NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA

ELECTRONICS DIVISION INTERNAL REPORT NO. 159

INTERFERENCE POTENTIAL FOR RADIO ASTRONOMY OBSERVATIONS AT GREEN BANK, WEST VIRGINIA

CRAIG R. MOORE AND JAMES L. DOLAN

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Craig R. Moore and James L. Dolan

Introduction

This report attempts to summarize possible sources of radio interference to radio astronomy observations at the NRAO, Green Bank, WV. The interference is considered to originate from three categories of sources: radiometers and electronics equipment at Green Bank, FCC and IRAC licensed emitters within and outside the Radio Quiet Zone, and unintentional sources of interference, i.e., emissions from automobile ignitions, power lines, TV boosters, etc. This report is intended as an aid to line observers in particular, so that they might judge the magnitude of the interference problem before they begin observations. It is strongly urged that this report be consulted whenever observations at wavelengths longer than 21 cm are contemplated. The National Radio Quiet Zone does not guarantee that there will be no interference at Green Bank; it merely provides that we will know more about the sources and potential than at any other location in the U. S.

A. Green Bank Electronics Equipment

Most of our radiometers are potential sources of narrow-band interference. A list of possible spurious signals is attached.

The most likely sources of inter-telescope interference are the Universal Local Oscillators which can generate up to 1 watt in the frequency range 1-2 GHz. We have had cases of this occurring: (1) between lab and 140-ft and (2) 140-ft and 300-ft. In these cases the RF output was tuned within the pass band of the line receivers.

The interferometer and 45-ft microwave link is also another known source of trouble, especially at 1300.0, 1347.4, 1347.5, and 1347.6 MHz. The link can be turned off for some observations; however, the 1347.5 signal might still be seen at the 300-ft telescope with the autocorrelator.

Spectral line observers would be well advised to check this list before observing. The Electronics Division engineer responsible for a system will attempt to minimize interference and warn the observers of possible problems.

It should be noted that only a few of these signals will be present at any one time, and most have never been seen as interference.

