Astron. Astrophys. 141, 376–382 (1984)

ASTRONOMY AND ASTROPHYSICS

A 4850 MHz survey of a part of the "GB region" and the combined counts of sources

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Received February 27, accepted May 21, 1984

Summary. The results of a survey of a part of the "GB region", made at a frequency of 4850 MHz are presented. This region had been surveyed earlier at a frequency of 1400 MHz. The present survey includes 99 sources above a limiting flux density of 0.030 Jy in a solid angle of 9.18 10^{-3} sterad. Two-point spectral indices for sources selected at 1400 and 4850 MHz are derived and discussed. The combined source counts of the present and other MPIfR-NRAO surveys near 5 GHz are presented, in tabular and graphical form. Power-law representations of the combined source counts are derived.

Key words: radio survey – source counts – spectra of sources – GB area

1. Introduction

This paper is the third in a series dealing with sensitive surveys of extragalactic sources at a frequency of 4850 MHz. In our previous two papers (Maslowski, Pauliny-Toth, Witzel and Kühr 1980, 1984; hereinafter referred to as $MPWK_1$ and $MPWK_2$, respectively) we have presented and discussed the results of two such surveys. These surveys overlap the 5C6 area (Pearson and Kus, 1978) and the 5C2 area (Pooley and Kenderdine, 1968) and are complete to flux density limits of 0.02 and 0.017 Jy respectively. They permitted a better determination of the number-flux density relation for weak sources at a high frequency and provided high-frequency spectral information for the sources detected.

In this paper, we report the results of a survey at 4850 MHz of a part of the GB area, to a limiting flux density of 0.030 Jy. The GB area, originally surveyed by Maslowski (1971, 1972) at 1400 MHz with the 91 m telescope of the National Radio Astronomy Observatory (NRAO), covered the range R.A. 7^h17^m to 16^h23^m, Dec. 45°.8 to 51°.7 (1970.23). The aim of the present survey was to provide a complete sample of sources stronger than 0.030 Jy from this region, together with spectral information for this sample.

The 4850 MHz observations and their reduction are briefly described in Sect. 2. Section 3 presents the results of the survey and gives the error analysis. The two-point spectral index distributions for sources selected at either 1400 MHz or 4850 MHz are discussed in Sect. 4. Finally, in Sect. 5, we present the combined source counts from a number of surveys made at frequencies near 4850 MHz.

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2. Observations and data reduction

The survey was performed between 15 January and 4 February 1977 with the 100 m telescope of the Max-Planck-Institut für Radioastronomie (MPIfR), using the same equipment, observing techniques and procedures of data reduction as those described in detail by $MPWK_1$. It was made by means of scans in right ascension, each 805 arcmin long, covering a declination range from 47°21′15″ to 50°59′25″ (1950.0) at intervals of 85 arcsec, i.e. about half the half-power beamwidth of 2.8 arcmin. The scans began at right ascension 10^h45^m (1950.0). The whole area of 14.55 10^{-3} sterad was surveyed twice in this way and gave two independent maps A and B of the area.

The data were calibrated by means of the same sources as in $MPWK_1$, namely 3C48, 3C147 and 3C295, for which the flux densities were taken to be 5.50, 8.37 and 6.72 Jy, respectively[1]. The flux density scale for the present survey is thus a factor of 1.013 higher than that of Kellerman et al. (1969; "KPW" scale) and a factor of 1.020 higher than that of Baars et al. (1977; "BGPW" scale).

Proceeding further exactly as in $MPWK_1$, we obtained, *a*) by forming $(A+B)/2$, the final "source map" which contains the discrete sources, confusion and noise, and *b*) by forming $(A-B)/2$, the "source-free map" which contains *only* noise and the effects of possible receiver instabilities, atmospheric fluctuations, pointing errors and any imperfections in the analysis. The latter, characterised by a r.m.s. noise of 0.0056 Jy per point, was used for the Monte Carlo error analysis referred to in Sect. 3. As in $MPWK_1$ an automatic source-extracting programme was applied to the "source map" to determine the positions and flux densities of sources stronger than 0.018 Jy (about 3.2 r.m.s.).

3. Survey results and errors

The final "source map" of the whole area of the present survey is shown in Fig. 1. The survey, however, partly overlaps the 5C2

1 Although there is evidence that 3C147 is variable (Kesteven et al. 1977), the scaling factors derived from the three sources agree with a standard deviation of 2.5%. The exclusion of 3C147 would change the flux density scale by 0.3%

