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A survey of the interference in the 13 and 20cm bands at the ATCA

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Summary

To investigate the possibilities of very wide bandwidth observations and multi-frequency synthesis at 13 and 20 cm we have scanned these two bands for interference. In the 20 cm band there is wide-band interference (GLONAS), two strong spikes (GPS) and various spikes across the band. A more sensitive scan of the best region, from 1320 MHz to 1460 MHz, shows wide band (~ 8–16 MHz) interference at much lower levels, but still well above the thermal noise in a 10s integration in standard continuum observations. The 13 cm band is relatively clean, except for four very strong, narrow spikes. These divide the band up, so there is no clean 128 MHz region.

Observations

The ATCA observations were made in the period 16–18 May, 1992 at several times to check for variations. We used antennas 1 and 2 (baseline 107 m) and phase tracked the south pole (i.e. no fringe rotation) while pointing the antennas in different directions. For most observations antenna 1 pointed at (Az,El)=(120°,85°) and antenna 2 at (Az,El)=(60°,85°), therefore no astronomical signals are present.

We observed with 64 MHz bandwidth and 1024 channels, 512 of these are independent, giving a resolution of 125 kHz. The bands were scanned by stepping in frequency by 32 MHz every 2 minutes, yielding a complete scan in about half an hour. In the 20 cm band we observed from 1248 MHz to 1760 MHz and in the 13 cm band from 2240 MHz to 2624 MHz.

Results

We show the results of the scans in figs. 1–10 and will discuss some details here. The plots show log(1 + ampl.) against frequency, the vertical scale gives only a rough estimate of the relative strengths because of occasional bad sampler statistics. The setup of the individual observations is given in Table 1.

Figs. 1–5 show the 13 cm band. Fig. 1 is a filtered version of fig. 2 with somewhat suppressed sidelobes. The four main spikes are all narrow band signals (i.e., the width in the plot is artificial) as can be seen in Fig 5., where the region with the peak at 2555 MHz has been filtered in the complex domain to remove the sidelobes. The spikes are located at resp. 2345, 2430, 2492.5, and 2555 MHz. Fig. 3 shows the effect of switching on the microwave oven in the lodge. The interference is fairly stable in time, only the smaller peaks around 2250 MHz show significant changes.

Figs. 6–12 show the 20 cm band. Fig. 6 is again a filtered version. Fig. 7-9 show the variations with time. Fig. 9 and 10 show the results of pointing the dishes at each other and pointing antenna 2 at 1, while 1 looks at the zenith. Changes in the interference levels are visible between these tests, but both fig. 9 and 10 are influenced by an increased system temperature. Comparison is further complicated because the external interference (GPS, GLONAS) changes on very short timescales, both in strength and position. The main peaks are located at 1275-1282, 1408, 1458, 1478, 1503, 1687, 1691 and 1694 MHz, with strong, variable broadband interference from 1520–1620 MHZ and weaker broadband emission around 1680, 1720 and 1750 MHz.

A long observation of the 1320–1420 region (fig. 12) shows the presence of weak broadband interference there as well.

For the 20 cm band there seems to be no hope for detection of HI at redshifts beyond $z = 0.09$. The possibilities for multi-frequency synthesis are very limited as there is only one reasonably clear region (1330–1450 MHz) for a 128 MHz band. A 64 MHz band could be placed around 1650 MHz.

In the 13 cm band the region above 2280 MHz is generally very clean, with interference concentrated in four strong and two weaker narrow spikes. If these could be tracked down and eliminated an 8% frequency difference between two clean 128 MHz bands would be available.

The results presented here show the worst case effects of interference, i.e., a short baseline and no fringe rotation. For long baselines and sources not too close to the pole, the interference will be much weaker and often even undetectable. However, the interference will show up for hour angles around $\pm 6^h$ and extensive editing of the short baselines may be required.

Table 1. Observations

Band	No.	Date/Time(UT)	Az(Ant 1)	El (Ant 1)	Az (Ant2)	El (Ant 2)
20cm	1	92-05-16 08:27	120	85	60	85
20cm	2	92-05-16 12:03	120	85	60	85
20cm	3	92-05-17 00:10	120	85	60	85
20cm	4	92-05-17 05:39	270	13	90	13
20cm	5	92-05-17 06:18	270	13	90	89
13cm	1	92-05-16 13:12	120	85	60	85
13cm	2	92-05-16 14:59	120	85	60	85
13cm	3	92-05-16 15.30	120	85	60	85