INTERFERENCE POTENTIAL OF EQUIPMENT AT GREEN BANK

LISTING BY FREQUENCY

Frequency MHz	Status	Potential Source	Location
30	P	Interferometer LO system	Interf. Baseline
35	P	Autocorrelator, Mark II, III	140' & 300' or Int.
40	P	Autocorrelator, Mark II, III	140' & 300' or Int.
43.0	†	VHF FM communications	Reber
100		Cooled 2 cm receiver	140'
100		Cassegrain receiver	140'
100	P	Universal LO	140' & 300'
90-100	P	Hydrogen maser	140'
103	P	IF Processor	140' & 300'
115	P	IF Processor	300' & 140'
100-160	P*	IF Processor - GR synthesizer	140' & 300'
120	P	Autocorrelator, Mark II, III	140' & 300' or Int.
124-180	*	12.4-18 GHz line receiver	140'
134.75		11 cm, 3-feed receiver	300'
240-300	P*	Universal LO - HP synthesizer	140', 300' & Int.
250-1150	*	100-1000 MHz receiver	140'
350-590	*	500-740 MHz receiver	140' or 300'
590-850	*	740-1000 MHz receiver	140' or 300'
650-890	*	500-740 MHz receiver	140' or 300'
670	†	Temp. calibration receiver	Little Big Horn
890-1150	*	740-1000 MHz receiver	140' or 300'
900		Cooled 2 cm receiver	140'
900	P	Universal LO	140' & 300'
1000-1250	*	5.2-10.4 GHz receiver	140'
1000-1600	P*	IF Processor	140' & 300'
1000-2150	*	1-2 GHz receiver	140' & 300'
1030	P	IF Processor	140' & 300'
1050-1090	*	Cassegrain receiver	140'
1050-1200	*	2-4 GHz receiver	140'
1079-1121	*	7.8 GHz cooled receiver	140'
1100		Cassegrain receiver	140'
1150	P	IF Processor	300' usually
1220-1290	*	Cooled 21 cm receiver	140' or 300'
1222.5	*	13 cm VLB receiver	140'
1250	†	Temp. calibration receiver	Little Big Horn
1272.5	*	11 cm Receiver	140' or 300'
1300	P	Universal LO	140' & 300'
1300	P	Link to 45'	Interf. Tower
1300-1550	*	2-4 GHz receiver	140'
1317.5	P	Interferometer LO	Interf. Baseline
1347.4	P	Link from 45'	45'
1347.5	P	Interferometer LO	Interf. Baseline
1347.6	P	Link to 45'	Interf. Tower
1390-1630	*	Cooled 18 cm receiver	140' or 300'
1400	P	Hydrogen maser	140'
1475-1575	*	Cassegrain receiver	140'
1520-1590	*	Cooled 21 cm receiver	140' or 300'
1550		21 cm, 4-feed	300'
1560-1660	*	6 cm TRG receiver	140' or 300'
1560-1720	*	2-4 GHz receiver	140'
1650-1950	*	2-4 GHz receiver	140'
1669-1731	*	Cooled 2 cm receiver	140'
1690-1930	*	Cooled 18 cm receiver	140' or 300'
1700	P	Universal LO	140' & 300'
1720-1780	*	Cooled 3 cm receiver	140'
1823-1954	*	Cassegrain receiver	140'
2100-2400	*	2-4 GHz receiver	140'
2445	*	13 cm VLB receiver	140'
2545	*	11 cm receiver	140' or 300'
2600-3100	*	2-4 GHz receiver	140'
2695		11 cm, 3-feed	300'
2695	P	Interferometer receivers	85' - 1, 2, 3
3150-3270	*	Cassegrain receiver	140'
3300-3900	*	2-4 GHz receiver	140'
4400		Cassegrain receiver	140'
4680-5160	*	6 cm AIL receiver	140' or 300'
4680-4980	*	6 cm TRG receiver	140' or 300'
5050-10,550	*	5.4-10.4 GHz receiver	140'
5390	P	Interferometer receivers	85' - 1, 2, 3
5390		11 cm, 3-feed receiver	300'
6938	†	Interferometer 21 cm receiver	85' - 1, 2, 3
7550-7850	*	7.8 GHz cooled receiver	140'
8085	P	Interferometer receivers	85' - 1, 2, 3
10,000-10,340	*	1-2 GHz receiver	140'
10,320-10,680	*	Cooled 3 cm receiver	140'
10,612		Cassegrain receiver	140'
11,320-11,390	*	2-4 GHz receiver	140'
11,835		13 cm VLB receiver	140'
12,400-18,000	*	12.4-18 GHz line receiver	140'
13,350-13,850	*	Cooled 2 cm receiver	140'
16,170	P	Interferometer receiver	85' - 1, 2, 3
17,450-19,050	*	Cassegrain receiver	140'
17,500	P	Link from 45'	45'
19,150-20,150	*	Cassegrain receiver	140'
20,000-21,000		500-700, 740-1000 MHz receivers	140' or 300'
20,000-22,000	†	Tourist receiver	2'
20,200-20,400		Cooled 21 cm receiver	140' or 300'
20,600		6 cm AIL receiver	140' or 300'
20,815		21 cm, 4-feed receiver	140' or 300'
20,815	†	Interferometer 21 cm receiver	85' - 1, 2, 3
21,700		Cooled 18 cm receiver	140' or 300'
23,670		13 cm VLB receiver	140'
27,450		11 cm receiver	140' or 300'
31,400-35,600	*	5.2-10.4 GHz receiver	140'
31,835		Cassegrain receiver	140'
33,400		7.8 GHz cooled receiver	140'
39,700		6 cm TRG receiver	140' or 300'
40,000		Cooled 3 cm receiver	140'
41,900		Cooled 2 cm receiver	140'

P - ON SEMI-PERMANENTLY. * - MOVES AROUND DURING OBSERVING SESSION. † - INTERMITTENT USAGE.