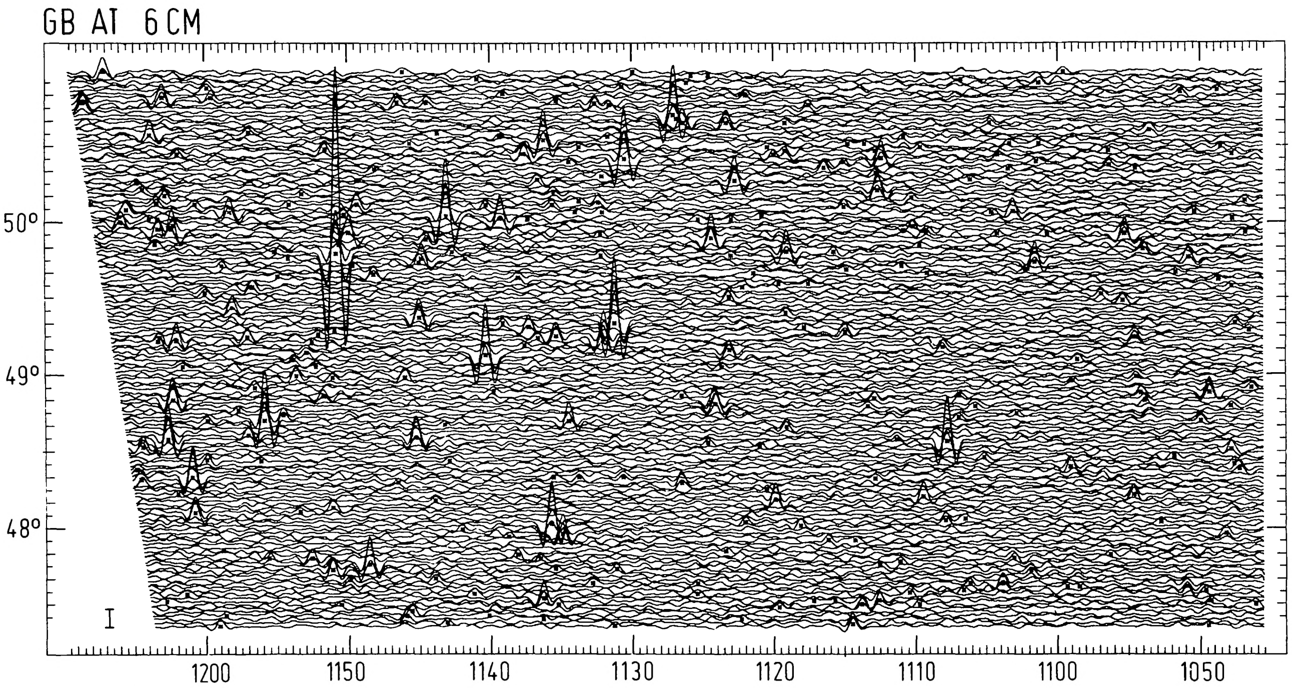

Fig. 1. Map of the area surveyed at 4850 MHz. The coordinates are right ascension (labelled hhmm) and declination, epoch 1950.0. The bar in the lower left corner represents a deflection of 0.1 Jy

area, which has already been surveyed by $MPWK_2$ to the lower limiting flux density of 17 mJy. The common area, of $5.37\ 10^{-3}$ sterad (right ascension range 10^h45^m to 11^h15^m at declination 47°29′45″ and to 11^h18^m at declination 50°59′25″ (1950.0)) is not further considered here. The sources in this common area were only used to check the mutual consistency of the two surveys.

The Monte Carlo analysis, using artificial sources added to the "source-free" map in the manner described by $MPWK_1$, showed the present survey is 99% complete at the flux density level of $S(4850)=0.030$ Jy. The comparison of sources in the area in common with the $MPWK_2$ survey was consistent with this value.

Table 1 lists the 99 sources having $S(4850) \geqq 0.030$ Jy which lie in the remaining area of $9.18\ 10^{-3}$ sterad of the present survey and is arranged as follows. Columns 1 to 3 give the source name, and the 1950.0 right ascension and declination. Columns 4 to 6 list the flux densities, in Jy, of the sources at 4850, 2695 and 1400 MHz. The 1400 MHz flux densities are taken from the GB catalogue (Maslowski, 1972), the 2695 MHz data are from measurements of GB sources stronger than 0.2 Jy (Maslowski, in preparation). In six cases, two neighbouring 4850 MHz sources were not resolved at 1400 and/or 2695 MHz; in these cases the sum of the 4850 MHz flux densities is quoted additionally in Col. 4, is indicated by an asterisk in Col. 1 and has been used for deriving spectral information. Column 7 gives the two-point spectral indices, α, based on the 4850 and 1400 MHz data and defined by $S \propto \text{frequency}^{\alpha}$.

The symbols *A*, *B* or *AB* given in Col. 8 identify the source as belonging to a sample selected at 4850 MHz, 1400 MHz or both frequencies and which is used for the spectral analysis (Sect. 4). Finally, Col. 9 lists other names of the 4850 MHz source, i.e. the GB designation (Maslowski, 1972), 3C (Bennett, 1962), BP (Bailey and Pooley, 1968), 4C/4CP (Gower et al. 1967; Caswell and Crowther, 1969). Peak flux densities are given in parentheses for significantly extended sources at 4850, 2695 and 1400 MHz, respectively. Where available, flux densities at 408 MHz from the *BP* catalogue and at 14850 MHz from our own unpublished measurements are also given.

