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A revised Galactic supernova remnant catalogue

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Abstract. A revised catalogue of 274 Galactic supernova remnants (SNRs) is presented, along with some simple statistics of their parameters. It is shown that the remnants that have recently been identified are generally faint, as is expected from the selection effects that apply to the identification of remnants.

Keywords : supernova remnants – catalogues – radio continuum: ISM – ISM: general

1. Introduction

Over the last twenty five years I have produced several published versions of a catalogue of Galactic SNRs (Green 1984, 1988, 1991; Stephenson & Green 2002; Green 2004), along with more detailed web-based versions (most recently in 2006). Here I present an updated version of the catalogue, now containing 274 remnants. Details of the catalogue are presented in Section 2, including notes on the SNRs added and removed since 2004. Section 3 briefly discusses some simple statistics of the objects in the current catalogue, and reviews the selection effects that apply to the identification of SNRs.

2. The SNR catalogue

The current version of the catalogue contains 274 SNRs, and is based on research in the published literature up to the end of 2008. For each remnant in the catalogue the following parameters are given.

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- **Galactic Coordinates** of the source centroid, quoted to a tenth of a degree as is conventional. (Note: in this catalogue additional leading zeros are not used.)
- **Right Ascension** and **Declination** of the source centroid. The accuracy of the quoted values depends on the size of the remnant, for small remnants they are to the nearest few seconds of time and the nearest minute of arc respectively, whereas for larger remnants they are rounded to coarser values, but are in every case sufficient to specify a point within the boundary of the remnant. These coordinates are almost always deduced from radio images rather than from X-ray or optical observations, and are for J2000.0.
- **Angular Size** of the remnant, in arcminutes, usually taken from the highest resolution radio image available. The boundary of most remnants approximates reasonably well to a circle or an ellipse. A single value is quoted for the angular size of the more nearly circular remnants, which is the diameter of a circle with an area equal to that of the remnant. For elongated remnants the product of two values is quoted, and these are the major and minor axes of the remnant boundary modelled as an ellipse. In a few cases an ellipse is not a satisfactory description of the boundary of the object (refer to the description of the individual object given in its catalogue entry), although an angular size is still quoted for information. For 'filled-centre' remnants the size quoted is for the largest extent of the observed radio emission, not, as at times has been used by others, the half-width of the centrally brightened peak.
- **Type** of the SNR: 'S' or 'F' if the remnant shows a 'shell' or 'filled-centre' structure, or 'C' if it shows 'composite' (or 'combination') radio structure with a combination of shell and filled-centre characteristics; or 'S?', 'F?' or 'C?', respectively, if there is some uncertainty, or '?' in several cases where an object is conventionally regarded as an SNR even though its nature is poorly known or not well-understood. (Note: the term 'composite' has been used in a different sense, by some authors, to describe SNRs with shell radio and centrally-brightened X-ray morphologies. An alternative term used to describe such remnants is 'mixed morphology', see Rho & Petre 1998.)
- **Flux Density** of the remnant at 1 GHz in jansky. This is *not* a measured value, but is deduced from the observed radio-frequency spectrum of the source. The frequency of 1 GHz is chosen because flux density measurements at frequencies both above and below this value are usually available.
- **Spectral Index** of the integrated radio emission from the remnant, α (here defined in the sense, $S \propto \nu^{-\alpha}$, where S is the flux density at a frequency ν), either a value that is quoted in the literature, or one deduced from the available integrated flux densities of the remnant. For several SNRs a simple power law is not adequate to describe their radio spectra, either because there is evidence that the integrated spectrum is curved or the spectral index varies across the face of the remnant. In these cases the spectral index is given as 'varies' (refer to the description of the remnant and appropriate references in the detailed catalogue entry for more information). In some cases, for example where the remnant is highly confused with thermal emission, the spectral index is given as '?' since no value can be deduced with any confidence.
- **Other Names** that are commonly used for the remnant. These are given in parentheses if the remnant is only a part of the source. For some remnants, notably the Crab nebula, not all common names are given.

A summary of the data available for all 274 remnants in the catalogue is given in Table 1.

A more detailed version of the catalogue is available on the World-Wide-Web from:

`http://www.mrao.cam.ac.uk/surveys/snrs/`

In addition to the basic parameters which are given in Table 1, the detailed catalogue contains the following information. (i) Notes if other Galactic coordinates have at times been used to label it (usually before good observations have revealed the full extent of the object, but sometimes in error), if the SNR is thought to be the remnant of a historical SN, or if the nature of the source as an SNR has been questioned (in which case an appropriate reference is usually given later in the entry). (ii) Short descriptions of the observed structure of the remnant at radio, X-ray and optical wavelengths, as applicable. (iii) Notes on distance determinations, and any point sources or pulsars in or near the object (although they may not necessarily be related to the remnant). (iv) References to observations are given for each remnant, complete with journal, volume, page, and a short description of what information each paper contains (for radio observations these include the telescopes used, the observing frequencies and resolutions, together with any flux density determinations). These references are *not* complete, but cover representative and recent observations of the remnant – up to the end of 2008 – and they should themselves include references to earlier work.

The detailed version is available as postscript or pdf for downloading and printing, or as HTML web pages for each individual remnant. The web pages include links to the 'NASA Astrophysics Data System' for each of the over two thousand references that are included in the detailed listings for individual SNRs.

Some of the parameters included in the catalogue are themselves of quite variable quality. For example, the radio flux density of each remnant at 1 GHz. This is generally of good quality, being obtained from several radio observations over a range of frequencies, both above and below 1 GHz. However, for a small number of remnants (16 remnants in the current catalogue) – often those which have been identified at other than radio wavelengths – no reliable radio flux density, or only a limit, is available. Also, although the detailed version of the catalogue contains notes on distances for many remnants reported in the literature, these have a range of reliability. Consequently the distances given within the detailed catalogue should be used with caution in any statistical studies.