INTERFERENCE POTENTIAL OF EQUIPMENT AT GREEN BANK

LISTING BY EQUIPMENT

Receiver	Signal on Cable	LO	Pump	Remarks
50- 80 MHz 110-250 MHz 250-500 MHz	None. None. None.	None. None. None.	None. None. None.	) IF Processor used as) frequency converter) for those receivers.
500-740	350-590, 650-890	350-590, 650-890	20-21 GHz	X2 downstairs.
740-1000	590-850, 890-1150	590-850, 890-1150	20-21 GHz	X2 downstairs.
100-1000	250-1150	250-1150	None.	X2 downstairs (if needed).
21 cm, 4-feed	1550	1550	20.215 GHz	
21 cm cooled	1220-1290, 1520-1590	1220-1290, 1520-1590	20.2-20.4 GHz	
18 cm cooled	1390-1630, 1690-1930	1390-1630, 1690-1930	21.7 GHz	
1-2 GHz	1000-2150 MHz	1000-2150	10.0-10.34 GHz	Set of four paramps.
2-4 GHz	1050-1200, 1300-1550, 1650-1950	2100-2400, 2600-3100, 3300-3900	11.23-11.39 GHz	Set of three multipliers and paramps.
2295 VLB	1222.5	2445	11,835 x 2	
11 cm, 3-feed	None.	2695	5390	2695 MHz oscillator locked to 134.75 MHz.
11 cm	1272.5	2545	27.45 GHz	
6 cm AIL	1560-1720	4680-5160	20.6 GHz	
6 cm TRG	1560-1660	4680-4980	39.7 GHz	
7.8 GHz cooled	1079-1121	7550-7850	33.4 GHz	
5.2-10.4 GHz	1000-1250	5050-10,550	31.4-35.6 GHz	Set of seven paramps.
3 cm cooled	1720-1780	10,320-10,680	40.0 GHz	
2 cm cooled	1669-1731 100	13,350-13,850 900	41.9 GHz	 2nd LO.
12.4-18 GHz	124-180 MHz	12,400-18,000	None.	Locked BWO LO.
Interferometer	30.0, 1317.5, 1347.5	1347.5	NA	Multiplexed X2,X4,X6,X12
		2695	5390	S-Band receiver
		8085	16,170	X-Band receiver
		1347.5	6930 x 3	21 cm receiver
	1300, 1347.6	NA	NA	Link to 45'
	17,500, 1347.4	NA	NA	Link from 45'
140' Cassegrain	1823-1970	17,450-19,250	NA	K-Band receiver.*
	1475-1575	19,150-20,150	NA	Ku-Band receiver.*
	100	1100 x 4	10,612 x 3	6 cm receiver.
	1080-1090	NA	3150-3270	18/21 cm receiver.*
Little Big Horn	NA	670 or 1250	NA	GR unit oscillator LO.
2' Tourist	NA	20,000-22,000	NA	

* 6 CM RECEIVER REQUIRED FOR IF AND 2ND CONVERSION.

OTHER SOURCES

(Above 15 MHz)

Equipment	Frequency	Remarks
VHF-FM Communications Transmitter	43.0	Mobile communications to 45-ft.
Autocorrelator — Mark II and Mark III	120.0 40.0 35.0	Crystal oscillators within RF enclosure.
IF Processor — 140-ft and 300-ft	100- 160 1000-1600 103 1030 115 1150	GR synthesizer. Multiplier and locked oscillator. Locked oscillator. Multiplier output. Crystal oscillator. Multiplier output.
Universal Local Oscillator	240-300 100 900, 1300, 1700	HP synthesizer. Locked oscillator) Frequency counter Multiplier output)
Hydrogen Maser — 140-ft	1400 90-100	1st LO Ionization oscillator.
Antenna Test Range	100 MHz - 90 GHz	Intermittent usage.

