated from the sidelobe energy at angles (measured in beamwidths) outside those used in the holographic mapping. For example, a 91X91 holography map includes sidelobes out to a radius of 1.44 degrees at 12 GHz or 0.15 degrees at 115 GHz.

The figure shows 115 GHz sun scan data from John Ball and models for the radial dependence on sidelobe energy. Estimates for the rms contribution of surface structure not seen by the 91X91 holography are

$$\textit{small scale rms} = 5 \pm 2 \textit{ mils}$$

and for structure seen by the 91X91 but not seen by the 51X51 maps

$$\textit{(91-51) rms} = 4.5 \pm 1 \textit{ mils}$$

From this information we can derive a better estimate for the total surface rms as follows:

$$\textit{(surface rms)}^2 = \textit{(91X91 rms)}^2 - \textit{(holog. noise)}^2 + \textit{(small scale rms)}^2$$

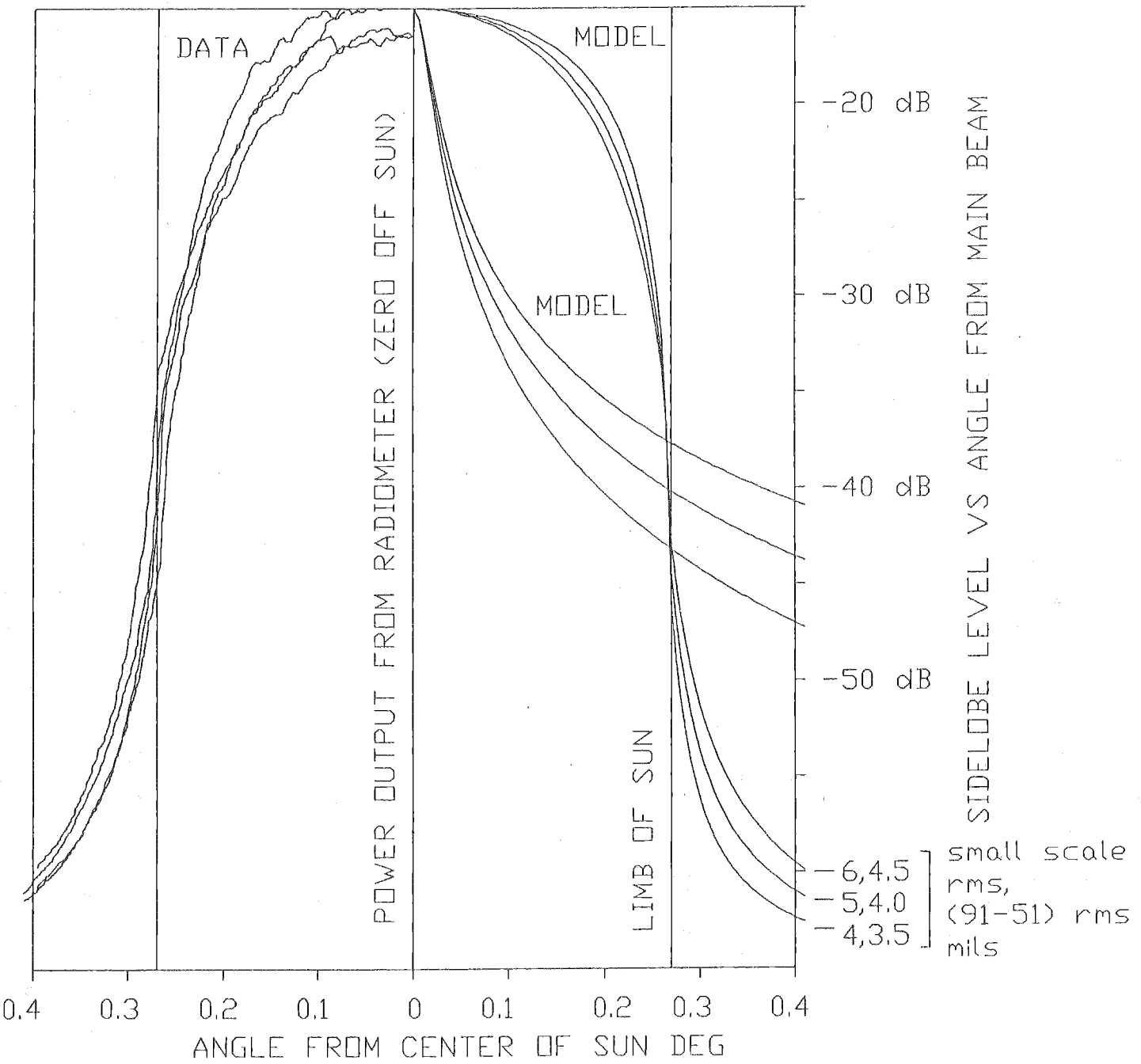
$$10.8^2 = 10.8^2 - 5^2 + 5^2 \qquad \textit{(map 218)}$$

