GR

November 4, 1947

14.5/904

Chief Communication Liaison Branch
Office of the Chief Signal Officer
Room 4D221 The Pentagon
Washington 25, D.C. X 6939

Attn: Mr. Arthur Beach

Gentlemen:

We have a copy of following report and wish to use some of the contents in a survey we are undertaking. In particular, we wish to publish the relative levels of cosmic noise along the galactic equator. Since our copy is marked "Confidential" we wish to learn whether or not the report is presently classified and if so, we request that measures be taken to declassify the report.

> "Measurement of Cosmic Noise at 60 mc" by K.F. Sanders, May 31, 1945, R.R.D.E., Research Report #285.

Very truly yours,

Grote Reber, Radio Physicist
Experimental Ionospheric Research Section
Central Radio Propagation Laboratory

GR:HG

Declassified Sept 17 ~~Feb 1946~~ 1947 per telephone with Horner 11-10-47

BRITISH COMMONWEALTH SCIENTIFIC OFFICE
United Kingdom Scientific Mission
1785 Massachusetts Avenue, N. W.
WASHINGTON 6, D. C.

Please quote File No. 315-0-0

Telephone DEcatur 9000 Extension 329

12th November 1947

Mr. G.Reber.
C.R.P.L.
Bureau of Standards.
Washington 25.D.C.

Dear Mr.Reber,

In confirmation of our telephone conversation two or three days ago, I am writing to inform you that the following two reports issued by R.R.D.E. are now declassified:-

No. 285. Measurement of cosmic noise at 60 Mc/s ~~per second~~.

No. 286. Intensity of cosmic noise; a survey of the data available.

The declassification of these two reports is in accordance with a list issued by R.R.D.E. and dated September 17th 1947.

Yours sincerely,

F. Horner.

F.Horner.

FH:fb

11-8-47

Sanders Data at 60 mc

When antenna temperature = 10^4 degrees.
$kTB = 1.37 \cdot 10^{-23} \cdot 10^4 \cdot 10^6 = 1.37 \cdot 10^{-13}$ watt/mc. bd.

Antenna 2 wavelengths long × ½ wavelength high.
Frequency 60 mc or $\lambda = 5$ meters = 500 cm.
Antenna area = 1000 × 250 = 250,000 sq cm = $2.5 \cdot 10^5$
antenna efficiency probably about 80%

Width of Beam about 42° in vertical direction and 30 in horizontal direction at half power points giving cone 42×30 = 1260 cir. deg.

$$I = \frac{4kTB}{\text{Area} \times \text{eff} \times \text{cone}} = \frac{4 \cdot 1.37 \cdot 10^{-13}}{2.5 \cdot 10^5 \cdot .80 \cdot 1260} = 2.2 \cdot 10^{-21} =$$

$22 \cdot 10^{-22}$ watts/sq.cm., cir. deg., mc., bd.

Therefore multiply all curve legends by 2.2 to get into same units as my 160 + 480 mc data

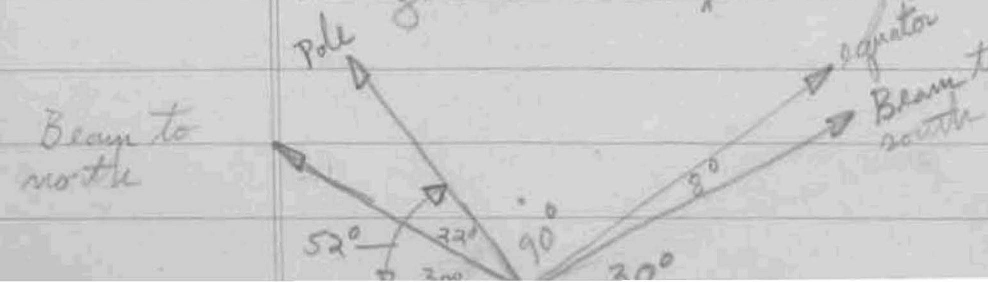
Explanation of Results on page 4

Data of Figures 3, 4, 5, 6 were made by taking data with the antenna revolving once in 20 minutes. Primary data of type shown in figures 8, 9, 10, 11 are obtained. Temperature from these curves is taken with the antenna pointed in directions North, East South and West, This data (usually only every other revolution, 40 min intervals) is plotted in figures 3, 4, 5, 6.