B. Licensed Transmitters Within the Radio Quiet Zone

When the radio controlled zone was authorized by the FCC and the IRAC in 1958, the NRAO started keeping records of all licenses issued within the area. Over the years some of the transmitters that were in existence before this time have been added to our records until at present the list is estimated to be about 97% complete. The computer printout of these licensed emitters is updated once each year, and copies are available to prospective observers; also, each telescope has at least one copy. The list includes pertinent technical parameters and a prediction of power density at Green Bank from each transmitter. Most of the transmitters are in point-to-point communications bands, FCC, or military aircraft bands, and broadcast bands. The list contains fixed licensed transmitters, other than amateur and citizen band, within the zone. A sample page from the report is attached.

However, stations outside the zone can also cause interference. In order to satistically sample band occupancy, a spectrum survey was made with wideband radiometers and a spectrum analyzer. This survey was made during the summer of 1971. The data is still indicative of signals actually observable at Green Bank. The survey covered the spectrum from 100 MHz to 4.0 GHz, and copies of this Electronics Division Internal Report No. 116 are available at all telescopes. A sample page from this report is attached. It should be pointed out that the attached page from the transmitter printout shows no licensed emitters between 172 MHz and 218 MHz within the Quiet Zone, and the page from the Green Bank survey shows several strong TV signals in the 204-216 MHz band.

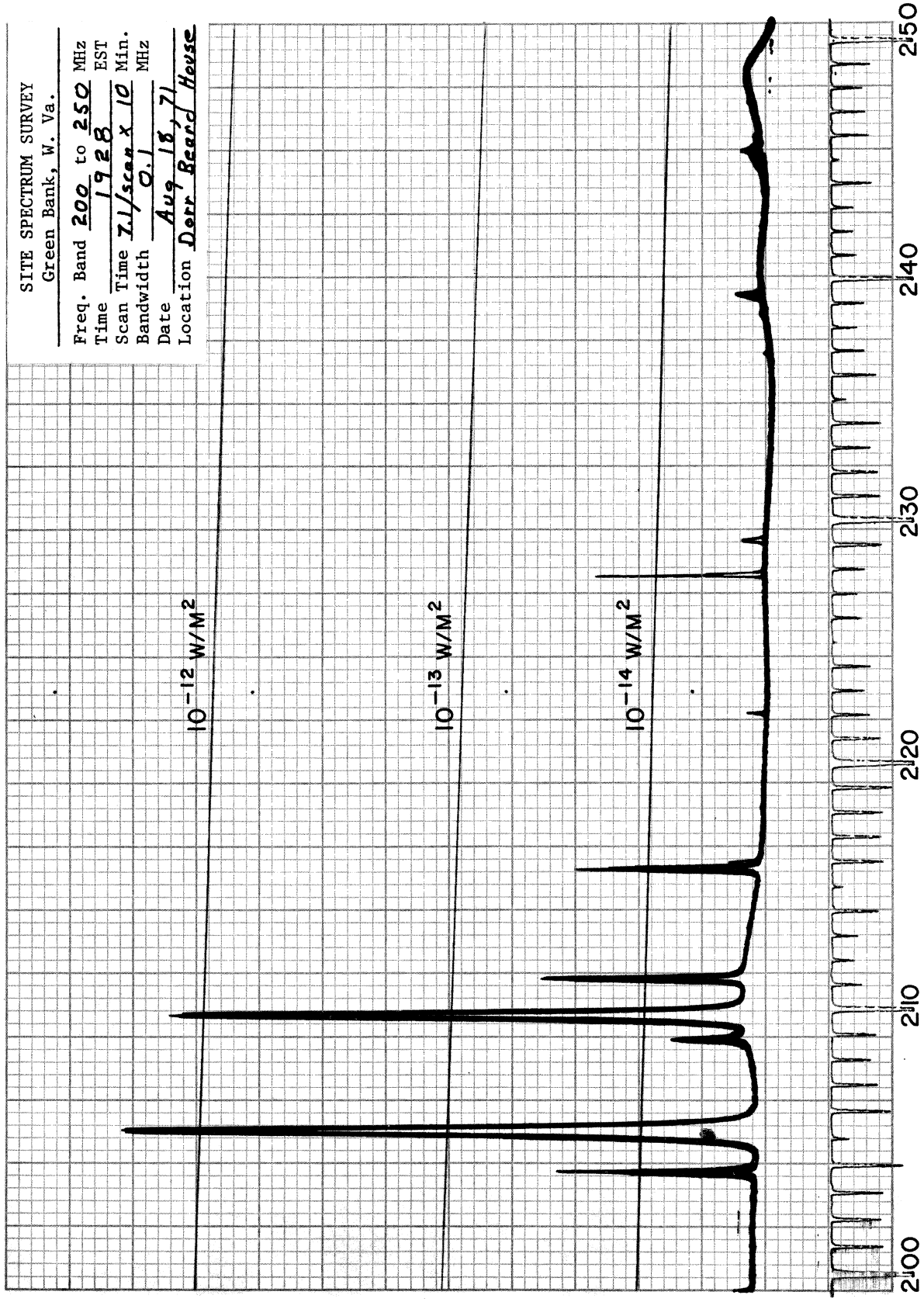
A brief description of the survey results follow.