Also as a check

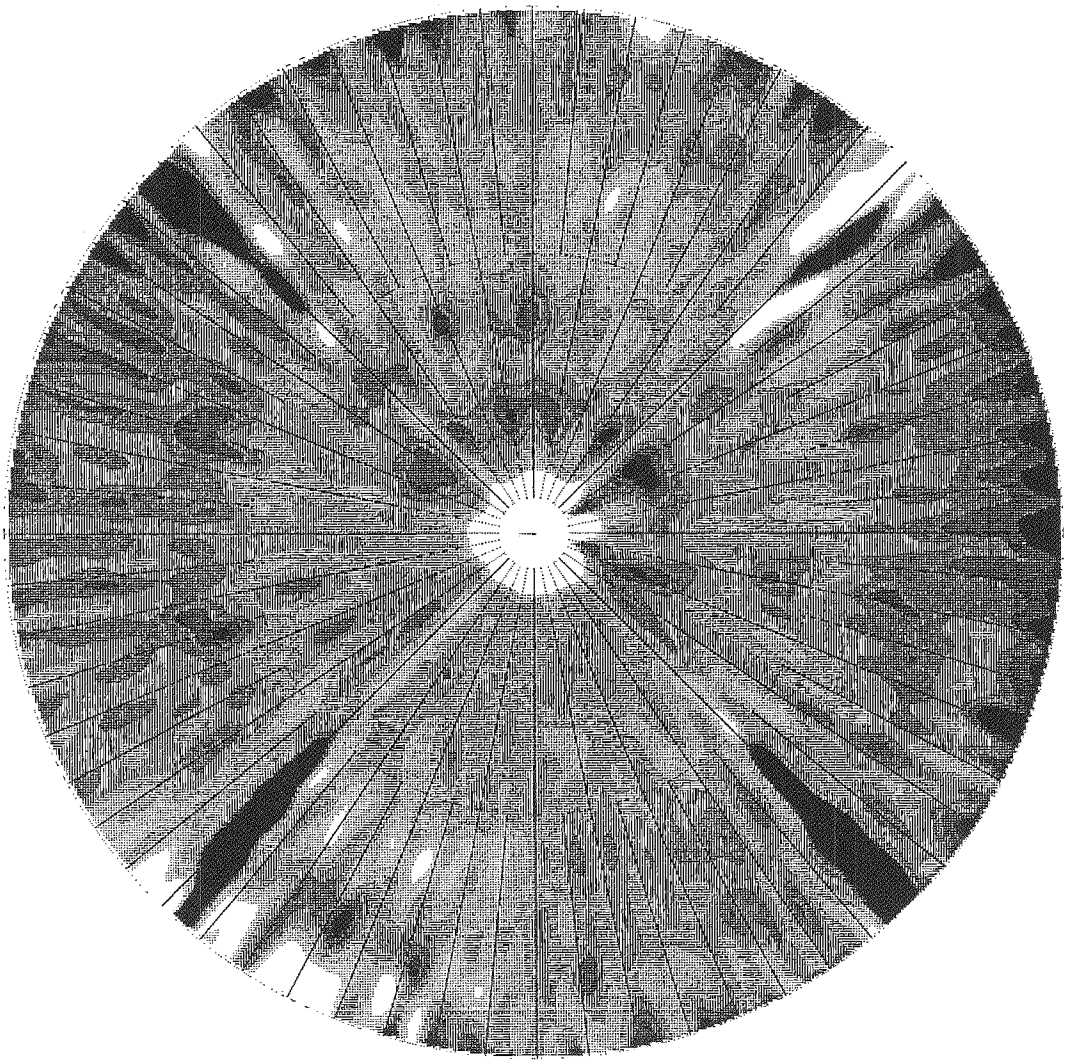
$$\textit{((91-51) rms)}^2 = \textit{(91X91 rms)}^2 - \textit{(91 holog. noise)}^2 + \textit{(51 holog. noise)}^2 - \textit{(51X51 rms)}^2$$

