OBSERVATIONS OF THE QUIET SUN WITH 6" RESOLUTION

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Solar radio emission at centimeter and millimeter wavelengths originates in the chromosphere and transition region and is a useful probe for the temperature and density in these regions. High spatial resolution observations of the quiet sun provide valuable information on the structure of the solar atmosphere. We have performed high resolution ($\sim$ 6"(E-W) x 15"(N-S)) observations at 6 cm with the Westerbork Synthesis Radio Telescope (WSRT) in June 1976 in order to search for the radio analog of the supergranulation network and to study the extent and symmetry of limb brightening. The use of the WSRT for high spatial resolution solar mapping has been described by Bregman and Felli (1976), Kundu et al. (1977), and others.

A central 10' x 10' disk region (E06N01) was observed for 12 hours on June 16, 1976. The unprocessed "dirty" map was dominated by the presence of grating ring responses due to two radio plages, McMath 14275 near the east limb and McMath 14271 near the center of the field. In order to produce a two-dimensional map free of these grating responses, we modeled the brightness distributions of these two plages and subtracted them from the "dirty" map. The resulting 6 cm map (Figure 1) is relatively free of grating responses due to strong sources and is the first radio map of the supergranulation network. The brightness temperature of typical "network" elements is $\sim 2.5 \times 10^4$K, while that of the radio "cells" is $\sim 1.5 \times 10^4$K. The contrast between the radio network and cells is $\sim$ 1.7:1 which is intermediate to that of the Ca^+ network and the Lyman α network. The radio map was compared with a Ca^+ spectroheliogram of the same region on the same day. It was found that the 6-cm network has the same scale as the Ca^+ network ($\sim$ 15"), somewhat larger than the width of the network in the EUV. The cell sizes in radio and Ca^+ are the same ($\sim$ 40" - 50").

On June 17, 1976, we observed the north, south, east and west limbs sequentially, spending about 5 minutes on each limb over a period of 12 hours. The east limb observations were contaminated by the presence of the strong plage McMath 14275; however, the maps of the north, south, and west limbs have permitted the determination of the radial brightness

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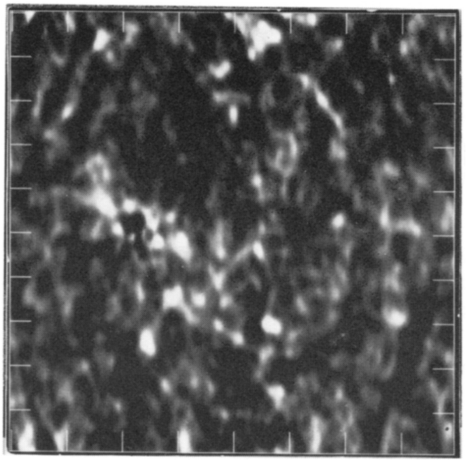

Figure 1: 10' x 10' WSRT 6-cm total intensity map of central disk region on June 16, 1976. Radio plage McMath 14271 has be subtracted from the map at left center.

temperature profiles. Since the limb showed prominent instrumental grating responses, we have modeled the radial brightness temperature profiles and have successfully removed the instrumental effects. A typical radial temperature profile is shown in Figure 2 for the south limb. We find limb brightening of 40-60% above the mean disk temperature. The peak in

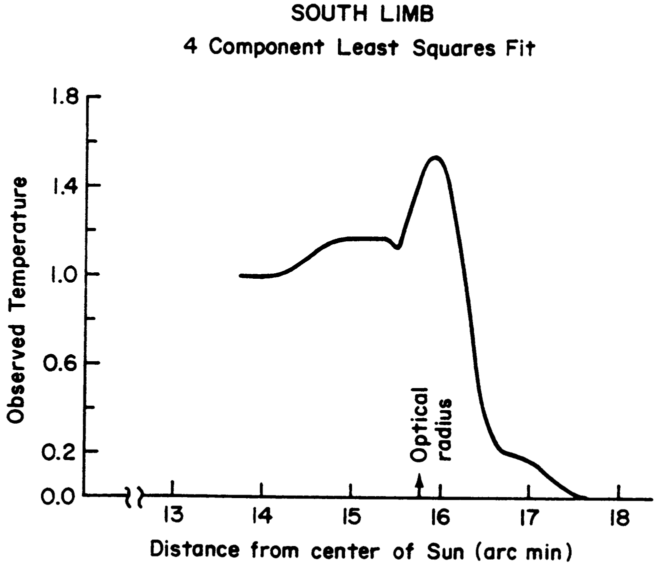

Figure 2: 6-cm radial brightness temperature profile.

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the limb brightening is located ∿ 15" outside the optical disk. The half power radius of the 6-cm emission is ∿ 45" outside the optical disk.

References

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Kundu, M. R., Alissandrakis, C. E., Bregman, J. D., and Hin, A. C.: 1977, *Ap. J.* 213, 278.

DISCUSSION

Dulk: You mention that some of the coldest regions on your map have a brightness temperature of 5000 K. That seems like an exceedingly low value for a wavelength of 6 cm. Can you comment on their reality?

Kundu: I would like to clarify some points. First, the cross-correlation coefficient of 0.24 between Ca K and 6 cm quiet sun map mainly comes from the fact, that we are dealing with two levels of the sun's atmosphere, separated by some 10,000 Km. The lower coefficients may simply mean that not all of the bright structures on the network boundaries extend vertically all the way up to the 6 cm level.

Secondly with respect to Dulk's question about 5000 K, let me clarify that we have subtracted 20,000 K from our data to show the structures on the quiet sun map. This value should be added to the temperatures quoted earlier.

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