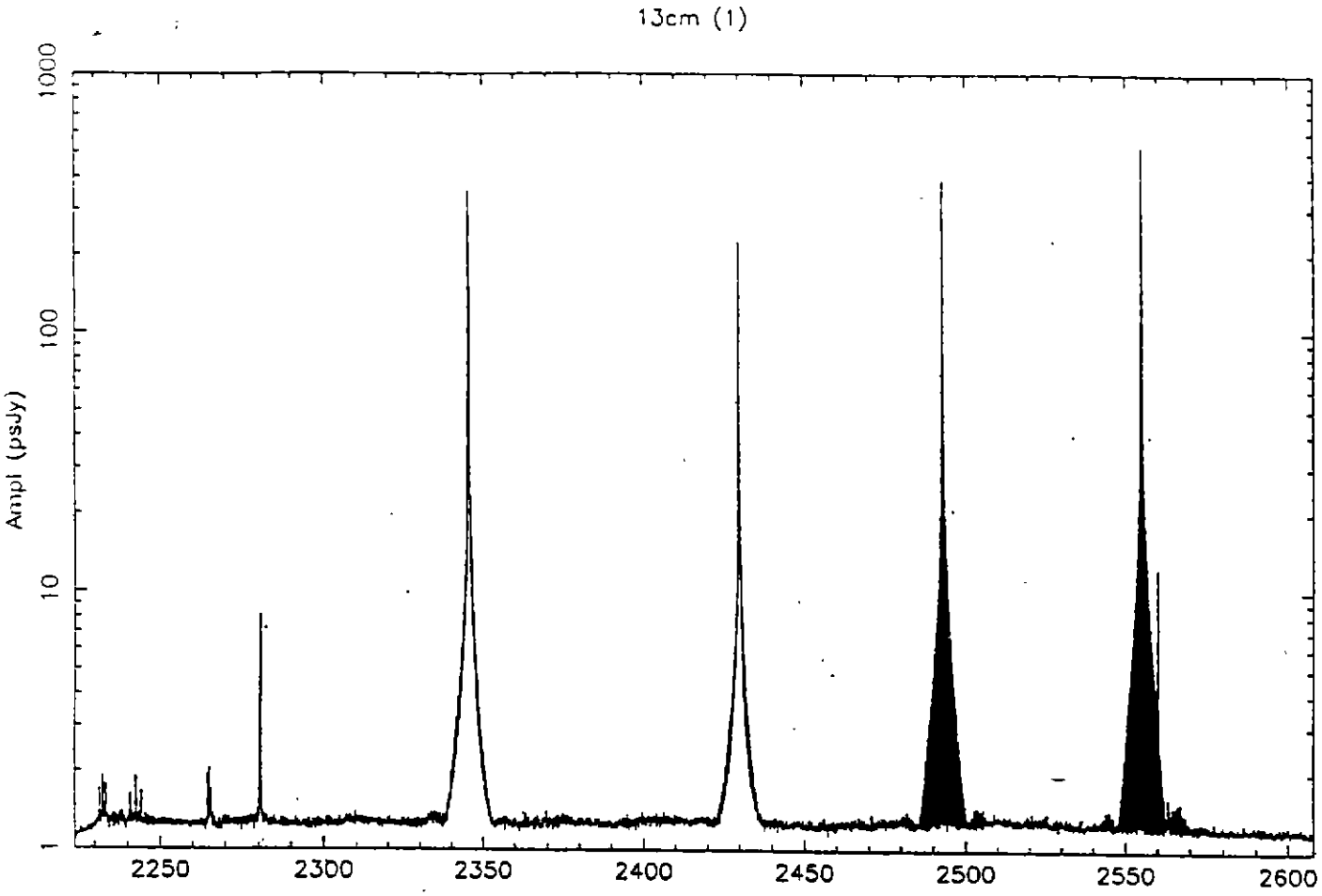


Figure 2

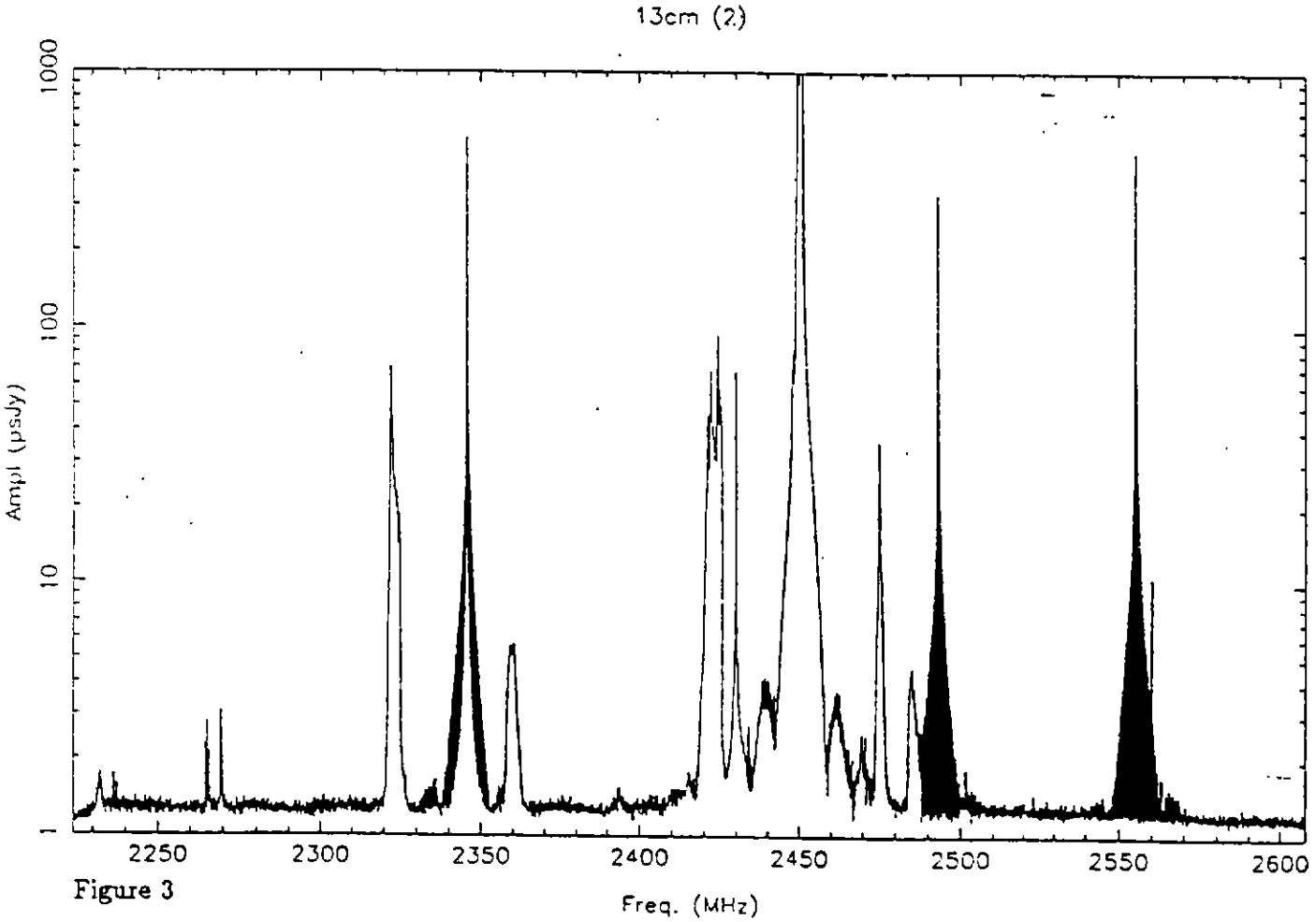


Figure 3