From: National Radio Quiet Zone
Transmitter Print Out, 9/74.

GREEN BANK
INTERFERENCE QUICK LOOK
08/22/74

	STAT NO	STAT CALL	LONG	LATD	CODE	FREQUENCY	DATE	EMISN	POWER	DENSITY	AZH	DST	POWER DENSITY SPECTRUM EXPONENT -21 . . . . . -9
			CARD CONTENTS										
1151	610		8013 0	3732 0	1	0.172300E 09	7 68	16F3	0.5E 02	2.0E-15	199	105	. . . . * . 2 . . . . .
1152	640	NAVY	79 4 0	38 9 0	1	0.218000E 09	06 57	M2P0	0.2E 07	2.0E-19	115	74	. . 2 . * . . . . .
1153	1099		794415	391650	1	0.252400E 09	03 67		0.1E 03	9.0E-21	5	94	.9. . . * . . . . .
1154	641	FAA	7952 0	3853 0	1	0.255400E 09	11 53	6A3	0.1E 03	1.0E-19	358	49	. . 1 . * . . . . .
1155	1343		80 558	385452	1	0.258000E 09	03 71	06A3	0.1E 03	2.0E-19	338	57	. . 2 . * . . . . .
1156	642	FAA	7945 0	38 6 0	1	0.263100E 09	01 62	6A3	0.1E 03	2.0E-15	111	102	. . . . * . 2 . . . .
1157	643	FAA	7911 0	3748 0	1	0.269200E 09	12 61	6A3	0.1E 03	4.0E-15	141	91	. . . . * . .4. . . .
1158	644	FAA	7844 0	38 6 0	1	0.279600E 09	12 57	6A3	0.1E 03	6.0E-22	111	103	. . . . - . . . . .
1159	645	FAA	7844 0	38 6 0	1	0.301400E 09	01 58	6A3	0.1E 03	4.0E-22	111	103	. . . . - . . . . .
1160	1362		784437	38 615	2	0.319000E 09	08 71	06A3	0.1E 03	2.0E-15	111	102	. . . . * . 2 . . . .
1161	646	FAA	7845 0	38 6 0	1	0.321300E 09	12 61	6A3	0.1E 03	2.0E-15	111	102	. . . . * . 2 . . . .
1162	1586		802412	375118	2	0.330800E 09	01 74	0.3A9	0.4E 01	2.0E-17	219	81	. . . . 2 . . . . .
1163	1579		7854 6	381535	2	0.332600E 09	12 73		0.4E 01	1.0E-18	103	83	. . . 1 * . . . . .
1164	1363		784437	38 615	2	0.346000E 09	08 71	06A3	0.1E 03	2.0E-15	111	102	. . . . * . 2 . . . .
1165	647	FAA	7911 0	3748 0	1	0.353900E 09	12 61	6A3	0.1E 03	3.0E-15	141	91	. . . . * . 3 . . . .
1166	648	FAA	7845 0	38 6 0	1	0.380300E 09	12 61	6A3	0.1E 03	2.0E-15	111	102	. . . . * . 2 . . . .
1167	649	KQC300	7951 0	3855 0	1	0.411300E 09	69	36F3	0.6E 02	1.0E-19	360	53	. . 1 . * . . . . .
1168	730	KQC300	7943 0	3857 0	1	0.415300E 09	69	36F3	0.6E 02	6.0E-22	10	57	. . . . - . . . . .
1169	1387		795059	385533	1	0.417000E 09	01 72	16F3	0.4E 01	1.0E-19	360	54	. . 1 . * . . . . .
1170	1528		7911 0	374740	1	0.417500E 09	04 73	100F9	0.1E 02	7.0E-18	141	91	. . . .7* . . . . .
1171	1386		795059	385533	1	0.418000E 09	01 72	16F3	0.3E 02	1.0E-19	360	54	. . 1 . * . . . . .
1172	1408		783751	3836 5	5	0.450000E 09	06 72	36F3	0.7E 00	2.0E-19	80	106	. . 2 . * . . . . .
1173	1513		783757	3836 5	6	0.450000E 09	03 73	36F3	0.7E 00	1.0E-18	80	106	. . . 1 * . . . . .
1174	388	KBG24	7854 2	374752	9	0.451000E 09	10 60	20F3	0.6E 02	2.0E-20	131	108	. 2 . . * . . . . .