Table 2 presents the results of the error analysis, obtained from Monte Carlo experiments in the manner described by $MPWK_1$. The table is self-explanatory and we here emphasise only that

(i) the systematic flux density overestimation, ΔS, given in row 1 was taken into account in deriving the two-point spectral indices quoted in Table 1; the quoted 4850 MHz flux densities are, however, not corrected for this effect. The spectral indices given in Table 1 thus differ by $\Delta\alpha = -0.08$, -0.06 and -0.01 from those based on observed 4850 MHz flux densities of 0.03, 0.05 and 0.14 Jy, respectively.

(ii) the correction factors given in row 4 must be applied to the observed source counts if these are based on the 4850 MHz flux densities quoted in Col. 4 of Table 1.

4. Spectral properties of the sources

Two complete samples of sources, selected at 4850 MHz and 1400 MHz, and having two-point spectral indices $\alpha(\nu_1, \nu_2)$[2], can be obtained from the data given in Table 1.

2 The notation $\alpha(\nu_1, \nu_2)$ is used here for the spectral index between frequencies ν_1 and ν_2, for sources selected at frequency ν_1.

The spectral indices in Table 1 are based on the quoted flux densities. Because the flux density scales at 4850 MHz and 1400 MHz are 2.0% higher and 3.6% lower, respectively, than the BGPW scale, all spectra would be steeper, on the latter scale, by 0.04 in α_{4850}^{1400}