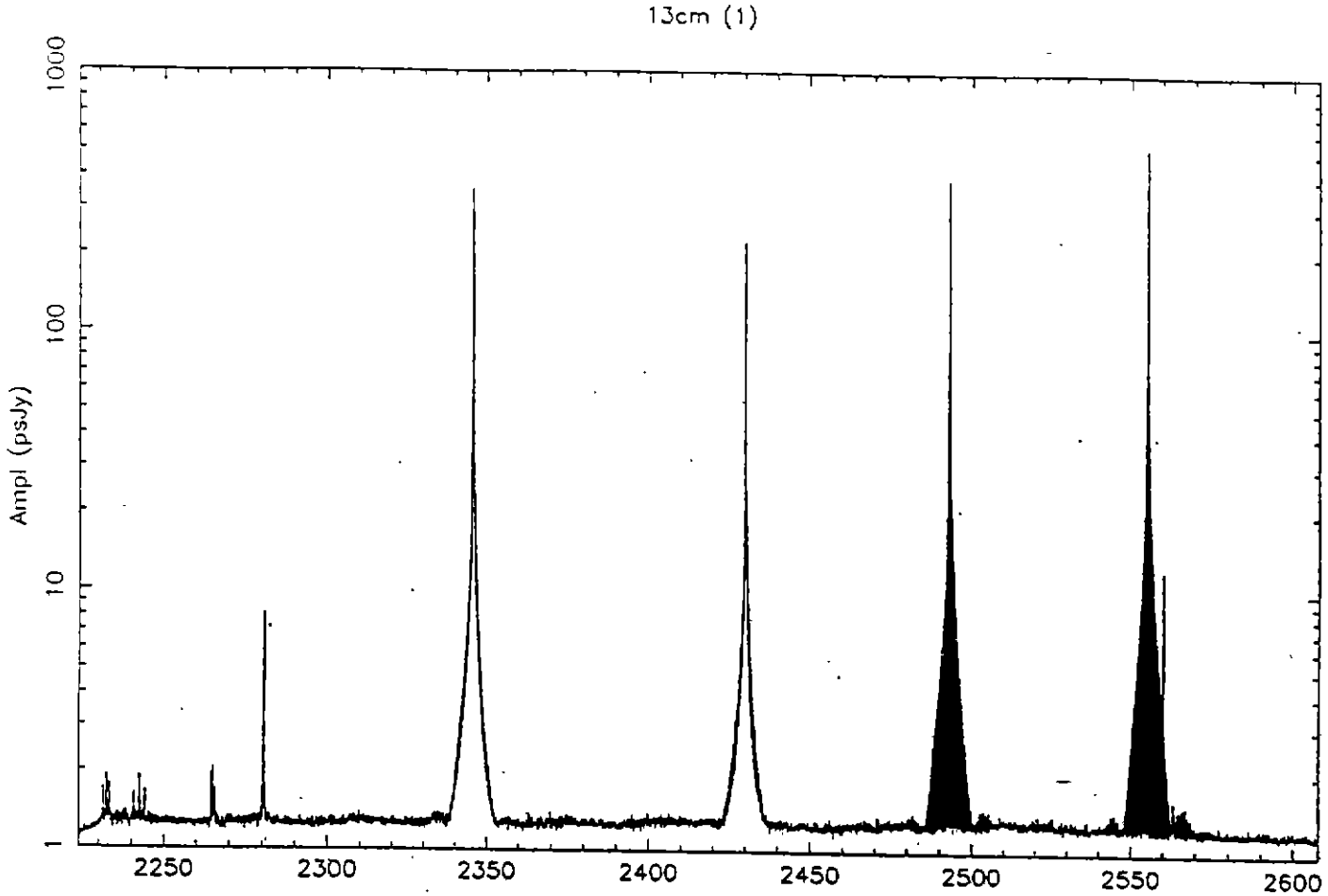


Figure 2

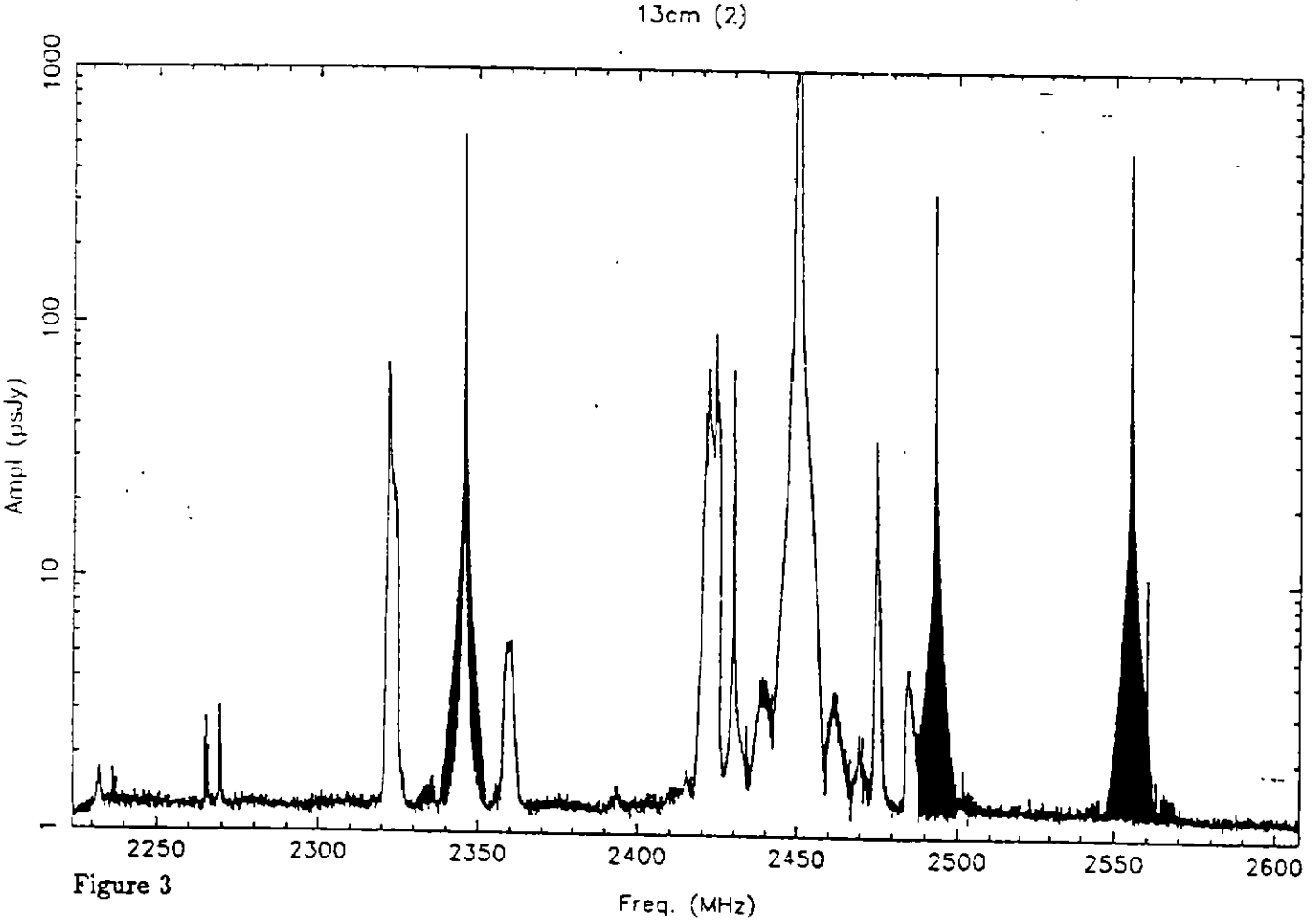


Figure 3