1175	1300		79 433	38 9 2	6	0.451000E 09	07 70	20F3	0.1E 02	1.0E-19	115	73	. . 1 . * . . . . .
1176	872	KJ096	802037	383015	9	0.451100E 09	02 64	40F3	0.5E 03	5.0E-12	281	44	. . . . * . . . .5. . .
1177	30	KQE65	794239	385613	9	0.451200E 09	06 52	40F3	0.5E 03	3.0E-16	11	56	. . . . * 3 . . . . .
1178	157	KIB83	7938 1	374915	9	0.451500E 09	04 50	20F3	0.4E 02	1.0E-19	165	70	. . 1 . * . . . . .
1179	1033	KPU26	792140	3732 0	9	0.451600E 09	11 66	40F3	0.2E 03	8.0E-21	157	108	.8. . . * . . . . .
1180	206	KJD46	791115	373415	7	0.451800E 09	01 60	40F3	0.2E 03	3.0E-16	149	111	. . . . * 3 . . . . .
1181	334	KJB70	791115	373415	7	0.451900E 09	06 59	40F3	0.6E 03	3.0E-16	149	111	. . . . * 3 . . . . .
1182	873	KJE20	791115	373415	7	0.451900E 09	03 60	20F3	0.2E 03	3.0E-16	149	111	. . . . * 3 . . . . .
1183	875	KRD59	79 440	385914	7	0.451900E 09	11 64	40F3	0.2E 03	4.0E-20	47	89	. .4. . * . . . . .
1184	427	KDH70	783757	3836 6	7	0.451900E 09	02 62	40F3	0.6E 03	2.0E-18	80	106	. . . 2 * . . . . .
1185	1522		79 250	383610	6	0.453000E 09	04 73	20F3	0.2E 03	3.0E-17	75	71	. . . . 3 . . . . .
1186	789	KVR95	791110	373330	4	0.453000E 09	02 65	20F3	0.2E 03	3.0E-23	150	113	. . . . - . . . . .
1187	502	KQJ94	802644	374812	8	0.453300E 09	04 58	40F3	0.6E 03	2.0E-15	218	88	. . . . * . 2 . . . .
1188	877	KIC66	79 250	38 937	8	0.453900E 09	08 50	40F3	0.5E 03	1.0E-18	114	75	. . . 1 * . . . . .
1189	878	KIY804	783757	3836 5	5	0.455000E 09	05 63	10F3	0.2E 02	2.0E-18	80	106	. . . 2 * . . . . .
1190	1409		785434	382712	5	0.455000E 09	06 72	36F3	0.2E 02	2.0E-18	89	80	. . . 2 * . . . . .
1191	1411		782458	382844	5	0.455000E 09	06 72	36F3	0.2E 02	2.0E-18	87	123	. . . 2 * . . . . .
1192	389	KBG25	785251	374516	9	0.456000E 09	10 60	20F3	0.6E 02	1.0E-20	132	113	. 1 . . * . . . . .
1193	879	KJ097	802459	382842	9	0.456100E 09	02 64	40F3	0.5E 03	1.0E-11	276	50	. . . . * . . . . 1 . .
1194	1175	KYU56	79 311	38 755	9	0.456100E 09	10 67	20F3	0.2E 03	2.0E-19	116	76	. . 2 . * . . . . .
1195	154	KQE64	7951 0	385533	9	0.456200E 09	06 52	40F3	0.5E 03	1.0E-19	360	54	. . 1 . * . . . . .
1196	158	KIB82	792737	374730	9	0.456500E 09	04 50	20F3	0.4E 02	3.0E-20	155	79	. 3 . . * . . . . .
1197	1027	KPU25	791115	373415	9	0.456600E 09	11 66	40F3	0.2E 03	3.0E-16	149	111	. . . . * 3 . . . . .
1198	880	KDH69	784057	383842	7	0.456900E 09	02 62	40F3	0.6E 02	9.0E-20	77	102	. .9. . * . . . . .
1199	1248	KBV71	801712	38 520	7	0.456900E 09	06 51	20F3	0.4E 02	6.0E-14	226	55	. . . . * . . .6. . . .
1200	194	KRD60	79 7 6	3859 2	7	0.457000E 09	11 66	40F3	0.6E 03	1.0E-20	46	87	. 1 . . * . . . . .