Table 1. List of sources

NAME	R.A. (1950.0)	DEC.	S(4850)	S(2695)	S(1400)	α_{4850}^{1400}	ID	REMARKS
1114+473	11 14 26.9	47 22 05.	0.058		0.12	-0.63	A	1114+47.4
1116+503	11 16 25.4	50 21 39.	0.051		< 0.09	>-0.52	A	
1117+507	11 17 30.1	50 46 40.	0.033					
1118+480	11 18 06.5	48 00 58.	0.040		0.10	-0.79		1118+48.0
1119+498	11 19 04.9	49 48 46.	0.124		< 0.09	>+0.24	A	
1119+486	11 19 05.4	48 39 44.	0.042					
1119+474	11 19 35.7	47 28 51.	0.033		0.14	-1.23		1119+47.5
1119+481	11 19 52.3	48 11 03.	0.095	0.14	0.21	-0.67	AB	1120+48.2
1119+504	11 19 59.0	50 26 50.	0.030	0.09	0.11	-1.10		1120+50.4
1121+509	11 21 59.5	50 50 18.	0.033		0.14	-0.87		1121+50.9 (- , - ,0.09)
1122+502	11 22 43.8	50 16 37.	0.134		0.11	+0.14	A	1122+50.3
1123+491	11 23 08.6	49 09 43.	0.057		< 0.09	>-0.42	A	
1123+495	11 23 08.7	49 30 40.	0.046		0.15	-1.00		1123+49.5 BP129, S(408)=0.68
1123+506	11 23 21.2	50 39 28.	0.071	0.15	0.21	-0.91	AB	1123+50.7
1124+488	11 24 10.2	48 50 10.	0.093	0.17	0.33	-1.05	AB	1124+48.8, DB, COMP.SEP. ABOUT 50 ARCSEC, S(14850)=0.012
1124+498	11 24 24.0	49 53 57.	0.130	0.26	0.53	-1.02	AB	1124+49.9 BP130, (- ,0.23,0.45), S(408)=1.34, S(14850)=0.035
1126+482	11 26 30.4	48 17 47.	0.061		0.15	-0.77	A	1126+48.3
1126+506	11 26 24.4	50 39 53.	0.077	0.17			A	BP132, S(408)=1.27, S(14850)=0.016
1127+507	11 27 04.0	50 42 26.	0.241	0.48			A	BP133, S(408)=1.64, S(14850)=0.071
*			0.312	0.65	1.18	-1.07	AB	1126+50.7, BP132 + BP133, (- ,0.48,1.08), S(408)=2.91
1130+504	11 30 30.2	50 25 08.	0.277	0.51	0.90	-0.95	AB	1130+50.4 BP131, S(408)=1.73, S(14850)=0.080
1131+477	11 31 06.5	47 43 55.	0.031					
1131+493	11 31 13.0	49 20 18.	0.398	0.57	1.19	-0.89	AB	1131+49.3 BP134, (0.36,0.52,1.08), S(408)=1.40, S(14850)=0.185
1131+492	11 31 58.6	49 14 11.	0.190	0.28	0.21	-0.08	AB	1132+49.2 (0.14, - , -)
1132+500	11 32 04.4	50 04 10.	0.033					
1132+501	11 32 21.5	50 07 57.	0.035	0.08	0.16	-1.28	B	1132+50.1
1132+507	11 32 34.8	50 47 07.	0.046					
1133+483	11 33 42.2	48 20 04.	0.030					
1134+486	11 34 26.3	48 41 54.	0.103		< 0.09	>+0.08	A	
1134+479	11 34 54.7	47 57 40.	0.107		< 0.09	>+0.11	A	
1135+474	11 35 14.2	47 29 45.	0.034					
1135+492	11 35 20.6	49 15 18.	0.079		< 0.09	>-0.14	A	
1135+501	11 35 35.5	50 06 60.	0.031					
1135+480	11 35 40.3	48 01 50.	0.275	0.34	0.38	-0.26	AB	1135+48.0 (- , - ,0.30), S(14850)=0.416
1136+505	11 36 10.8	50 32 39.	0.170	0.32	0.62	-1.05	AB	1136+50.5 BP136, 4C/4CP50.32, S(408)=1.80, S(14850)=0.053
1136+475	11 36 15.5	47 32 19.	0.101	0.17	0.25	-0.76	AB	1136+47.5 (0.090,0.13,0.21), S(14850)=0.025
1136+502	11 36 36.6	50 16 55.	0.038					
1137+493	11 37 16.2	49 18 52.	0.066	0.12	0.27	-1.18	AB	1137+49.3 BP135, (- ,0.09,0.21), S(408)=0.81, S(14850)=0.017
1137+504	11 37 33.2	50 27 03.	0.060	0.12	0.21	-1.06	AB	1137+50.4
1138+496	11 38 00.0	49 38 18.	0.032					
1139+500	11 39 15.4	50 01 42.	0.137		0.19	-0.28	AB	1139+50.0
1140+491	11 40 19.0	49 07 57.	0.303	0.52	1.00	-0.96	AB	1140+49.1 BP137, 4C/4CP49.21, S(408)=3.38, S(14850)=0.085
1141+475	11 41 08.1	47 34 00.	0.030					
1142+498	11 42 39.3	49 48 35.	0.030					
1143+500	11 43 04.0	50 02 50.	0.321	0.66	1.48	-1.23	AB	1143+50.0 3C266,BP138, 4C/4CP50.33, S(408)=5.23, S(14850)=0.07
1143+476	11 43 55.4	47 40 14.	0.030					
1144+507	11 44 26.3	50 47 28.	0.035					
1144+498	11 44 29.4	49 53 34.	0.041					
1144+497	11 44 48.5	49 45 57.	0.087	0.15	0.32	-1.08	AB	1144+49.8, S(14850)=0.038
1145+493	11 45 00.2	49 22 32.	0.110		0.10	+0.05	A	1144+49.4
1145+485	11 45 14.2	48 35 27.	0.122	0.23	0.45	-1.08	AB	1145+48.6 BP139, 4C/4CP48.33, S(408)=1.82, S(14850)=0.027
1145+474A	11 45 32.2	47 27 09.	0.041					PART OF 1146+47.4
1145+474B	11 45 55.2	47 25 03.	0.035					1146+47.4 (- ,0.12,0.23)
*			0.077	0.16	0.29	-1.08	AB	
1146+489	11 46 00.7	48 59 09.	0.055	0.09	0.18	-1.01	AB	1146+49.0
1146+507	11 46 28.9	50 47 28.	0.052		0.12	-0.72	A	1146+50.8
1148+496	11 48 11.3	49 39 33.	0.046					
1148+477	11 48 32.7	47 45 43.	0.162	0.34	0.69	-1.17	AB	1148+47.8 BP140, 4C+47.33, S(408)=2.3, S(14850)=0.043
1149+501	11 49 21.3	50 07 03.	0.068		0.09	-0.26	A	1149+50.1
1149+499	11 49 56.9	49 55 57.	0.106		0.22	-0.62	AB	1150+50.0
1150+497	11 50 48.0	49 47 48.	1.126	1.61	1.87	-0.41	AB	1150+49.8 BP141, 4C/4CP49.22, S(408)=3.24, S(14850)=0.787
1151+481	11 51 07.5	48 08 01.	0.048	0.09	0.21	-1.23	B	1151+48.2 (- , - ,0.18)
1151+477	11 51 09.0	47 43 15.	0.111	0.17	0.25	-0.68	AB	1151+47.7 4C+47.34, S(14850)=0.029
1151+504	11 51 34.2	50 28 55.	0.050		0.13	-0.82	A	1151+50.4
1151+488	11 51 43.2	48 51 40.	0.034		0.10	-0.93		1151+48.9
1152+478	11 52 34.9	47 48 08.	0.052		< 0.09	>-0.49	A	
1153+489	11 53 37.9	48 59 30.	0.057	0.10	0.18	-0.97	AB	1153+49.0 4CP49.22A
1154+487	11 54 33.5	48 44 20.	0.038					
1155+487	11 55 52.0	48 42 02.	0.278	0.30	0.17	+0.39	AB	1156+48.7
1156+489	11 56 33.0	48 54 55.	0.046					
1156+495	11 56 43.5	49 34 14.	0.054		< 0.09	>-0.47	A	
1156+505	11 56 53.8	50 35 42.	0.033					
1157+486	11 57 00.2	48 36 23.	0.046					
1157+492	11 57 03.2	49 14 50.	0.055		< 0.09	>-0.46	A	
1158+494	11 58 05.8	49 26 14.	0.062	0.12	0.20	-0.99	AB	1158+49.4 BP142, 4C/4CP49.23, S(408)=0.87
1158+500	11 58 17.0	50 03 47.	0.078	0.12	0.21	-0.84	AB	1158+50.1
1159+508A	11 59 34.4	50 49 11.	0.040					
1159+508B	11 59 50.3	50 53 00.	0.040					
*			0.080		0.16	-0.59	AB	1159+50.8
1159+484	11 59 54.1	48 26 45.	0.039		0.11	-0.89		1200+48.5
1200+495	12 00 01.6	49 32 07.	0.031		0.09	-0.90		1200+49.5
1200+501	12 00 42.1	50 07 00.	0.030					
1200+481	12 00 46.8	48 06 07.	0.088		0.19	-0.65	AB	1200+48.1 (- , - ,0.16)
1200+483	12 00 56.5	48 19 59.	0.194		< 0.09	>+0.61	A	
1202+492	12 02 03.2	49 13 25.	0.098	0.16	0.25	-0.78	AB	1202+49.2 BP145, S(408)=0.82, S(14850)=0.040
1202+499A	12 02 11.7	49 58 30.	0.049					PART OF 1202+50.0 A
1202+499B	12 02 21.0	49 57 17.	0.109				A	1202+50.0 A, BP146, S(408)=1.40, S(14850)=0.071
*			0.158	0.24	0.41	-0.77	AB	
1202+488	12 02 21.0	48 49 50.	0.135	0.28	0.46	-1.01	AB	1202+48.8 BP144, S(408)=0.91, S(14850)=0.026
1202+485	12 02 40.5	48 34 38.	0.200	0.30	0.53	-0.79	AB	1202+48.5 BP143, 4CP48.33 A, S(408)=1.36, S(14850)=0.064
1202+501	12 02 49.9	50 10 23.	0.045					
1203+508	12 03 01.5	50 49 11.	0.085	0.16	0.28	-0.99	AB	1202+50.8, S(14850)=0.028
1203+499	12 03 17.0	49 57 15.	0.065	0.18	0.35	-1.03	AB	1202+50.0 B, (- ,0.14,0.22)
1203+501	12 03 23.9	50 07 30.	0.035					
1203+505	12 03 51.8	50 34 29.	0.100	0.13	0.23	-0.70	AB	1203+50.6 BP147, S(408)=0.75
1204+485	12 04 25.4	48 31 43.	0.060		< 0.09	>-0.38	A	
1204+483A	12 04 31.6	48 19 03.	0.053				A	PART OF 1204+48.3, S(14850)=0.016
1204+483B	12 04 47.3	48 22 57.	0.030					1204+48.3
*			0.083	0.12	0.27	-1.00	AB	
1205+500	12 05 30.8	50 04 49.	0.060				A	PART OF 1205+50.0
1205+499	12 05 54.1	49 59 52.	0.061				A	1205+50.0
*			0.121	0.16	0.29	-0.73	AB	
1207+509	12 07 08.0	50 59 24.	0.084	0.14	0.22	-0.80	AB	1207+51.0
1208+507	12 08 33.6	50 47 16.	0.062	0.12	0.21	-1.03	AB	1208+50.8