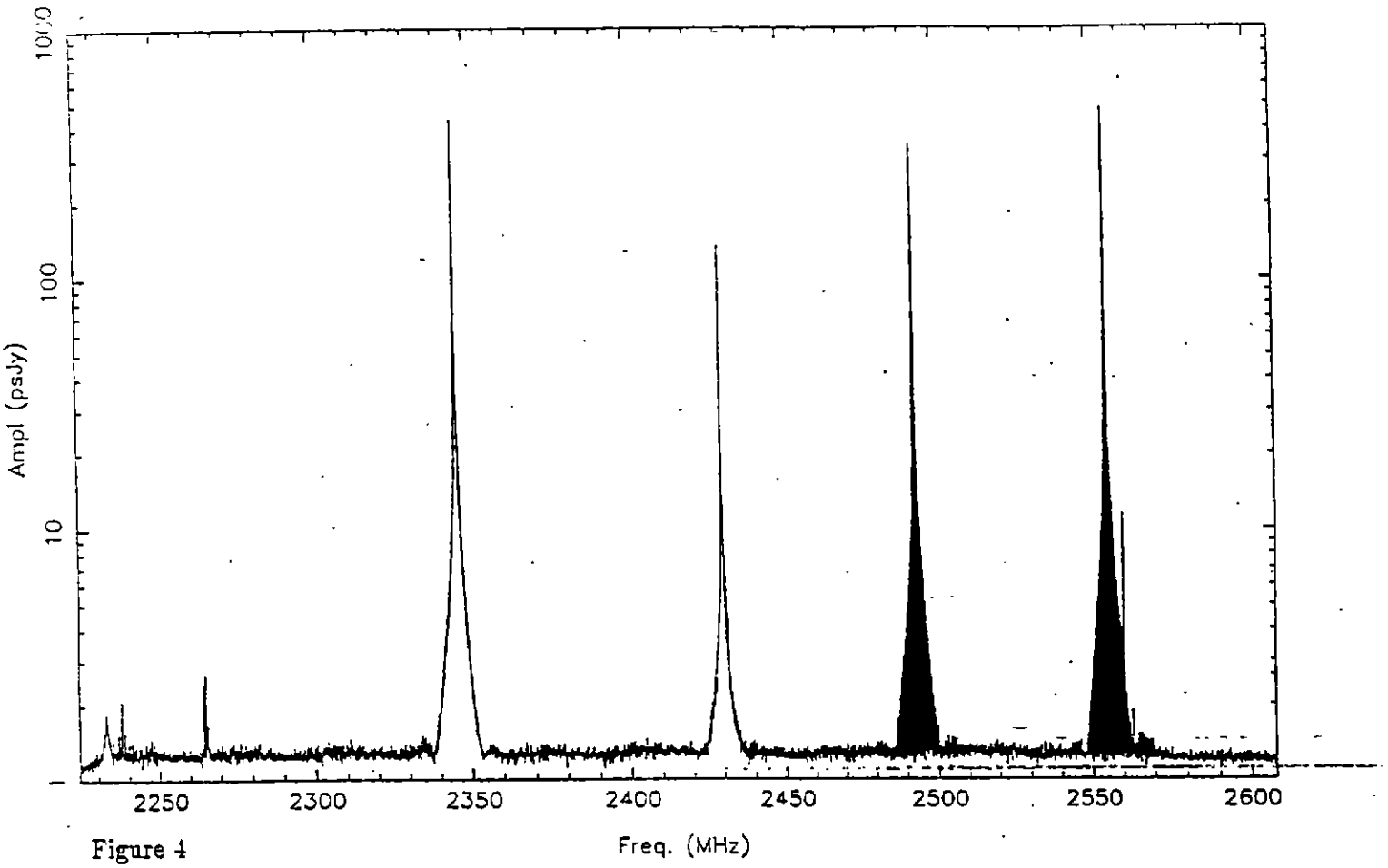


Figure 4

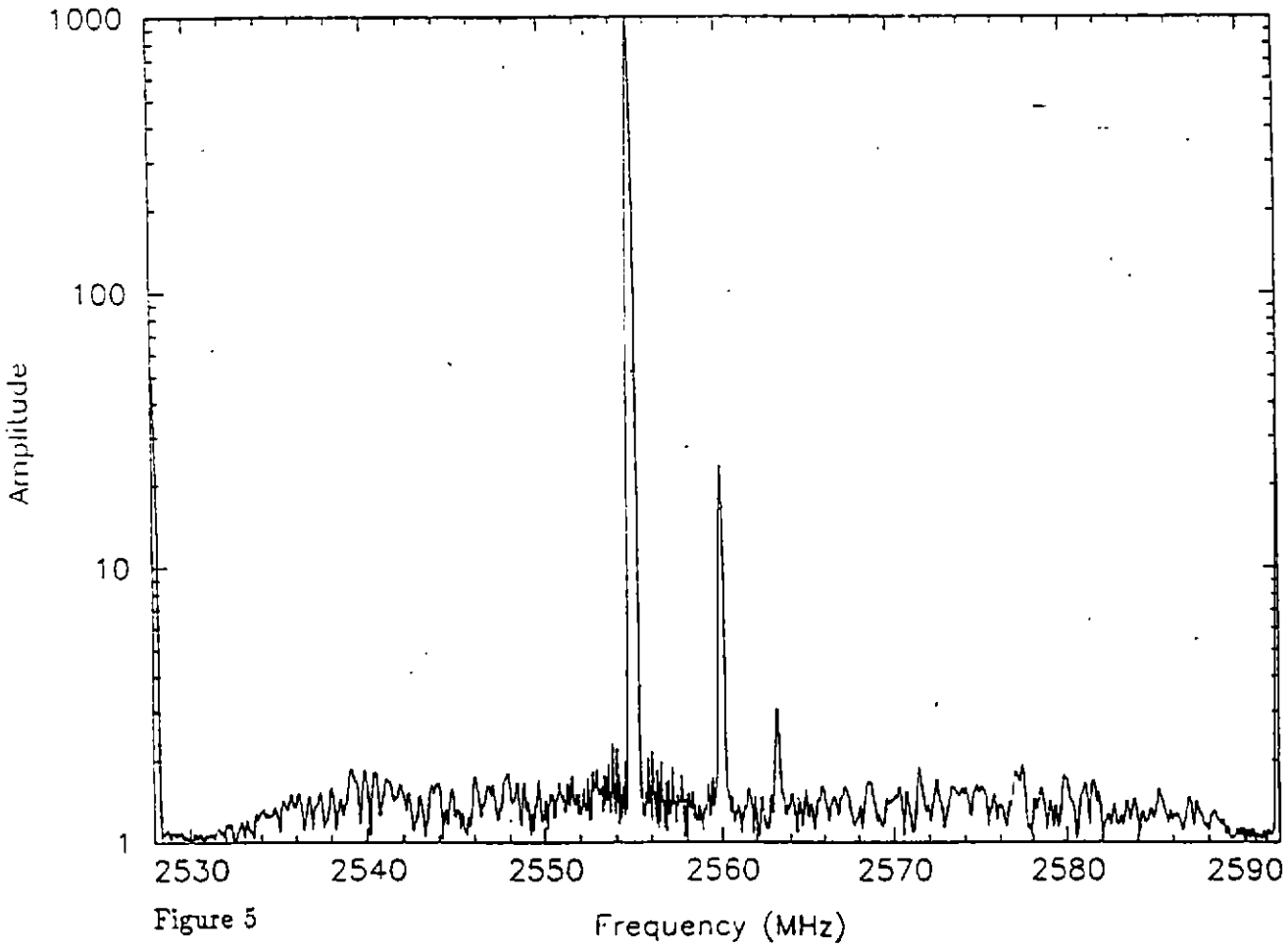
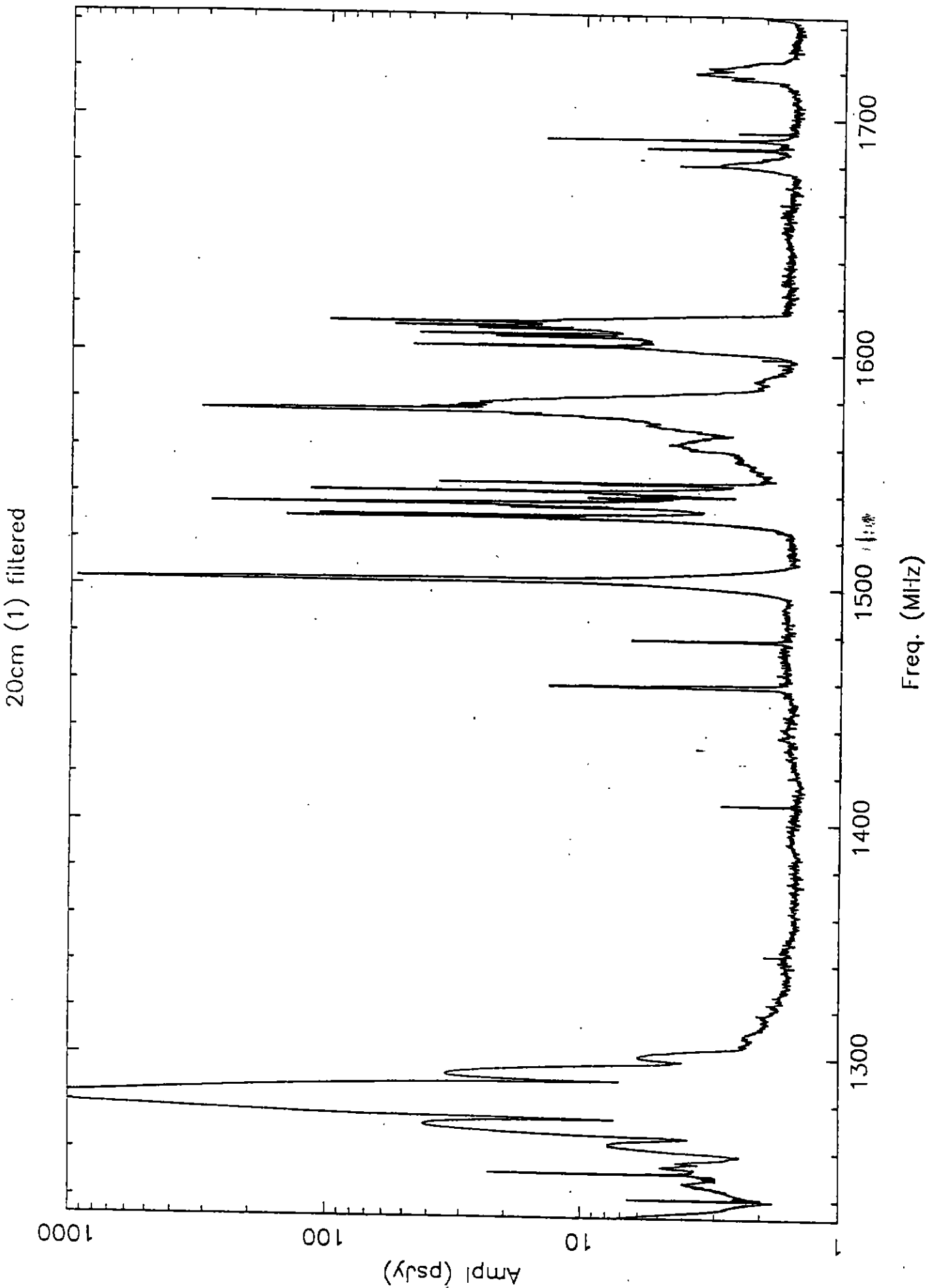


Figure 5

Figure 6


20cm (1) filtered
Ampl (psJy)
1000
100
10
1
1300
1400
1500
1600
1700
Freq. (MHz)