From: Electronics Division Internal Report No. 116,
"Green Bank Environmental Spectrum Survey: Summer 1971".



1) 100-108: Commercial FM; no chance to observe.

2) 108-118: Radio location omni; possible to observe narrow band between transmitters.

3) 118-137: VHF aircraft, air-to-ground, ground-to-air. Very strong signals; no chance for effective observations.

4) 137-148: Government, 2-meter amateur band. Possible to observe on some frequencies; very little 2-meter amateur activity in the area. Bands should be kept narrow and tunable.

5) 148-200: Includes point-to-point communications bands and commercial television. Small chance of observations. Lots of spurious TV signals make measurements risky.

6) 200-250: More TV up to 216 MHz.

220-225 -- 1 1/4 meter amateur band should be good spot to observe; no amateur activity in this area.

225-250 -- fixed mobile; not much activity here; may be possible to observe with narrow bandwidth and tunable front-end.

7) 250-375: Mostly government band, with some aircraft. It may be possible to observe with selected bands and tunable front-end. Some aircraft activity and point-to-point communications.

8) 375-500: Fixed and mobile, and some meteorological aids around 400 MHz.

406.1-410 -- allocated to radio astronomy. May be possible to observe in 410-470 MHz region, but 450-470 MHz is heavily assigned.

470 -- beginning of UHF TV channels. Channel 15 is at Roanoke, Virginia and exceeds 10^{-12} W/m^2 at Green Bank.

9) 500-1000: TV broadcast to 806 MHz. Channel 37 (608-614 MHz) can be used for radio astronomy for the present. The remainder of the band is doubtful because of TV assignments outside the zone. It may be possible to select a band that is not assigned near Green Bank. This would have to be done on an individual basis.

10) 1000-2000: DME-TACAN on 1.1 GHz $\pm$ 100 MHz. Avoid this area; these aircraft signals make observing virtually impossible.

1200-1350 -- considerable radar signals in this area. Possible to observe only under carefully controlled conditions. Some satellite signals just above radio astronomy band, extending up to 1700 MHz. Also radiosondes around 1680 MHz. SMS series satellites centered around 1681 MHz with sidebands extending through the 1660-1670 MHz band.