Table 2. Errors, corrections and differential counts of sources from the present survey

Flux density range, S	≥600	<600 ≥140	<140 ≥50	<50 ≥30	mJy
Flux density over-estimation of point source, $\Delta S = S_{Obs} - S_{Real}$	0.0	0.9	3.6	2.8	mJy
Flux density error of point source, σ_{NCS}, 1)		±7.5	± 5.6	± 4.9	mJy
Position error, σ_{NCP}, 2)		±9.0	±15.	±20.	arcsec
Correction factor	1.000	1.018	0.957	0.871	
Observed source counts, n_{Obs}	1	12	46	40	
Corrected source counts, n_{Cor}	1.0	12.21	44.02	34.84	
Normalized source counts, n_{Cor}/n_o, 3)	-	1.309 ±.375	1.136 ±.171	0.614 ±.104	

1) Systematic calibration error not included (see text).
2) Systematic pointing error of the telescope not included.
3) The counts are normalized by: $n_o = 90 \cdot S^{-2.5}$.
All symbols are as in $MPWK_1$.

The sample selected at 1400 MHz (denoted by "*B*" in Col. 8 of Table 1) consists of 43 sources having $S(1400) \geqq 0.16$ Jy (the completeness limit of the GB survey), all of which are detected by the present survey. The distribution of $\alpha(1400, 4850)$ is shown as a histogram in Fig. 2 (top) and is characterised by a median index $\bar{\alpha}(1400, 4850) = -0.96 \pm .033$, with a dispersion, $\sigma = 0.21$. In comparison, for sources from the 5C2 area, $MPWK_2$ found $\bar{\alpha}(1415, 4850) = -0.86 \pm .026$ and $\sigma = 0.21$. This suggests that the sources in the present survey have, on the average, a steeper spectrum in this frequency interval than those in the 5C2 area, by an amount, $\Delta\alpha = 0.10 \pm .043$. This effect, if real, is not due to systematic differences in the flux densities of the GB survey and the Westerbork 1415 MHz flux densities of sources in the 5C2 area since these have been found to be in good agreement (Gillespie, 1979; Katgert, 1975, 1977). It may reflect a dependence of the spectral index on the 1400 MHz flux density: for the 21 sources having $S(1400) < 0.27$ Jy, $\bar{\alpha} = -0.78 \pm .049$ whereas for the 22 sources with $S(1400) \geqq 0.27$ Jy $\bar{\alpha} = -1.02 \pm .033$. In the sample of 68 5C2 sources selected at 1415 MHz, however, only 3 sources have $S(1415) \geqq 0.27$ Jy. A similar flattening of the spectra with decreasing flux density has been found for even weaker sources in the 5C2 region ($MPWK_2$; Katgert, 1975 and 1977).