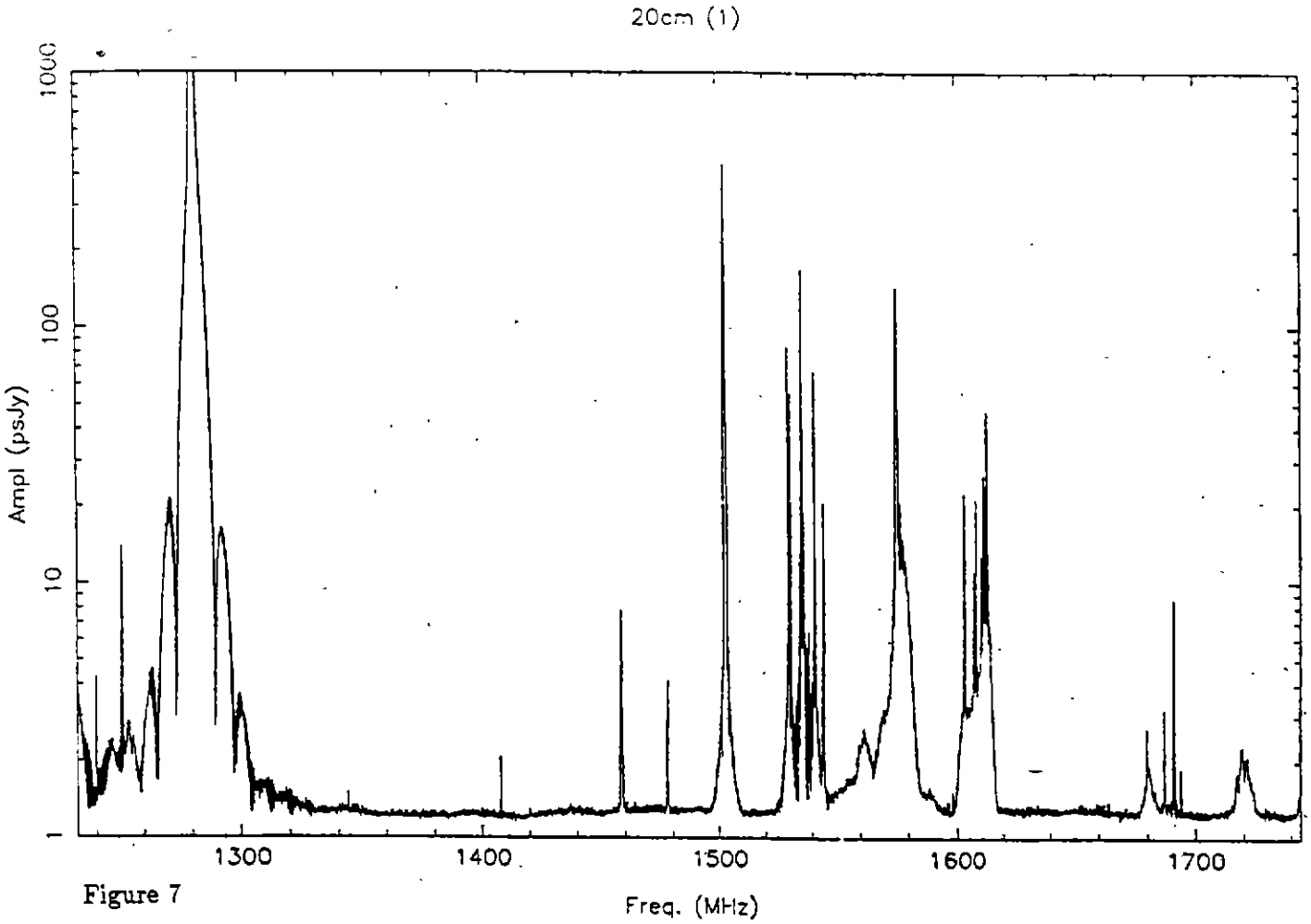


Figure 7

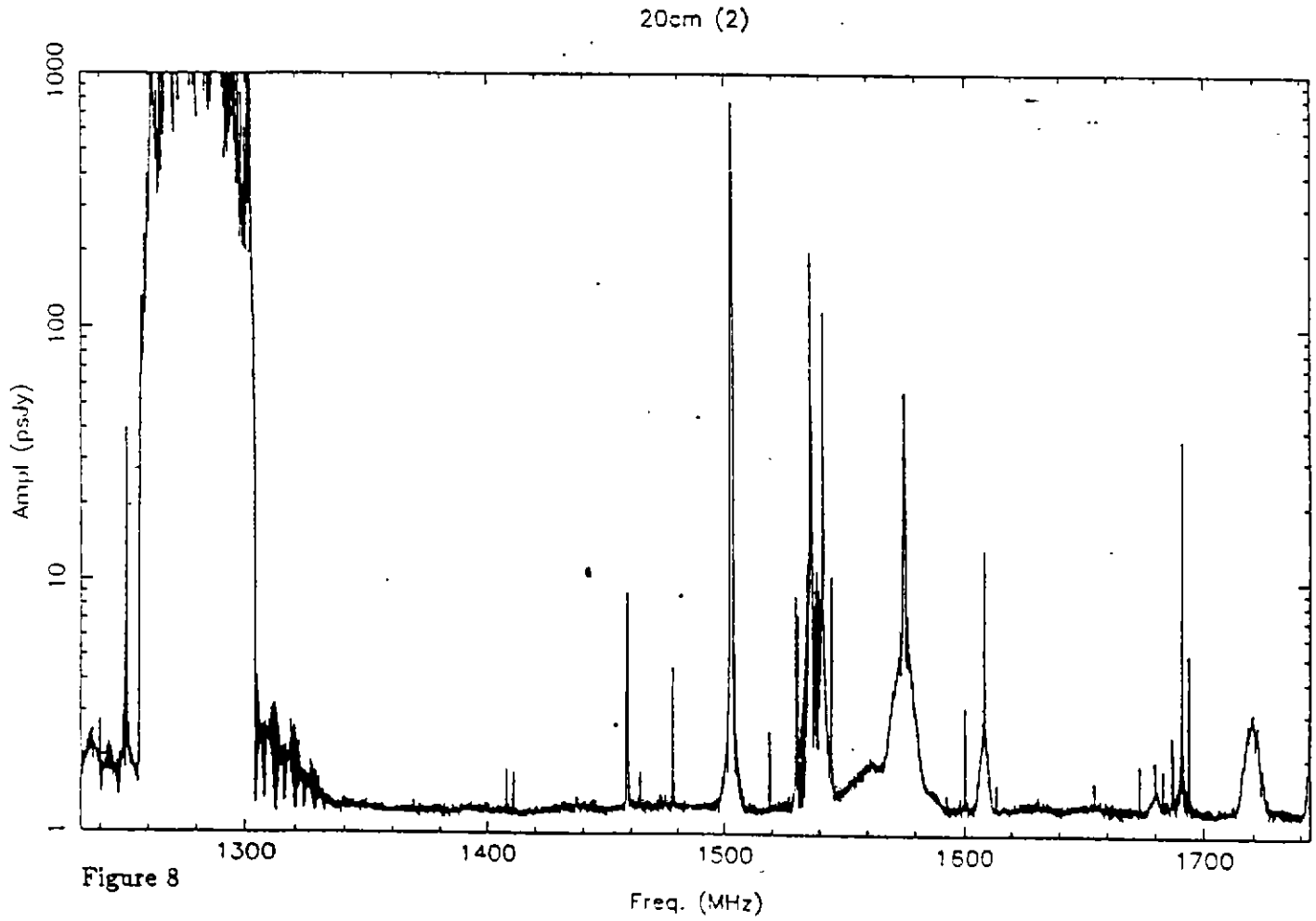


Figure 8