Data of figure 7 is taken by pointing the antenna in South direction and letting the sky go by as the earth rotates. Circle data more likely than line. See comment in second paragraph page 4.

Curves 8, 9, 10, 11 are remarkably like Jansky's original data at 20 mc. The period of antenna rotation of both Jansky & Sanders was 20 min.

Half intensity points of Fig 7 are 3 hours apart. This is an angle of 45° at the celestial equator. The measurements were made at about latitude 52°. The center of the beam is 30° above the southern horizon. Thus the beam points at declination −8°.



This is as low an angle as system can get to, Fig 2 gives

(0.7 voltage) as 20° apart. Thus width of milkyway at Dec - 8° is 45° - 20° or 25°. Obviously only slightly over one half the celestial sphere can be covered. By sufficient manipulation some figure for intensity of various parts of the milkyway might be had from Cygnus thru Canis Major. These will only be relative to the maximum value of figure 7. The small peak at 7hrs time on figure 5 is from Canis Major. Thus it seems the intensity from winter milkyway near - 8° dec in Canis Major is only about 1/3 that of the Summer Milkyway near - 8° dec in Aquila. Other points at higher declination may be secured from east & west pointing data. ~~If the antenna had no back lobes, the north pointing data would show little variation with time. Actually at high latitude the region of Cassiopeia appears more or less in beam at various times. This accounts for variations of figure 3 and a figure might be had for intensity of high declination regions from this data.~~

Note: Diffraction theory shows the 1/2 intensity points of an array 2 wavelengths long should be about 30° wide. If this value is subtracted from the observed 45°, then the milkyway is really only 15° wide in Aquila.

Figures 5 + 7 give position to which the antenna pointed directly in right ascension. When pointed south the beam scanned out a line in the sky along declination $-8°$. Thus Sidereal Time shown on figures 5 + 7 is really right ascension. When pointed north the beam scanned out a line in the sky at a distance 22° from the pole or at declination $+68°$. Thus the antenna comes closest to the milkyway at about 0040 RA. This corresponds to 1240 on figure 3 because the abcissae of all figures in in terms of the right ascension (sidereal time) of the meridian from pole, thru zenith to south. Consequently, add 1200 to time given in figure 3 to get R.A.

Case VI page 207, Palmer & Leigh

$$\sin a = \frac{\sin b \sin \alpha}{\sin \beta} = \frac{\sin 30^\circ \sin 52^\circ}{\sin 90^\circ} = .395$$

$a = 23\frac{1}{4}^\circ$

Thus when antenna points east or west it scans out a line in the sky along dec $+23\frac{1}{4}^\circ$

$$\tan \tfrac{1}{2} c = \tan \tfrac{1}{2}(a-b) \frac{\sin \frac{1}{2}(\alpha+\beta)}{\sin \frac{1}{2}(\alpha-\beta)}$$

$$= \tan \tfrac{1}{2}\left(23\tfrac{1}{4}-30\right) \frac{\sin \frac{1}{2}(52+90)}{\sin \frac{1}{2}(52-90)}$$

$$= \tan -3\tfrac{3}{8}^\circ \frac{\sin 71^\circ}{\sin -19^\circ} = -.0591 \frac{.946}{-.326}$$

$= .1717$

$\frac{1}{2} C = 9\frac{3}{4}^\circ$

$C = 19\frac{1}{2}^\circ$

$90 - 19\frac{1}{2} = 70\frac{1}{2}^\circ = 4.7 =$ 4 hrs 40 min.