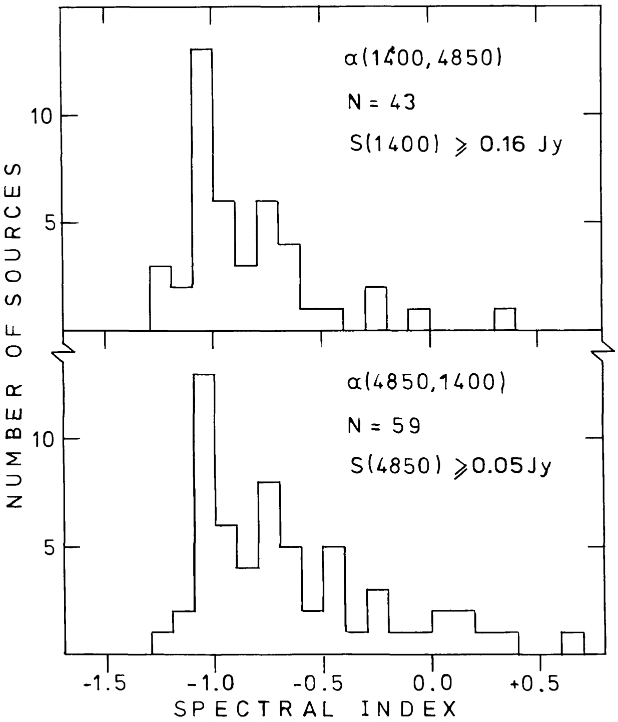

Fig. 2. The distribution of two-point spectral indices for two complete samples of sources selected at 1400 MHz (top) and at 4850 MHz (bottom)

Although the present survey is complete to a flux density limit of 0.03 Jy, the 4850 MHz sample denoted by "*A*" in Col. 8 of Table 1 is confined to the 59 sources having $S(4850) \geqq 0.05$ Jy for the purpose of spectral analysis. Even at this higher flux density limit, 11 sources in the sample have no counterparts in the GB catalogue and only lower limits to the spectral indices are given in Table 1. The distribution of the spectral indices $\alpha(4850, 1400)$ is shown in Fig. 2 (bottom) and is characterised by a median index $\bar{\alpha}(4850, 1400) = -0.77 \pm .052$, with a dispersion $\sigma = 0.40$. The percentage, *F*, of sources having $\alpha \geqq -0.5$ is (31 ± 6) percent. These characteristics are in good agreement with those found by $MPWK_2$ for sources lying in the 5C2 area, for which $\bar{\alpha} = -0.74 \pm .044$, $\sigma = 0.36$ and $F = (32 \pm 5)\%$.

5. Combined source counts

Figure 3 shows (as a heavy line) the normalised, differential source counts near 5 GHz, obtained from a combination of the present survey and the following MPIfR-NRAO surveys: "S1" (Kellermann et al., 1968), "S2" (Pauliny-Toth et al., 1972), "S3" (Pauliny-Toth and Kellermann, 1972), "S4" (Pauliny-Toth et al., 1978a), "S5" (Kuhr et al., 1981), "I" (Pauliny-Toth and Kellerman, 1972), "D" (Davis, 1971) and several deeper surveys (Pauliny-Toth et al., 1978b; Pauliny-Toth et al., 1980; Maslowski et al., 1981 and 1984). In addition, the 5 GHz source counts compiled from the Parkes surveys by Pauliny-Toth et al. (1978a) have been included. For all these surveys, sufficient information about systematic errors was available to enable us to apply corrections for incompleteness. In combining the data, sources in overlapping areas were excluded from the appropriate survey to ensure the independence of the final source counts. The normalisation has been made to $\Delta N_0 = 90\, S^{-5/2}$. Figure 3 also shows the separate source counts from four surveys where the information was insufficient for us to make the proper corrections (Willis and Miley, 1979; Ledden et al., 1980; Wall et al., 1982a; Owen et al., 1983). For comparison, the separate source counts from the present survey are also shown.

The combined source counts in differential form are also tabulated in Table 3. They cover about 3 decades in flux density, divided into 24 intervals. The division was to some extent forced on us by the different flux density limits of the surveys and by the numbers of sources in the different intervals. Table 3 is arranged as follows:

Col. 1 – the flux density range, $S_i < S_{i+1}$
Col. 2 – Δm, the number of sources in $S_i \leqq S < S_{i+1}$
Col. 3 – $\Delta m'$, corrected number of sources
Col. 4 – solid angle of the area containing these sources
Col. 5 – $\Delta N'$, corrected source density (sterad^{-1})