2.1 Changes from the 2004 version

The following remnants have been added to the catalogue since the last published version (Green 1984).

- G32.4+0.1, identified by Yamaguchi et al. (2004).

- Two 2nd quadrant remnants, G96.0+2.0 and G113.0+0.2, identified by Kothes, Uyanıker & Reid (2005).
- G337.2+0.1, which was confirmed as a SNR by Combi et al. (2005).
- 31 new SNRs in the region $4\overset{\circ}{.}5 < l < 22\overset{\circ}{.}0$, $|b| < 1\overset{\circ}{.}25$ (G5.5+0.3, G6.1+0.5, G6.5−0.4, G7.2+0.2, G8.3−0.0, G8.9+0.4, G9.7−0.0, G9.9−0.8, G10.5−0.0, G11.0−0.0, G11.1−0.7, G11.1−1.0, G11.1+0.1, G11.8−0.2, G12.2+0.3, G12.5+0.2, G12.7−0.0, G12.8−0.0, G14.1−0.1, G14.3+0.1, G15.4+0.1, G16.0−0.5, G16.4−0.5, G17.0−0.0, G17.4−0.1, G18.1−0.1, G18.6−0.2, G19.1+0.2, G20.4+0.1, G21.0−0.4 and G21.5−0.1) identified by Brogan et al. (2006). (There are the 31 objects classed as 'I' or 'II', i.e. those thought to be very or fairly confidently identified as SNRs by Brogan et al.)
- G83.0−0.3, which had been suggested as a SNR by Taylor, Wallace & Goss (1992), and is now included in the catalogue following improved observations by Kothes et al. (2006) which confirm its nature.
- G108.2−0.6, identified by Tian, Leahy & Foster (2007).
- G315.1+2.7, which had been suggested as a candidate SNR by Duncan et al. (1995, 1997), and was confirmed as a SNR by optical and radio survey observations by Stupar, Parker & Filipović (2007a).
- G327.2−0.1, a shell remnant found around the magnetar 1E 1547.0−5408, see Gelfand & Gaensler (2007).
- G332.5−5.6, identified by Reynoso & Green (2007).
- G350.1−0.3, which was listed in early versions of the catalogue, but was removed from the version in Green (1991), as observations by Salter et al. (1986) did not allow a clear identification of the nature of this source. Recently Gaensler et al. (2008) have presented new observations of this source, including H I absorption observations which indicate it is Galactic, which – along with other observations, including its X-ray emission – support an SNR identification. However, its structure at radio wavelengths is rather different from other known remnants.
- G353.6−0.7, a shell remnant associated with HESS J1731−347 identified by Tian et al. (2008).
- Three sources – G355.4+0.7, G358.1+1.0, G358.5−0.9 – which had been identified as possible SNRs by Gray (1994), have now been added to the catalogue, following further observations by Roy & Bhatnagar (2006) which confirm their nature.

Since 2004 two objects have been removed from the catalogue, as they have been identified as H II regions, namely: G166.2+2.5 (=OA 184), see Foster et al. (2006); and G84.9+0.5, see Foster et al. (2007), and also see Kothes et al. (2006).

As noted above, the detailed catalogue is based on published papers up to the end of 2008, and hence the catalogue does not include remnants identified more recently (e.g. Green 2009; Hurley-Walker et al. 2009).

2.2 Possible and Probable SNRs

In addition to the observational selection effects that are discussed further in Section 3.2, it should be noted that the catalogue is far from homogeneous. It is particularly difficult to be uniform in terms of which objects are considered as definite remnants, and are included in the catalogue, rather than listed as possible or probable remnants which require further observations to clarify their nature. Although many remnants, or possible remnants, were first identified from wide-area radio surveys, many others have been observed with diverse observational parameters, making uniform criteria for inclusion in the main catalogue difficult. The detailed version of the catalogue contains notes both on those objects no longer thought to be SNRs, and on many possible and probable remnants that have been reported in the literature.

3. Discussion

3.1 Some simple statistics

There are 16 Galactic SNRs that are either not detected at radio wavelengths, or are poorly defined by current radio observations, so that their flux density at 1 GHz cannot be determined with any confidence: i.e. 94% have a flux density at 1 GHz included in the catalogue. Of the catalogued remnants, $\approx$ 40% are detected in X-ray, and $\approx$ 20% in the optical. At both of these wavebands, Galactic absorption hampers the detection of distant remnants.

In the current version of the catalogue, 78% of remnants are classed as shell (or possible shell), 12% are composite (or possible composite), and 4% are filled-centre (or possible filled centre) remnants. The type of the remaining remnants is not clear from current observations, or else they are objects which are conventionally regarded as SNRs although they do not fit well into any of the conventional types (e.g. CTB80 (=G69·0+2·7), MSH 17−39 (=G357·7−0·1)).

3.2 Selection effects

Although several Galactic SNRs have been identified at other than radio wavelengths, in practice the dominant selection effects are those that are applicable at radio wavelengths. Simplistically, two selection effects apply to the identification of Galactic SNRs due to the difficulty in identifying (i) faint remnants and (ii) small angular size remnants (see Green 1991, 2004, 2005 for more detailed discussions).