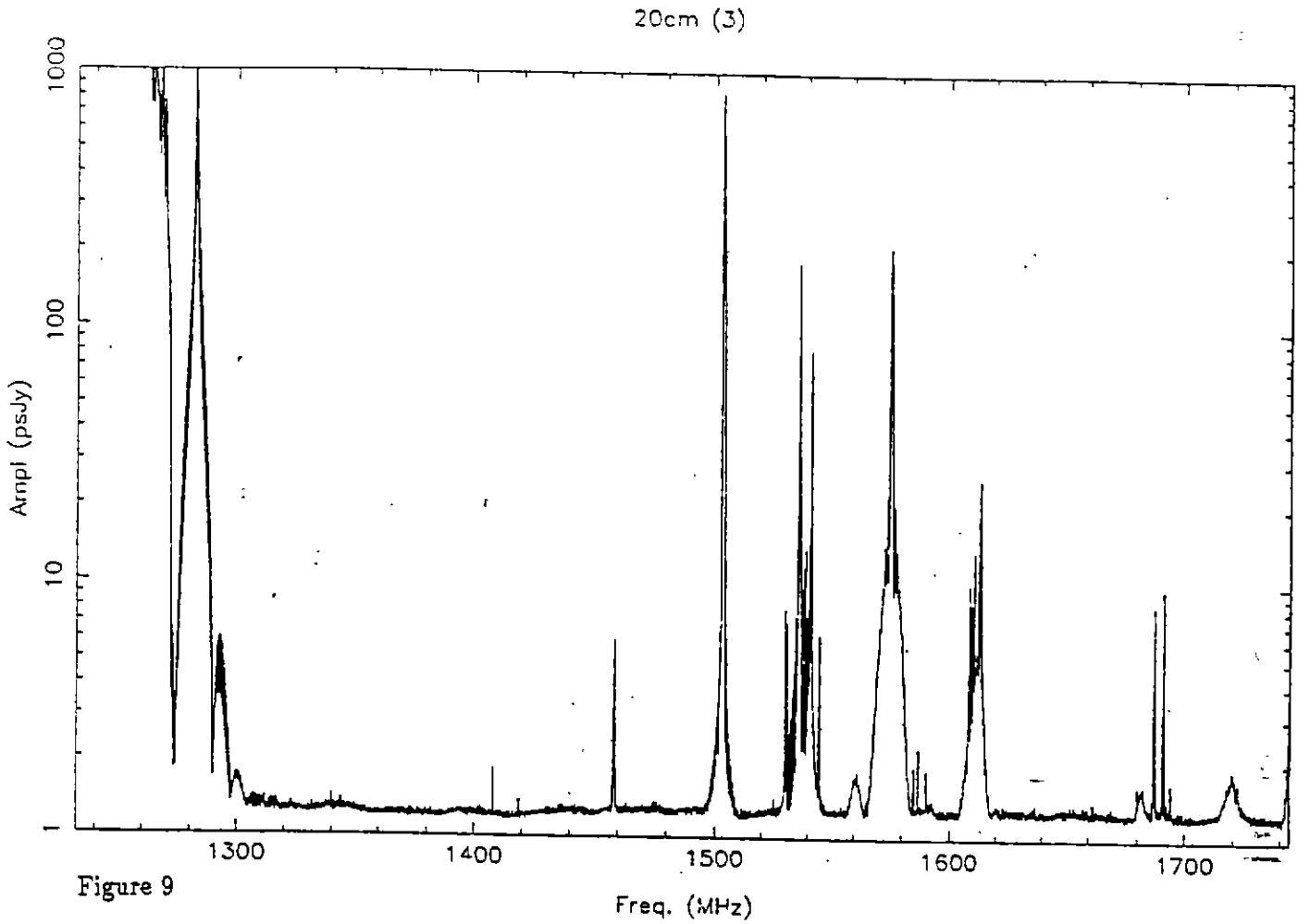


Figure 9

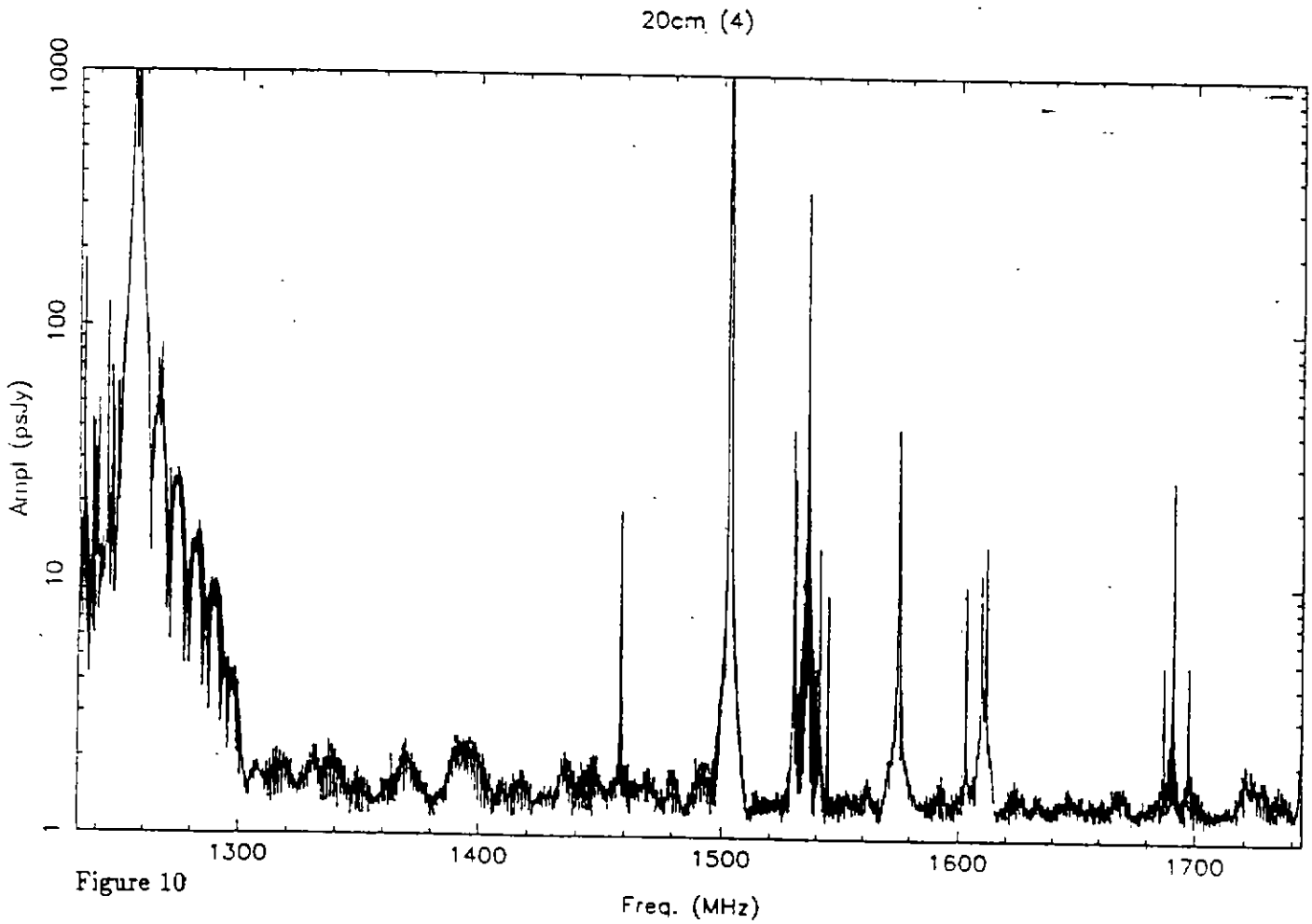


Figure 10