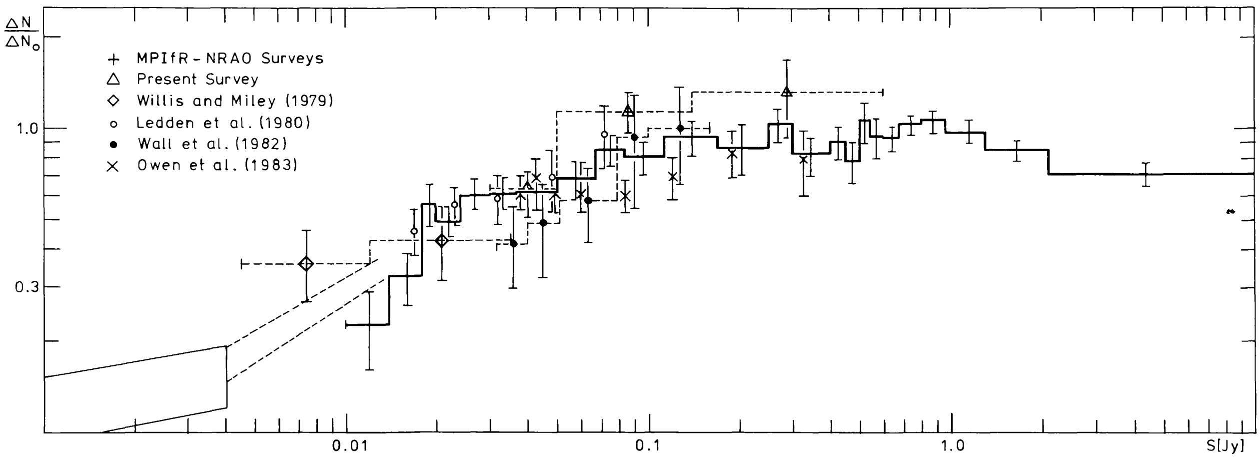

Fig. 3. Differential source counts near 5 GHz. The counts obtained by combining the present survey with other MPIfR-NRAO surveys are shown by the heavy line. The length of the error bars represents the $\pm 1\sigma$ statistical error $2(\Delta m)^{-1/2}\,\Delta N'/\Delta N_0$, where m is the number of sources in a given flux density interval of Table 3. The counts from four other published surveys are shown separately, and, for comparison, the counts from the present survey are also shown. All the counts are normalised to a differential count $\Delta N_0 = 90\,S^{-5/2}$. The results of the $P(D)$ analysis of Wall et al. (1982b) are represented by the $\pm 1\sigma$ probability area outlined by a solid line

Col. 6 – $\Delta N'/\Delta N_0$, source count normalised by $\Delta N_0 = 90\,S^{-5/2}$ and its statistical error $(\Delta m)^{-1/2}\,\Delta N'/\Delta N_0$.

Since the differential counts presented in Table 3 are well defined at least down to a flux density of 0.018 Jy, they can be

Table 3. Combined, differential counts of sources at 5 GHz

Flux density (Jy)	Δm	Δm′	Area (sterad)	ΔN′	ΔN′/ΔN$_0$	
0.010						
	8	8.5	0.001582	5372.	0.226 ±	0.077
0.014						
	26	27.94	0.007555	3698.	0.325	0.062
0.018						
	37	37.75	0.01834	2059.	0.567	0.092
0.020						
	63	60.70	0.02482	2446.	0.482	0.062
0.024						
	72	69.42	0.02482	2798.	0.610	0.073
0.030						
	69	65.04	0.03400	1913.	0.614	0.076
0.037						
	67	63.67	0.03400	1894.	0.618	0.077
0.050						
	46	43.92	0.03400	1292.	0.678	0.102
0.067						
	73	68.73	0.08606	799.	0.840	0.101
0.083						
	66	63.36	0.08606	736.	0.791	0.099
0.113						
	59	58.35	0.08606	678.	0.937	0.123
0.170						
	28	28.00	0.08606	325	0.865	0.164
0.250						
	62	64.88	0.5476	118.	1.032	0.128
0.300						
	56	58.02	0.5476	106.	0.828	0.109
0.400						
	55	60.0	1.718	34.9	0.909	0.117
0.450						
	37	39.0	1.718	22.7	0.781	0.125
0.500						
	39	44.0	2.238	19.7	1.063	0.160
0.540						
	44	46.0	2.238	20.6	0.930	0.137
0.600						
	134	139.	6.807	20.4	0.924	0.078
0.680						
	162	162.	6.807	23.8	1.028	0.081
0.800						
	150	150.	7.081	21.2	1.055	0.086
0.960						
	205	209.	9.301	22.5	0.964	0.067
1.300						
	161	163.	9.301	17.5	0.844	0.066
2.100						
	130	130.	9.301	14.0	0.709	0.062
	1849	1860.3		24451.3		

expressed in the form of power laws. For this purpose, we have applied the method of Refsdal (1969), which is statistically correct provided the number of sources in a given interval is not small (Crawford et al., 1970). This is true even though the method starts from the corrected integral counts ($N(>S) = KS^{-\beta}$), because it effectively works on uncorrelated data. The method, unlike other, statistically more sophisticated methods (Jauncey, 1967; Crawford et al., 1970), has the advantage of being easily adapted to the present case, where the sources observed in different flux density intervals come from different solid angles of sky.