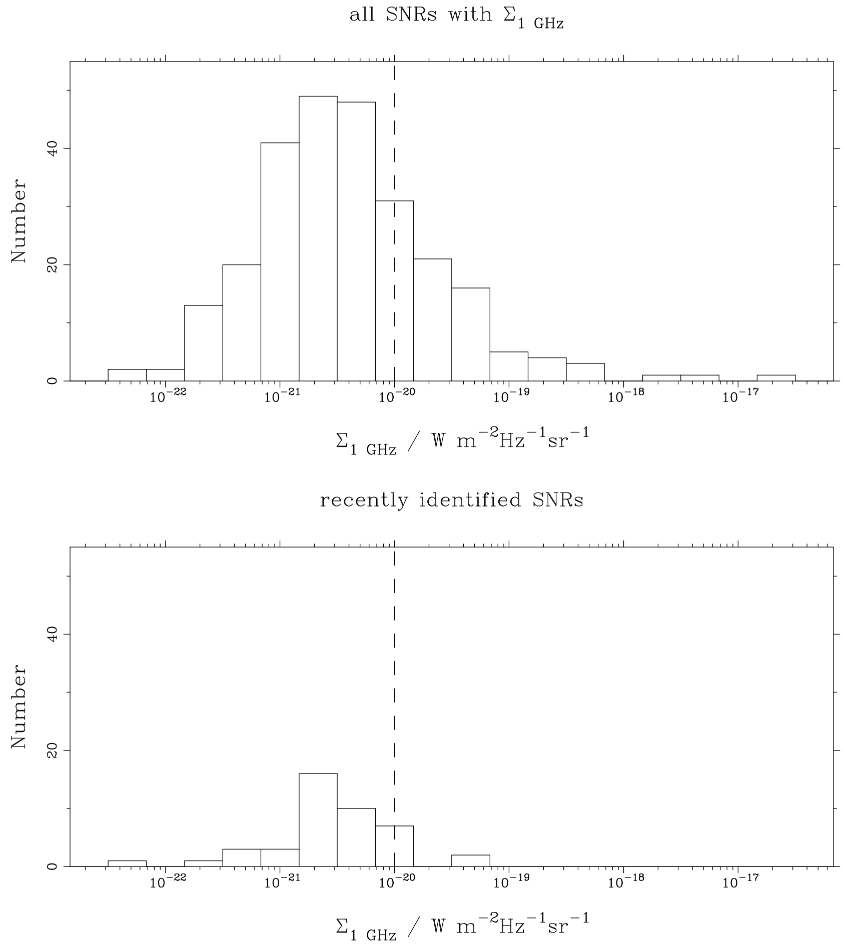

Figure 1. Histograms in surface brightness at 1 GHz for (top) all 258 Galactic SNRs with 1-GHz flux densities, and (bottom) the remnants included in the catalogue since 2004. The dashed lines mark the nominal completeness limit of the catalogue, see text.

In terms of surface brightness, which is distance-independent, the wide-area radio surveys covering the Galactic plane mean that the catalogue is thought to be complete down to about $\Sigma_{1\ \mathrm{GHz}} \approx 10^{-20}$ W m^{-2} Hz^{-1} sr^{-1} (Green 2004, 2005). Fig. 1 shows a histogram of $\Sigma_{1\ \mathrm{GHz}}$ for the 258 remnants in the current catalogue for which 1-GHz flux densities are available, and also for those remnants included in the catalogue since the 2004 version. This shows that the majority of newly identified remnants are indeed fainter than nominal completeness limit of $\approx 10^{-20}$ W m^{-2} Hz^{-1} sr^{-1}. Most of these are from the deep survey of a limited region of the Galactic plane by Brogan et al. (2006) (see Section 2.1 above). The are a few newly-identified remnants that are brighter than the nominal surface brightness completeness limit of the catalogue of $\approx 10^{-20}$ W m^{-2} Hz^{-1} sr^{-1}. The brightest two of these, namely G337·2+0·1 and G350·1−0·3, both have

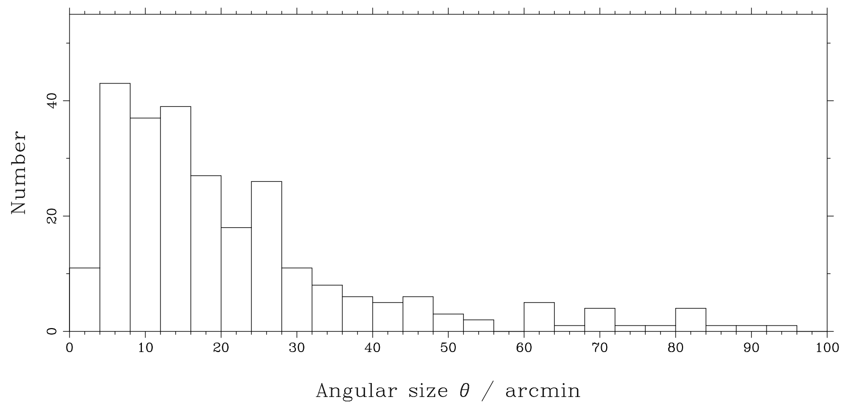

Figure 2. Histogram of the angular size of 261 Galactic SNRs (13 remnants larger than 100 arcmin are not included).

relatively small angular sizes (≤ 4 arcmin). Such small SNRs are difficult to identify because their structure is not easily recognised without high enough resolution observations. It is difficult to quantify the angular size selection effect – see Green (2004) for some further discussion – but Fig. 2 shows a histogram of the observed angular sizes of remnants in the current catalogue. (Note: for elongated remnants, which have angular sizes given as $n \times m$ arcmin^2 in the catalogue, a single diameter of $\sqrt{nm}$ has been used in this histogram.) Since much of the Galactic plane is now covered by several recent radio surveys – the Canadian/VLA/Southern Galactic Plane Surveys, see English et al. (1998); McClure-Griffiths et al. (2001); Taylor et al. (2003); Stil et al. (2006) – with a resolution of ≈ 1 arcmin, systematic searches using these should be able to identify small angular size remnants that have not been recognised in previous surveys with lower resolution.

Due to these selection effects, care has to be taken in using the catalogue for statistical studies. For example, Fig. 3 shows the distribution of both samples: (a) all SNRs, and (b) the brighter ones (with $\Sigma_{1\ \mathrm{GHz}} \geq 10^{-20}$ W m^{-2} Hz^{-1} sr^{-1}), to illustrate the surface brightness selection effect. This shows that relatively many more remnants are seen in the 2nd and 3rd Galactic quadrants and away from $b = 0°$, when looking at the whole catalogue rather than the brighter remnants. This is expected, as the Galactic background is fainter in these regions, and hence it is easier to identify faint SNRs here.