1800-2000 -- mostly government; may be possible to observe under controlled conditions.

11) 2000-4000: Regular observations carried out on 2695 MHz (11 cm) and 3100 MHz (9 cm). Some trouble with ATS series satellites but not expected to be permanent -- at present only about 2 to 3 hours per week. Not much known about remainder of band, but it should be possible to observe relatively interference-free in selected areas.

C. Other Sources of Interference

The potential interfering signals discussed in the preceding paragraphs are intended, man-made signals of one type or another. Possibly the more troublesome type of interference is unintended radiation from various sources, particularly in the range from 100 to 1000 MHz. Interference from commercial power lines, oscillating TV boosters, gasoline engine ignition systems, defective switches, relays, etc., adinfinitum, are definite possibilities.

An effort is made to keep local sources suppressed, but astronomers and operators should report instances of this type of interference to the Electronics Division.

ADDENDUM

NATIONAL RADIO ASTRONOMY OBSERVATORY

INTERFERENCE POTENTIAL AT GREEN BANK, WEST VIRGINIA

BANDS WHERE OBSERVATIONS ARE SUBJECT TO INTERFERENCE:

88	-	108 MHz	.....	FM commercial.
118	-	137 MHz	.....	VHF communications bands.
174	-	216 MHz	.....	Commercial VHF TV.
240	-	250 MHz	.....	Wideband computer noise.
470	-	590 MHz	.....	Commercial UHF TV.
1000	-	1200 MHz	.....	DME, TACAN, Elkins radar 1179 MHz.
1275	-	1325 MHz	.....	Radar.
1300	±	1 MHz	.....	Interferometer link.
1347.5	±	1 MHz	.....	Interferometer link.
1683	±	5 MHz	.....	SMS satellites, radiosondes.
2660	±	30 MHz	.....	ATS-6 satellite.
17500	±	1 MHz	.....	Interferometer link.

BANDS WHERE OBSERVATIONS MAY BE MADE UNDER CONTROLLED CONDITIONS:

108	-	118 MHz		
137	-	174 MHz		
216	-	470 MHz		
590	-	1000 MHz	.....	UHF TV. (Some channels available on high end.)
1200	-	1275 MHz	.....	Airport radar at 1209 MHz.
1275	-	2000 MHz		
2000	-	4000 MHz		
4000	-	8000 MHz	.....	Common carrier: 4000 MHz ± 300 MHz. Satellite : 6100 ± 300 MHz, 7300-7750 MHz.
8600	-	16000 MHz	.....	Satellites around 8000-8400 MHz and 11.7-12.2 GHz. Airborne radar 9.0-9.2 GHz.
16000	-	25000 MHz	.....	Interferometer link at 17.5 GHz.

BANDS PRESENTLY USED OR THAT HAVE BEEN USED SUCCESSFULLY:

Frequency	Bandwidth	
144 MHz	1 MHz	
184 MHz	1 MHz	
236 MHz	1 MHz	
258 MHz	3 MHz	
321.5 MHz	10 MHz	
394 MHz	10 MHz	
440 MHz	3 MHz	
515.5 MHz	3 MHz	(between TV video and audio)
610 MHz	10 MHz	
770 MHz	10 MHz	
835 MHz	10 MHz	
920 MHz	10 MHz	
970 MHz	10 MHz	

Plus all allocated radio astronomy bands to 40 GHz.

For detailed information, refer to Electronics Division Internal Reports Nos. 116, 147, 155, and 159. For information on licensed transmitters, see "National Radio Quiet Zone Transmitter Printout" (updated each year). It should be noted that below about 500 MHz local power distribution lines are an intermittent problem, and on-line computers can cause interference to local and adjacent instruments, particularly in the 240-250 MHz band. It is the observer's responsibility to inquire about these problems. Contact Jim Dolan, NRAO, Green Bank (304-456-2011, ext. 203).