When antenna points east it points to a place in sky 4 hrs 40 min later than meridian so add 4 hrs 40 min to sidereal time of Fig 4 to convert to right ascension.

When antenna points west subtract 4 hrs 40 min from sidereal time of figure 6 to convert to

Bearing is direction in azimuth on the earth at the observer. Zero bearing is true north. Bearing increases to 90° at east, 180° at south and 270° at west. Thus according to note above figure 8 the antenna swept around the azimuth with continual decreasing bearing or it passed thru south going from west to east.

It would be desirable to take the data off figures 8 to 11 at bearings of 30° and 330°; also 60° and 300°. This should give eight more points at each of two declinations at approximately +52° + +38° respectively. Perhaps it would be simpler to choose one set of data at bearings 45° and 315° for more points along declination approx +46° after all the beam is so wide this is probably only resolution of significance.

11-3-47
G. Reber

Apparently the situation may be described qualitatively as follows. Consideration of free-free transitions indicate we are enveloped in a luminous haze, the optical depth of which, increases with frequency. By using different frequencies we may sound the haze to various depths and thereby deduce some idea of the shape of this body of material.

First, assume we are located inside and somewhere along the axis of a banana. If we sound the depth of the banana to only 3/8 inch we deduce that the material is uniformly distributed around us in all directions. By increasing the frequency we may probe the contents of banana to about one inch. This tells us that the material is definitely limited in some directions but may or may not be in others. Perhaps this is about the state of affairs at 20 mc as determined by Jansky's original data.

Going up to 64 mc (Hey, Phillips & Parsons) may probe out to a distance of 2½ inches and we find the banana is curved and has two major directions of Sagittarius and Cygnus.

Raising the frequency to 160 mc (Ap. J. 1944) shows we are in a structure more like a

Furthermore it is apparent that the different arms of the star fish have different lengths.

Passing on up in frequency to 480 mc (1946+7 data) confirms the fact that the star fish has four arms, being able to see farther down the arms. Also, it seems that two of the arms (Cygnus + Orion) are split at the ends rather like the claws of a lobster. The arms appear more slender and one (Sagittarius) has a side projection pointing up from it similar to the top fin on a fish.

By now we have some idea of the shape of the haze which we live in; but if we wish to learn more of the details of the claws and fin we must be able to see further and with greater resolution.

The above ditty lays emphasis on the different pictures secured at different frequencies due to increase in the depth of perception. Actually all data was not secured with equipment of equal resolving power. Thus some of the increased detail at the higher frequencies must be attributed to this cause. However, if a mirror 100 ft in diameter were available, I believe it is very unlikely that constant intensity contours at 160 mc would be secured which were identical with those obtained at 480 mc using a 32 ft mirror.

11-3-47

Calibration of Receiver

See data book on 1-15-47 for dummy antenna tests.

$V_s = .42$, $V_{ant} = .20$, $V_{on} = .46$

Thus with 300° antenna temperature

$$\Delta = \frac{.46-.42}{.42} = \frac{.04}{.42} = .095$$

$kTB = 1.37 \cdot 10^{-23} \cdot 300 \cdot 10^{6} = 4.1 \cdot 10^{-15}$ watt /mc band

Area of mirror $= 7.2 \cdot 10^{5}$ sq cm

Efficiency of " $= .85$

Cone size $= 3\frac{1}{2}° \times 4° = 14$ circular degrees.

Total Power $= 4kTB$ {kTB = available power = ½ generated power in antenna; antenna power only horizontal component = ½ total power}

Intensity $\frac{4 \cdot 4.1 \cdot 10^{-15}}{7.2 \cdot 10^{5} \cdot .85 \cdot 14} = 19.1 \cdot 10^{-22}$ watt /sq cm, cir deg, mc bd.

Δ	I in watts/sq. cm., cir. deg., mc. bd.	
.095	19.1	Curve markings
.020	4.0	2.0
.010	2.0	1.0
.005	1.0	.5
.002	.4	.2
.001	.2	.1