In addition to selection effects that apply to the identification of Galactic SNRs, many statistical studies also require distances for all remnants. The surface brightness–diameter ('Σ−D') relation is often used for such studies, but – as has been discussed in Green (2004, 2005) – there are problems with this method given the large range of properties shown by Galactic SNRs, and the observational selection effects. Also, as discussed in detail in Green (2005), it should be noted that some Σ−D relations in the literature (e.g. Case & Bhattacharya 1998; Stupar et al. 2007b) have been derived using least-squares regression minimising deviation in terms of log(Σ), rather than in terms of log(D). As the Σ−D relation is used to derive a diameter (and hence distance) from an observed surface brightness, then least-squares in terms of log(D) is appropriate. Given

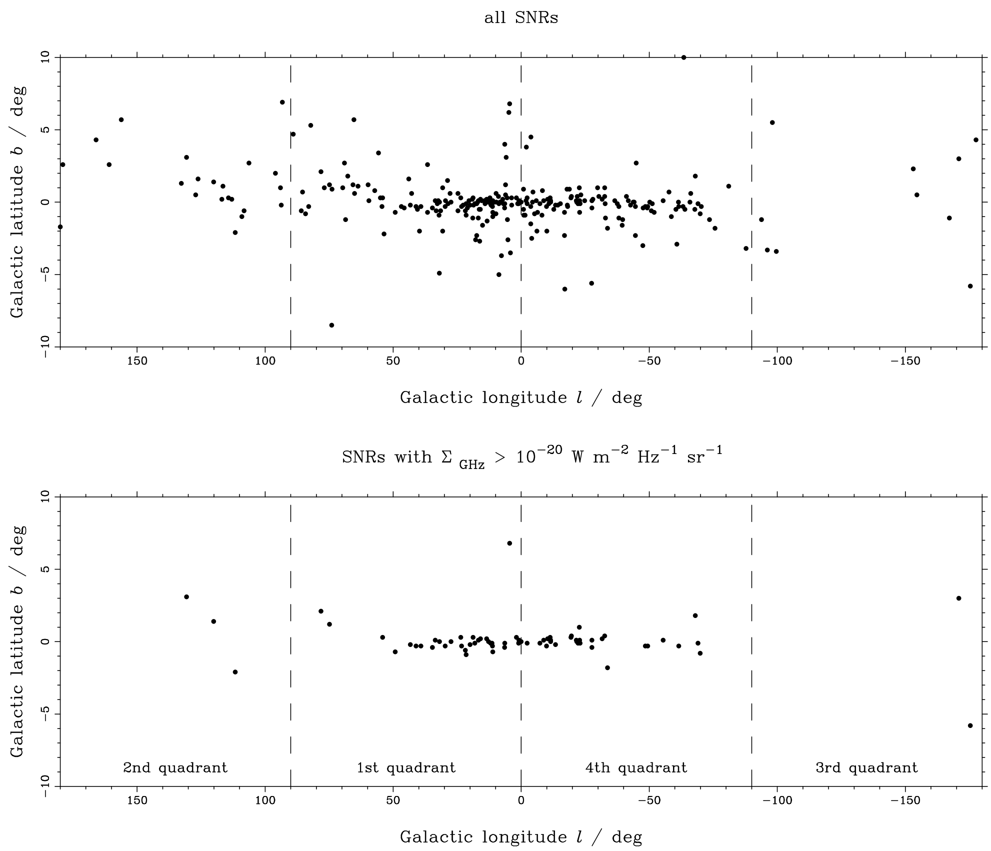

Figure 3. Galactic distribution of (top) all Galactic SNR and (bottom) those SNRs with a surface brightness at 1 GHz greater than 10^{-20} W m^{-2} Hz^{-1} sr^{-1}. (Note that the latitude and longitude axes are not on the same scale.)

the large scatter in the observed properties of SNRs with known distances, then using a least-square regression in terms of $\log(\Sigma)$ leads to a significantly flatter Σ–D slope than if a regression in terms of $\log(D)$ is used. This leads to an overestimate of the diameters, and hence distances, for all faint remnants.

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Table 1. Galactic Supernova Remnants: summary data.

l	b	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
0.0	+0.0	17 45 44	−29 00	3.5 × 2.5	S	100?	0.8?	Sgr A East
0.3	+0.0	17 46 15	−28 38	15 × 8	S	22	0.6	
0.9	+0.1	17 47 21	−28 09	8	C	18?	varies	
1.0	−0.1	17 48 30	−28 09	8	S	15	0.6?	
1.4	−0.1	17 49 39	−27 46	10	S	2?	?	
1.9	+0.3	17 48 45	−27 10	1.5	S	0.6	0.6	
3.7	−0.2	17 55 26	−25 50	14 × 11	S	2.3	0.65	
3.8	+0.3	17 52 55	−25 28	18	S?	3?	0.6	
4.2	−3.5	18 08 55	−27 03	28	S	3.2?	0.6?	
4.5	+6.8	17 30 42	−21 29	3	S	19	0.64	Kepler, SN1604, 3C358
4.8	+6.2	17 33 25	−21 34	18	S	3	0.6	
5.2	−2.6	18 07 30	−25 45	18	S	2.6?	0.6?	
5.4	−1.2	18 02 10	−24 54	35	C?	35?	0.2?	Milne 56
5.5	+0.3	17 57 04	−24 00	15 × 12	S	5.5	0.7	
5.9	+3.1	17 47 20	−22 16	20	S	3.3?	0.4?	
6.1	+0.5	17 57 29	−23 25	18 × 12	S	4.5	0.9	
6.1	+1.2	17 54 55	−23 05	30 × 26	F	4.0?	0.3?	
6.4	−0.1	18 00 30	−23 26	48	C	310	varies	W28
6.4	+4.0	17 45 10	−21 22	31	S	1.3?	0.4?	
6.5	−0.4	18 02 11	−23 34	18	S	27	0.6	
7.0	−0.1	18 01 50	−22 54	15	S	2.5?	0.5?	
7.2	+0.2	18 01 07	−22 38	12	S	2.8	0.6	
7.7	−3.7	18 17 25	−24 04	22	S	11	0.32	1814−24
8.3	−0.0	18 04 34	−21 49	5 × 4	S	1.2	0.6	
8.7	−5.0	18 24 10	−23 48	26	S	4.4	0.3	
8.7	−0.1	18 05 30	−21 26	45	S?	80	0.5	(W30)
8.9	+0.4	18 03 58	−21 03	24	S	9	0.6	
9.7	−0.0	18 07 22	−20 35	15 × 11	S	3.7	0.6	
9.8	+0.6	18 05 08	−20 14	12	S	3.9	0.5	
9.9	−0.8	18 10 41	−20 43	12	S	6.7	0.4	
10.5	−0.0	18 09 08	−19 47	6	S	0.9	0.6	
11.0	−0.0	18 10 04	−19 25	11 × 9	S	1.3	0.6	
11.1	−1.0	18 14 03	−19 46	18 × 12	S	5.8	0.6	
11.1	−0.7	18 12 46	−19 38	11 × 7	S	1.0	0.7	
11.1	+0.1	18 09 47	−19 12	12 × 10	S	2.3	0.4	