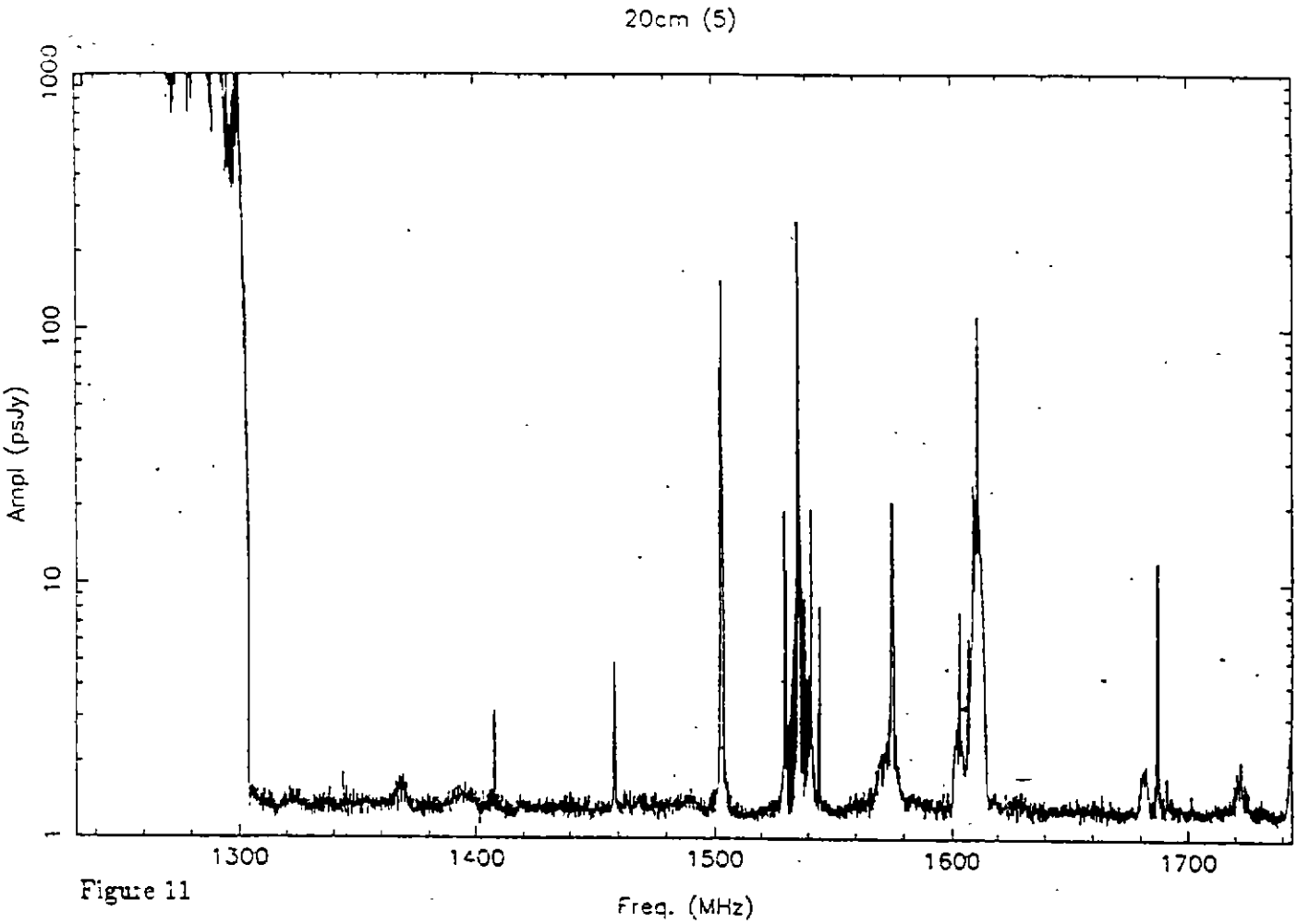


Figure 11

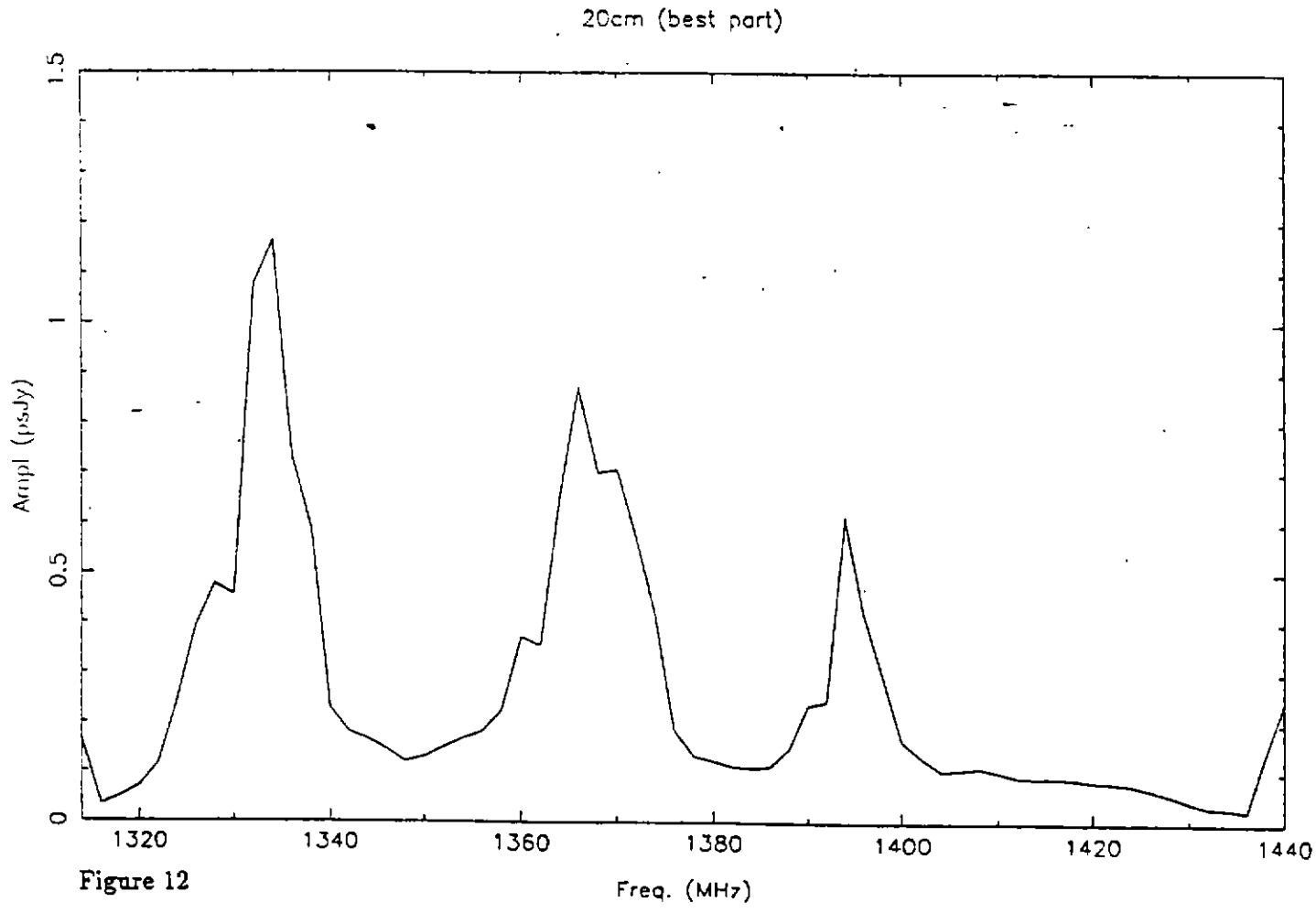


Figure 12