$$5.5^2 = 10.8^2 - 5^2 + 3^2 - 8.4^2 \qquad \textit{(map 218)}$$

I have placed a relatively large uncertainty on the small scale and (91-51) estimates. The small scale is especially uncertain because I have assumed that the sidelobe level goes to zero beyond 0.5 degrees. Sun scans which cover a wider scan angle would lead to a significantly better estimate and I recommend more data be taken when the new subreflector is in place. This work is very preliminary. The main beam is assumed to have a sinc pattern with the surface scatter lobes decaying with a power law. Other functional forms need to be studied.



SUN SCAN DATA VS MODELS



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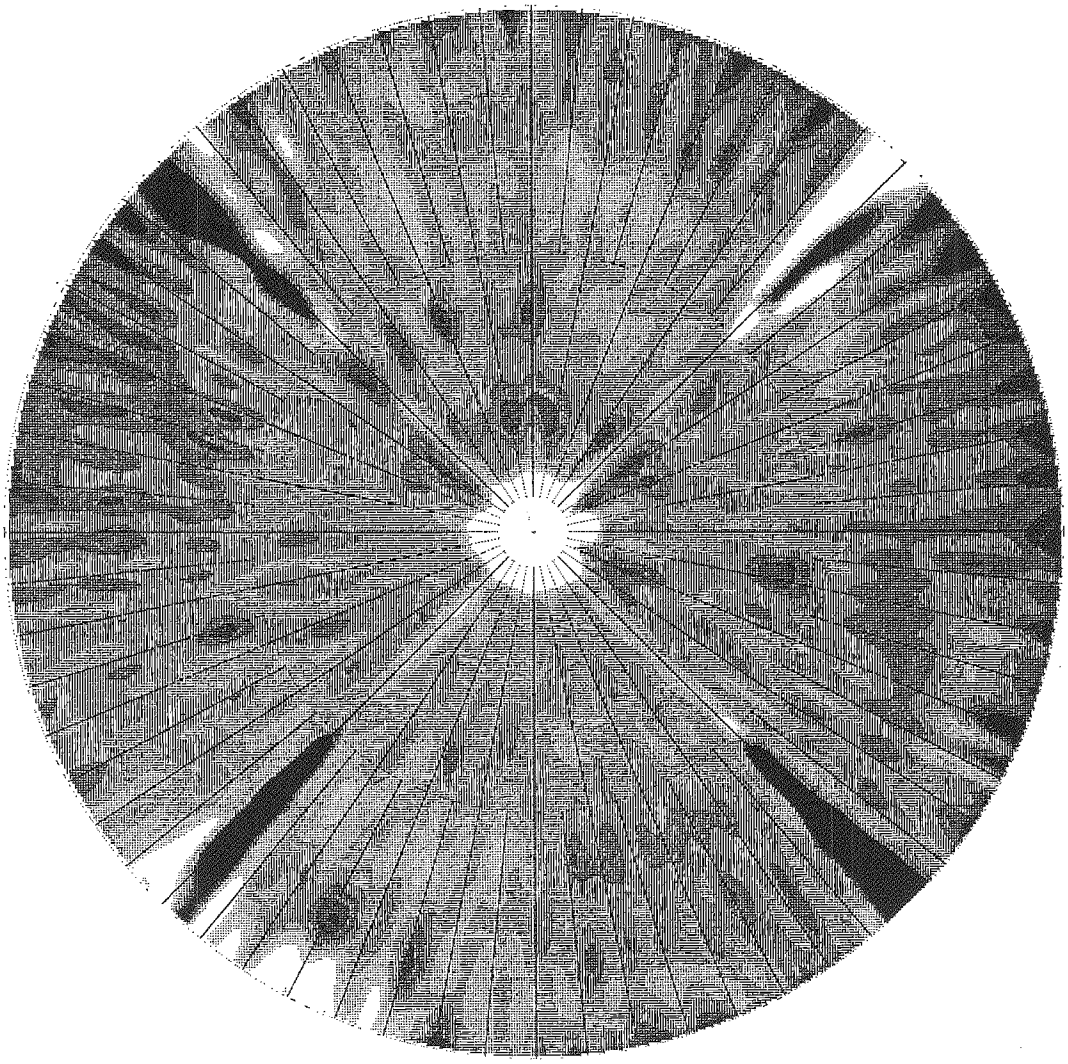
SURFACE DEVIATION IN MILS