Table 1. (continued).

l	*b*	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
11.2	−0.3	18 11 27	−19 25	4	C	22	0.6	
11.4	−0.1	18 10 47	−19 05	8	S?	6	0.5	
11.8	−0.2	18 12 25	−18 44	4	S	0.7	0.3	
12.0	−0.1	18 12 11	−18 37	7?	?	3.5	0.7	
12.2	+0.3	18 11 17	−18 10	6 × 5	S	0.8	0.7	
12.5	+0.2	18 12 14	−17 55	6 × 5	C?	0.6	0.4	
12.7	−0.0	18 13 19	−17 54	6	S	0.8	0.8	
12.8	−0.0	18 13 37	−17 49	3	C?	0.8	0.5	
13.3	−1.3	18 19 20	−18 00	70 × 40	S?	?	?	
13.5	+0.2	18 14 14	−17 12	5 × 4	S	3.5?	1.0?	
14.1	−0.1	18 15 52	−16 34	6 × 5	S	0.5	0.6	
14.3	+0.1	18 15 58	−16 27	5 × 4	S	0.6	0.4	
15.1	−1.6	18 24 00	−16 34	30 × 24	S	5.5?	0.8?	
15.4	+0.1	18 18 02	−15 27	15 × 14	S	5.6	0.6	
15.9	+0.2	18 18 52	−15 02	7 × 5	S?	5	0.6?	
16.0	−0.5	18 21 56	−15 14	15 × 10	S	2.7	0.6	
16.2	−2.7	18 29 40	−16 08	17	S	2	0.5	
16.4	−0.5	18 22 38	−14 55	13	S	4.6	0.7	
16.7	+0.1	18 20 56	−14 20	4	C	3.0	0.6	
16.8	−1.1	18 25 20	−14 46	30 × 24?	?	2?	?	
17.0	−0.0	18 21 57	−14 08	5	S	0.5	0.5	
17.4	−2.3	18 30 55	−14 52	24?	S	4.8?	0.8?	
17.4	−0.1	18 23 08	−13 46	6	S	0.4	0.7	
17.8	−2.6	18 32 50	−14 39	24	S	4.0?	0.3?	
18.1	−0.1	18 24 34	−13 11	8	S	4.6	0.5	
18.6	−0.2	18 25 55	−12 50	6	S	1.4	0.4	
18.8	+0.3	18 23 58	−12 23	17 × 11	S	33	0.4	Kes 67
18.9	−1.1	18 29 50	−12 58	33	C?	37	varies	
19.1	+0.2	18 24 56	−12 07	27	S	10	0.5	
20.0	−0.2	18 28 07	−11 35	10	F	10	0.0	
20.4	+0.1	18 27 51	−11 00	8	S	3.1	0.4	
21.0	−0.4	18 31 12	−10 47	9 × 7	S	1.1	0.6	
21.5	−0.9	18 33 33	−10 35	4	C	6?	0.0	
21.5	−0.1	18 30 50	−10 09	5	S	0.4	0.5	
21.8	−0.6	18 32 45	−10 08	20	S	69	0.5	Kes 69

Table 1. (continued).