Applying this method to the data in Table 3, we have estimated the exponent, γ, of the corresponding differential counts ($dN(S)/dS = -kS^{-\gamma}$, where $\gamma = \beta + 1$) for four flux density intervals in each of which the "goodness of fit" test showed that k and γ were constant. The resulting values are:

1) $S \geqq 0.800$ Jy, $k = 90.1 \pm 2.4$, $\gamma = 2.75 \pm .069$

2) $0.800 > S \geqq 0.067$ Jy, $k = 75.8 \pm 2.7$, $\gamma = 2.51 \pm .052$

3) $0.067 > S \geqq 0.018$ Jy, $k = 131.3 \pm 4.3$, $\gamma = 2.24 \pm .067$

4) $0.018 > S \geqq 0.010$ Jy, $k = 460 \pm 150$, $\gamma = 1.8 \pm .14$.

Below the level of the direct source counts (0.010 Jy), the population law has recently been estimated by Wall et al. (1982b) on the basis of the $P(D)$ analysis (Scheuer, 1957; Condon, 1974). the result of this analysis is shown in Fig. 3 by the $\pm 1\sigma$ probability area outlined by the solid line, the best-fit value being $(k, \gamma) = (127, 2.10)$. This result indicates less convergence in the counts below 0.004 Jy than suggested by the direct source counts in the range 0.010 to 0.018 Jy. Although the latter are based on only 34 sources, the further evidence of rapid convergence of the counts below 0.01 Jy came very recently from the VLA (Very Large Array) synthesis surveys of several small regions of the sky. Namely, Bennett et al. (1983) surveyed 13 small areas of the sky (each 12.8 arcmin square) and found 13 sources covering the flux density range $0.5 \leqq S < 10$ mJy. Next, Fomalont et al. (1983) found 8 sources from their Deep Survey with $0.05 \leqq S < 2$ mJy and 24 sources from the Intermediate Survey with $0.35 \leqq S < 12$ mJy.

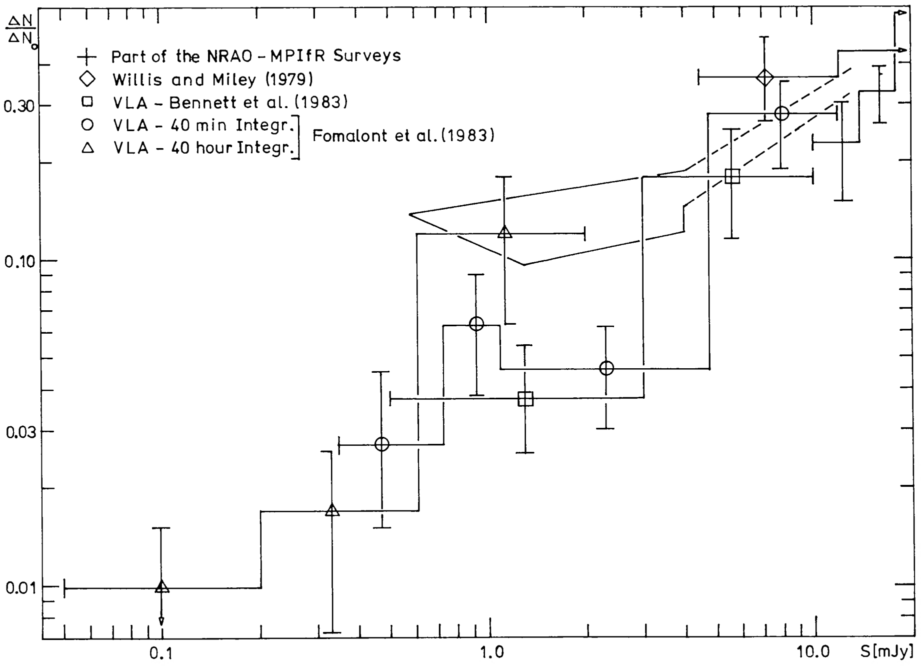

Fig. 4. VLA differential source counts near 5 GHz based on: 13 sources with $0.5 \leqq S < 10$ mJy (Bennett et al., 1983), 8 sources with $0.05 \leqq S < 2$ mJy and 24 sources with $0.35 \leqq S < 12$ mJy (Fomalont et al., 1983). The estimation of the sky source density based on the $P(D)$ analysis (Wall et al., 1982b) is also shown by the probability area outlined by the solid line. Normalization – as in Fig. 3

These 45 sources allowed to extend the direct source counts below 10 mJy by about 2.5 orders in flux density as shown in Fig. 4. It is obvious that further VLA observations of sources in this very important flux density interval are required to improve the statistic for a quantitative determination of the slope of the counts and of the source density.

Acknowledgements. We wish to thank Dr. R. Porcas for valuable comments and critical remarks on the manuscript. We also wish to thank the telescope operators in Effelsberg, and the staff of the computer division at the MPIfR in Bonn and of the computer centre "CYFRONET" in Cracow for their help during data processing.

J. Maslowski wishes to thank Prof. R. Wielebinski for his invitation and hospitality during his stay at the MPIfR.

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