222



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SURFACE DEVIATION IN MILS

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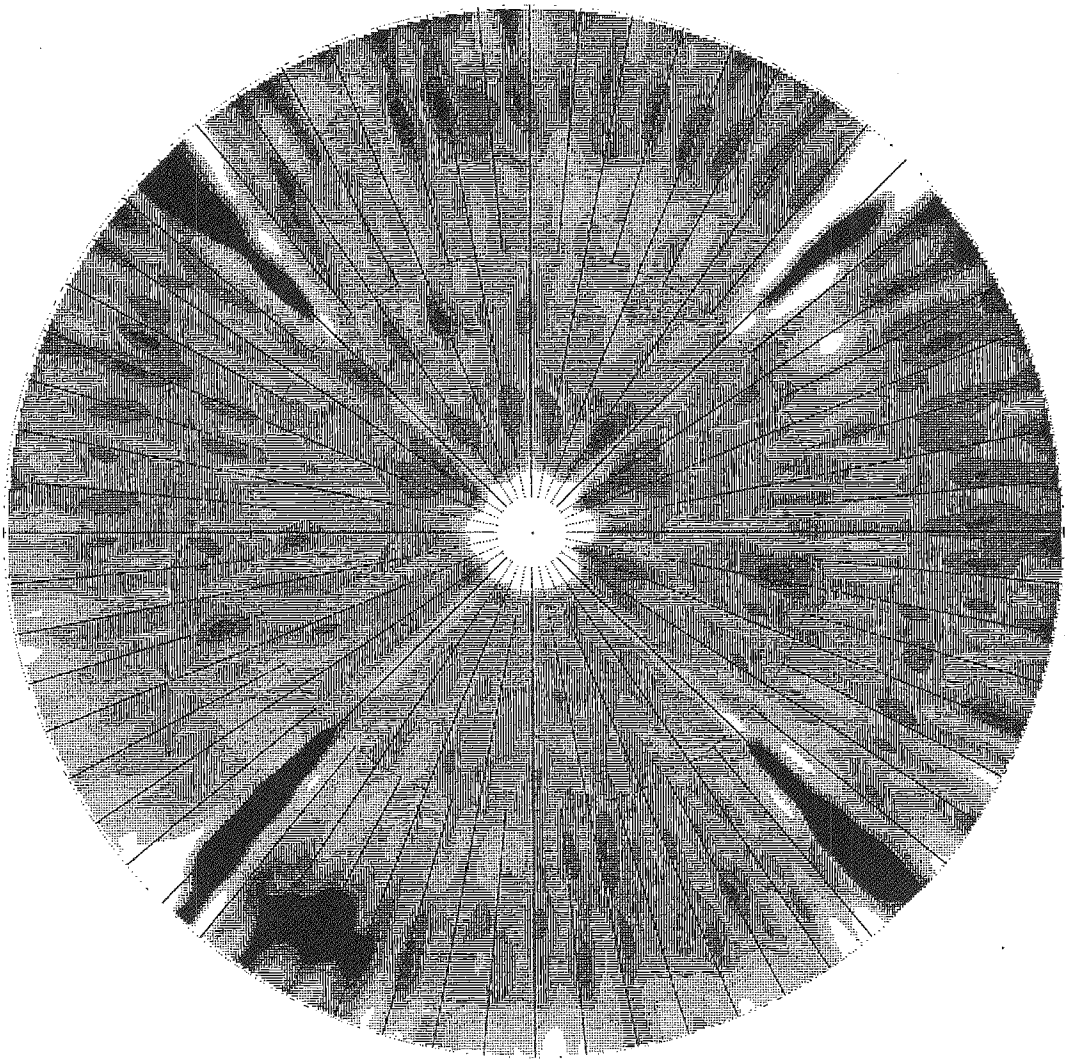