l	b	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
22.7	−0.2	18 33 15	−09 13	26	S?	33	0.6	
23.3	−0.3	18 34 45	−08 48	27	S	70	0.5	W41
23.6	+0.3	18 33 03	−08 13	10?	?	8?	0.3	
24.7	−0.6	18 38 43	−07 32	15?	S?	8	0.5	
24.7	+0.6	18 34 10	−07 05	30 × 15	C?	20?	0.2?	
27.4	+0.0	18 41 19	−04 56	4	S	6	0.68	4C−04.71
27.8	+0.6	18 39 50	−04 24	50 × 30	F	30	varies	
28.6	−0.1	18 43 55	−03 53	13 × 9	S	3?	?	
28.8	+1.5	18 39 00	−02 55	100?	S?	?	0.4?	
29.6	+0.1	18 44 52	−02 57	5	S	1.5?	0.5?	
29.7	−0.3	18 46 25	−02 59	3	C	10	0.7	Kes 75
30.7	−2.0	18 54 25	−02 54	16	?	0.5?	0.7?	
30.7	+1.0	18 44 00	−01 32	24 × 18	S?	6	0.4	
31.5	−0.6	18 51 10	−01 31	18?	S?	2?	?	
31.9	+0.0	18 49 25	−00 55	7 × 5	S	24	0.49	3C391
32.0	−4.9	19 06 00	−03 00	60?	S?	22?	0.5?	3C396.1
32.1	−0.9	18 53 10	−01 08	40?	C?	?	?	
32.4	+0.1	18 50 05	−00 25	6	S	0.25?	?	
32.8	−0.1	18 51 25	−00 08	17	S?	11?	0.2?	Kes 78
33.2	−0.6	18 53 50	−00 02	18	S	3.5	varies	
33.6	+0.1	18 52 48	+00 41	10	S	22	0.5	Kes 79, 4C00.70, HC13
34.7	−0.4	18 56 00	+01 22	35 × 27	C	230	0.37	W44, 3C392
36.6	−0.7	19 00 35	+02 56	25?	S?	?	?	
36.6	+2.6	18 48 49	+04 26	17 × 13?	S	0.7?	0.5?	
39.2	−0.3	19 04 08	+05 28	8 × 6	C	18	0.6	3C396, HC24, NRAO 593
39.7	−2.0	19 12 20	+04 55	120 × 60	?	85?	0.7?	W50, SS433
40.5	−0.5	19 07 10	+06 31	22	S	11	0.5	
41.1	−0.3	19 07 34	+07 08	4.5 × 2.5	S	22	0.48	3C397
42.8	+0.6	19 07 20	+09 05	24	S	3?	0.5?	
43.3	−0.2	19 11 08	+09 06	4 × 3	S	38	0.48	W49B
43.9	+1.6	19 05 50	+10 30	60?	S?	8.6?	0.2?	
45.7	−0.4	19 16 25	+11 09	22	S	4.2?	0.4?	
46.8	−0.3	19 18 10	+12 09	17 × 13	S	14	0.5	(HC30)
49.2	−0.7	19 23 50	+14 06	30	S?	160?	0.3?	(W51)
53.6	−2.2	19 38 50	+17 14	33 × 28	S	8	0.75	3C400.2, NRAO 611

Table 1. (continued).

l	*b*	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
54.1	+0.3	19 30 31	+18 52	1.5	F?	0.5	0.1	
54.4	−0.3	19 33 20	+18 56	40	S	28	0.5	(HC40)
55.0	+0.3	19 32 00	+19 50	20 × 15?	S	0.5?	0.5?	
55.7	+3.4	19 21 20	+21 44	23	S	1.4	0.6	
57.2	+0.8	19 34 59	+21 57	12?	S?	1.8?	?	(4C21.53)
59.5	+0.1	19 42 33	+23 35	15	S	3?	?	
59.8	+1.2	19 38 55	+24 19	20 × 16?	?	1.6	0.5	
63.7	+1.1	19 47 52	+27 45	8	F	1.8	0.3	
65.1	+0.6	19 54 40	+28 35	90 × 50	S	5.5	0.61	
65.3	+5.7	19 33 00	+31 10	310 × 240	S?	52?	0.6?	
65.7	+1.2	19 52 10	+29 26	22	F	5.1	varies	DA 495
67.7	+1.8	19 54 32	+31 29	15 × 12	S	1.0	0.5	
68.6	−1.2	20 08 40	+30 37	23	?	0.7?	0.0?	
69.0	+2.7	19 53 20	+32 55	80?	?	120?	varies	CTB 80
69.7	+1.0	20 02 40	+32 43	16 × 14	S	2.0	0.7	
73.9	+0.9	20 14 15	+36 12	27	S?	9	0.23	
74.0	−8.5	20 51 00	+30 40	230 × 160	S	210	varies	Cygnus Loop
74.9	+1.2	20 16 02	+37 12	8 × 6	F	9	varies	CTB 87
76.9	+1.0	20 22 20	+38 43	9	?	1.2	0.60	
78.2	+2.1	20 20 50	+40 26	60	S	320	0.51	DR4, γ Cygni SNR
82.2	+5.3	20 19 00	+45 30	95 × 65	S	120?	0.5?	W63
83.0	−0.3	20 46 55	+42 52	9 × 7	S	1	0.4	
84.2	−0.8	20 53 20	+43 27	20 × 16	S	11	0.5	
85.4	+0.7	20 50 40	+45 22	24?	S	?	0.2	
85.9	−0.6	20 58 40	+44 53	24	S	?	0.2	
89.0	+4.7	20 45 00	+50 35	120 × 90	S	220	0.38	HB21
93.3	+6.9	20 52 25	+55 21	27 × 20	C?	9	0.45	DA 530, 4C(T)55.38.1
93.7	−0.2	21 29 20	+50 50	80	S	65	0.65	CTB 104A, DA 551
94.0	+1.0	21 24 50	+51 53	30 × 25	S	13	0.48	3C434.1
96.0	+2.0	21 30 30	+53 59	26	S	0.3	0.5	
106.3	+2.7	22 27 30	+60 50	60 × 24	C?	6	0.6	
108.2	−0.6	22 53 40	+58 50	70 × 54	S	8	0.5	
109.1	−1.0	23 01 35	+58 53	28	S	22	0.50	CTB 109
111.7	−2.1	23 23 26	+58 48	5	S	2720	0.77	Cassiopeia A, 3C461
113.0	+0.2	23 36 35	+61 22	40 × 17?	?	?	?	

Table 1. (continued).

l	b	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
114.3	+0.3	23 37 00	+61 55	90 × 55	S	5.5	0.5	
116.5	+1.1	23 53 40	+63 15	80 × 60	S	10	0.5	
116.9	+0.2	23 59 10	+62 26	34	S	8	0.61	CTB 1
119.5	+10.2	00 06 40	+72 45	90?	S	36	0.6	CTA 1
120.1	+1.4	00 25 18	+64 09	8	S	56	0.65	Tycho, 3C10, SN1572
126.2	+1.6	01 22 00	+64 15	70	S?	6	0.5	
127.1	+0.5	01 28 20	+63 10	45	S	12	0.45	R5
130.7	+3.1	02 05 41	+64 49	9 × 5	F	33	0.07	3C58, SN1181
132.7	+1.3	02 17 40	+62 45	80	S	45	0.6	HB3
156.2	+5.7	04 58 40	+51 50	110	S	5	0.5	
160.9	+2.6	05 01 00	+46 40	140 × 120	S	110	0.64	HB9
166.0	+4.3	05 26 30	+42 56	55 × 35	S	7	0.37	VRO 42.05.01
179.0	+2.6	05 53 40	+31 05	70	S?	7	0.4	
180.0	−1.7	05 39 00	+27 50	180	S	65	varies	S147
182.4	+4.3	06 08 10	+29 00	50	S	1.2	0.4	
184.6	−5.8	05 34 31	+22 01	7 × 5	F	1040	0.30	Crab Nebula, 3C144, SN1054
189.1	+3.0	06 17 00	+22 34	45	C	160	0.36	IC443, 3C157
192.8	−1.1	06 09 20	+17 20	78	S	20?	0.6?	PKS 0607+17
205.5	+0.5	06 39 00	+06 30	220	S	160	0.5	Monoceros Nebula
206.9	+2.3	06 48 40	+06 26	60 × 40	S?	6	0.5	PKS 0646+06
260.4	−3.4	08 22 10	−43 00	60 × 50	S	130	0.5	Puppis A, MSH 08−4*4*
261.9	+5.5	09 04 20	−38 42	40 × 30	S	10?	0.4?	
263.9	−3.3	08 34 00	−45 50	255	C	1750	varies	Vela (XYZ)
266.2	−1.2	08 52 00	−46 20	120	S	50?	0.3?	RX J0852.0−4622
272.2	−3.2	09 06 50	−52 07	15?	S?	0.4	0.6	
279.0	+1.1	09 57 40	−53 15	95	S	30?	0.6?	
284.3	−1.8	10 18 15	−59 00	24?	S	11?	0.3?	MSH 10−5*3*
286.5	−1.2	10 35 40	−59 42	26 × 6	S?	1.4?	?	
289.7	−0.3	11 01 15	−60 18	18 × 14	S	6.2	0.2?	
290.1	−0.8	11 03 05	−60 56	19 × 14	S	42	0.4	MSH 11−6*1*A
291.0	−0.1	11 11 54	−60 38	15 × 13	C	16	0.29	(MSH 11−6*2*)
292.0	+1.8	11 24 36	−59 16	12 × 8	C	15	0.4	MSH 11−5*4*
292.2	−0.5	11 19 20	−61 28	20 × 15	S	7	0.5	
293.8	+0.6	11 35 00	−60 54	20	C	5?	0.6?	
294.1	−0.0	11 36 10	−61 38	40	S	>2?	?	

Table 1. (continued).

l	b	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
296.1	−0.5	11 51 10	−62 34	37 × 25	S	8?	0.6?	
296.5	+10.0	12 09 40	−52 25	90 × 65	S	48	0.5	PKS 1209−51/52
296.8	−0.3	11 58 30	−62 35	20 × 14	S	9	0.6	1156−62
298.5	−0.3	12 12 40	−62 52	5?	?	5?	0.4?	
298.6	−0.0	12 13 41	−62 37	12 × 9	S	5?	0.3	
299.2	−2.9	12 15 13	−65 30	18 × 11	S	0.5?	?	
299.6	−0.5	12 21 45	−63 09	13	S	1.0?	?	
301.4	−1.0	12 37 55	−63 49	37 × 23	S	2.1?	?	
302.3	+0.7	12 45 55	−62 08	17	S	5?	0.4?	
304.6	+0.1	13 05 59	−62 42	8	S	14	0.5	Kes 17
308.1	−0.7	13 37 37	−63 04	13	S	1.2?	?	
308.8	−0.1	13 42 30	−62 23	30 × 20?	C?	15?	0.4?	
309.2	−0.6	13 46 31	−62 54	15 × 12	S	7?	0.4?	
309.8	+0.0	13 50 30	−62 05	25 × 19	S	17	0.5	
310.6	−0.3	13 58 00	−62 09	8	S	5?	?	Kes 20B
310.8	−0.4	14 00 00	−62 17	12	S	6?	?	Kes 20A
311.5	−0.3	14 05 38	−61 58	5	S	3?	0.5	
312.4	−0.4	14 13 00	−61 44	38	S	45	0.36	
312.5	−3.0	14 21 00	−64 12	20 × 18	S	3.5?	?	
315.1	+2.7	14 24 30	−57 50	190 × 150	S	?	?	
315.4	−2.3	14 43 00	−62 30	42	S	49	0.6	RCW 86, MSH 14−6*3*
315.4	−0.3	14 35 55	−60 36	24 × 13	?	8	0.4	
315.9	−0.0	14 38 25	−60 11	25 × 14	S	0.8?	?	
316.3	−0.0	14 41 30	−60 00	29 × 14	S	20?	0.4	(MSH 14−5*7*)
317.3	−0.2	14 49 40	−59 46	11	S	4.7?	?	
318.2	+0.1	14 54 50	−59 04	40 × 35	S	>3.9?	?	
318.9	+0.4	14 58 30	−58 29	30 × 14	C	4?	0.2?	
320.4	−1.2	15 14 30	−59 08	35	C	60?	0.4	MSH 15−5*2*, RCW 89
320.6	−1.6	15 17 50	−59 16	60 × 30	S	?	?	
321.9	−1.1	15 23 45	−58 13	28	S	>3.4?	?	
321.9	−0.3	15 20 40	−57 34	31 × 23	S	13	0.3	
322.5	−0.1	15 23 23	−57 06	15	C	1.5	0.4	
323.5	+0.1	15 28 42	−56 21	13	S	3?	0.4?	
326.3	−1.8	15 53 00	−56 10	38	C	145	varies	MSH 15−5*6*
327.1	−1.1	15 54 25	−55 09	18	C	7?	?	