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SURFACE DEVIATION IN MILS

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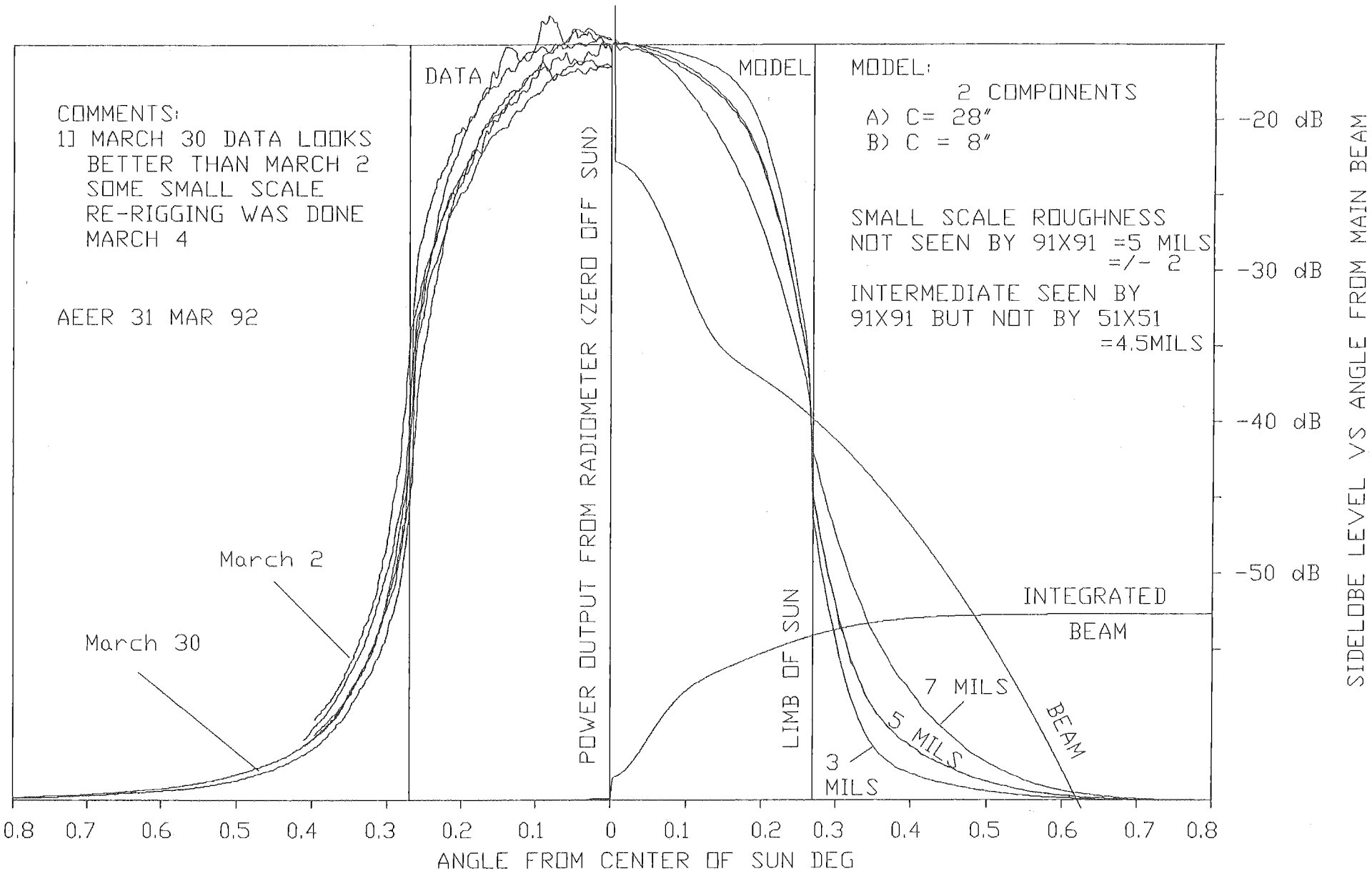

SUN SCAN DATA VS MODELS