Table 1. (continued).

l	*b*	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
327.2	−0.1	15 50 55	−54 18	5	S	0.4	?	
327.4	+0.4	15 48 20	−53 49	21	S	30?	0.6	Kes 27
327.4	+1.0	15 46 48	−53 20	14	S	1.9?	?	
327.6	+14.6	15 02 50	−41 56	30	S	19	0.6	SN1006, PKS 1459−41
328.4	+0.2	15 55 30	−53 17	5	F	15	0.0	(MSH 15−5*7*)
329.7	+0.4	16 01 20	−52 18	40 × 33	S	>34?	?	
330.0	+15.0	15 10 00	−40 00	180?	S	350?	0.5?	Lupus Loop
330.2	+1.0	16 01 06	−51 34	11	S?	5?	0.3	
332.0	+0.2	16 13 17	−50 53	12	S	8?	0.5	
332.4	−0.4	16 17 33	−51 02	10	S	28	0.5	RCW 103
332.4	+0.1	16 15 20	−50 42	15	S	26	0.5	MSH 16−5*1*, Kes 32
332.5	−5.6	16 43 20	−54 30	35	S	2?	0.7?	
335.2	+0.1	16 27 45	−48 47	21	S	16	0.5	
336.7	+0.5	16 32 11	−47 19	14 × 10	S	6	0.5	
337.0	−0.1	16 35 57	−47 36	1.5	S	1.5	0.6?	(CTB 33)
337.2	−0.7	16 39 28	−47 51	6	S	1.5	0.4	
337.2	+0.1	16 35 55	−47 20	3 × 2	?	1.5?	?	
337.3	+1.0	16 32 39	−46 36	15 × 12	S	16	0.55	Kes 40
337.8	−0.1	16 39 01	−46 59	9 × 6	S	18	0.5	Kes 41
338.1	+0.4	16 37 59	−46 24	15?	S	4?	0.4	
338.3	−0.0	16 41 00	−46 34	8	C?	7?	?	
338.5	+0.1	16 41 09	−46 19	9	?	12?	?	
340.4	+0.4	16 46 31	−44 39	10 × 7	S	5	0.4	
340.6	+0.3	16 47 41	−44 34	6	S	5?	0.4?	
341.2	+0.9	16 47 35	−43 47	22 × 16	C	1.5?	0.6?	
341.9	−0.3	16 55 01	−44 01	7	S	2.5	0.5	
342.0	−0.2	16 54 50	−43 53	12 × 9	S	3.5?	0.4?	
342.1	+0.9	16 50 43	−43 04	10 × 9	S	0.5?	?	
343.0	−6.0	17 25 00	−46 30	250	S	?	?	RCW 114
343.1	−2.3	17 08 00	−44 16	32?	C?	8?	0.5?	
343.1	−0.7	17 00 25	−43 14	27 × 21	S	7.8	0.55	
344.7	−0.1	17 03 51	−41 42	10	C?	2.5?	0.5	
345.7	−0.2	17 07 20	−40 53	6	S	0.6?	?	
346.6	−0.2	17 10 19	−40 11	8	S	8?	0.5?	
347.3	−0.5	17 13 50	−39 45	65 × 55	S?	?	?	

Table 1. (continued).

l	*b*	RA (J2000) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
348.5	−0.0	17 15 26	−38 28	10?	S?	10?	0.4?	
348.5	+0.1	17 14 06	−38 32	15	S	72	0.3	CTB 37A
348.7	+0.3	17 13 55	−38 11	17?	S	26	0.3	CTB 37B
349.2	−0.1	17 17 15	−38 04	9 × 6	S	1.4?	?	
349.7	+0.2	17 17 59	−37 26	2.5 × 2	S	20	0.5	
350.0	−2.0	17 27 50	−38 32	45	S	26	0.4	
350.1	−0.3	17 17 40	−37 24	4?	?	6?	0.8?	
351.2	+0.1	17 22 27	−36 11	7	C?	5?	0.4	
351.7	+0.8	17 21 00	−35 27	18 × 14	S	10	0.5?	
351.9	−0.9	17 28 52	−36 16	12 × 9	S	1.8?	?	
352.7	−0.1	17 27 40	−35 07	8 × 6	S	4	0.6	
353.6	−0.7	17 32 00	−34 44	30	S	2.5?	?	
353.9	−2.0	17 38 55	−35 11	13	S	1?	0.5?	
354.1	+0.1	17 30 28	−33 46	15 × 3?	C?	?	varies	
354.8	−0.8	17 36 00	−33 42	19	S	2.8?	?	
355.4	+0.7	17 31 20	−32 26	25	S	5?	?	
355.6	−0.0	17 35 16	−32 38	8 × 6	S	3?	?	
355.9	−2.5	17 45 53	−33 43	13	S	8	0.5	
356.2	+4.5	17 19 00	−29 40	25	S	4	0.7	
356.3	−0.3	17 37 56	−32 16	11 × 7	S	3?	?	
356.3	−1.5	17 42 35	−32 52	20 × 15	S	3?	?	
357.7	−0.1	17 40 29	−30 58	8 × 3?	?	37	0.4	MSH 17−39
357.7	+0.3	17 38 35	−30 44	24	S	10	0.4?	
358.0	+3.8	17 26 00	−28 36	38	S	1.5?	?	
358.1	+0.1	17 37 00	−29 59	20	S	2?	?	
358.5	−0.9	17 46 10	−30 40	17	S	4?	?	
359.0	−0.9	17 46 50	−30 16	23	S	23	0.5	
359.1	−0.5	17 45 30	−29 57	24	S	14	0.4?	
359.1	+0.9	17 39 36	−29 11	12 × 11	S	2?	?	