A Catalogue of Galactic Supernova Remnants

(2017 June version)

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If you make use of the detailed version of the catalogue, then please also cite:

- Green D. A., 2017, *'A Catalogue of Galactic Supernova Remnants (2017 June version)'*, Cavendish Laboratory, Cambridge, UK (available at `"http://www.mrao.cam.ac.uk/surveys/snrs/"`).

1. The Catalogue Format

This catalogue of Galactic supernova remnants (SNRs) is an updated version of those presented in detail in Green (1984, 1988) and in summary form in Green (1991, 1996, 2004, 2009, 2014) – hereafter Versions I, II, III, IV, V, VI and VII respectively – and on the World-Wide-Web, in versions of 1995 July, 1996 August, 1998 September, 2000 August, 2001 December, 2004 January, 2006 April and 2009 March. (Version IV, although published in 1996, was produced in 1993, and a detailed version of this was made available on the World-Wide-Web in 1993 November. The summary data from the 2001 December version of the catalogue was also published as an Appendix in Stephenson & Green 2002.)

This, the 2017 June version of the catalogue, contains 295 SNRs (which is one more than in the previous version; two remnants have been added, and one object removed), with over fifteen hundred references in the detailed listings, plus notes on many possible or probable remnants. For each remnant in the catalogue the following parameters are given.

- **Galactic Coordinates** of the source centroid, quoted to the nearest tenth of a degree as is conventional. (Note: in this catalogue additional leading zeros are not used.)
- **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.
- **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 usually deduced from radio maps rather than from X-ray or optical observations, and are for J2000.0.
- **Angular Size** of the remnant, in arcmin, usually taken from the highest resolution radio map 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.

- **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. Note that some young remnants – notably G111.7–2.1 (=Cassiopeia A) and G184.6–5.8 (=Crab Nebula) – show secular variations in their radio flux.
- **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.
- **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. Until recently only a few remnants were classified as composite remnants, as available observations were only able to identify the more obvious pulsar-powered, flatter radio spectrum filled-centre components within shells. However, in recent years improved observations – particularly in X-rays with the Chandra satellite – have identified many faint, pulsar powered nebulae in what until then had been identified as pure shell remnants. (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.)

In the detailed listings, for each remnant, notes on a variety of topics are given. First, it is noted if other Galactic coordinates have at times been used to label it (usually before good observations have revealed the full extent of the object), 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). Brief descriptions of the remnant from the available radio, optical and X-ray observations as applicable are then given, together with notes on available distance determinations, and any point sources or pulsars in or near the object (although they may not necessarily be related to the remnant). Finally, appropriate published 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 2016 in this version of the catalogue – and they should themselves include references to earlier work.

The references do not generally include large observational surveys – of particular interest in this respect are: the Effelsberg 100-m survey at 2.7 GHz of the Galactic plane $358° \le l \le 240°$, $|b| \le 5°$ by Reich *et al.* (1990) and Fürst *et al.* (1990a); reviews of the radio spectra of some SNRs by Kassim (1989), Kovalenko, Pynzar' & Udal'tsov (1994) and Trushkin (1998); the Parkes 64-m survey at 2.4 GHz of the Galactic plane $238° < l < 365°$, $|b| < 5°$ by Duncan *et al.* (1995) and Duncan *et al.* (1997); the Molonglo Galactic plane survey at 843 MHz of $245° < l < 355°$, $|b| < 1\overset{\circ}{.}5$ by Green *et al.* (1999); the survey of $345° < l < 255°$, $|b| < 5°$ at 8.35 and 14.35 GHz by Langston *et al.* (2000); Multi-Array Galactic Plane Imaging Survey (MAGPIS), see White, Becker & Helfand (2005) and Helfand *et al.* (2006); the VLA Galactic Plane Survey, see Stil *et al.* (2006); the survey of HI emission towards SNRs by Koo & Heiles (1991); surveys of IRAS observations of SNRs and their immediate surroundings by Arendt (1989) and by Saken, Fesen & Shull (1992); various Spitzer surveys of inner galaxy (Reach *et al.* 2006; Carey *et al.* 2009; Pinheiro Gonçalves *et al.* 2011); the catalogue by Fesen & Hurford (1996) of UV/optical/infra-red lines identified in SNRs; references to the first Fermi SNR catalogue (Acero *et al.* 2016) are included for the 30 'Classified Candidates' and 14 'Marginally Classified Candidates' remnants listed in Table 1, but not for the other remnants with non-detections. Also see Ferrand & Safi-Harb (2012), present a census of X-/γ-ray observations of Galactic SNRs and pulsar wind nebulae (PWNe), updates of which are available at `http://www.physics.umanitoba.ca/snr/SNRcat/`.

A summary of the data available for all 295 remnants in the catalogue is given in Table I. The other names for SNRs are listed in Table II, and the abbreviations for journals, proceedings and telescopes are listed in Table III. The detailed listings for each SNR are given in Table IV.

2. Revisions and Notes

2.1 Objects no longer thought to be SNRs

The following objects, which were listed in Version I of the catalogue were removed because they were no longer thought to be remnants, or were poorly observed (see Version II for references and further details): G2.4+1.4 (see also Gray 1994a; Goss & Lozinskaya 1995; Polcaro *et al.* 1995), G41.9–4.1 (=CTB 73, PKS 1920+06), G47.6+6.1 (=CTB 63), G53.9+0.3 (part of HC40), G93.4+1.8 (=NRAO 655), G123.2+2.9, G194.7+0.4 (the Origem Loop, but see below for more recent work), G287.8–0.5 (see below), G322.3–1.2 (=Kes 24) and G343.0–6.0 (but see below). G358.4–1.9, which was listed in Version IV of the catalogue, was removed, as following the discussion of Gray (1994a), as it is not clear that this is a SNR. G240.9–0.9, G299.0+0.2 and G328.0+0.3, which were listed in 1995 July version of the catalogue, were removed from the 1996 August version, following the improved observations of Duncan *et al.* (1996) and Whiteoak & Green (1996). For the 1998 September revision of the catalogue G350.0–1.8 was incorporated into G350.0–2.0, and G337.0–0.1 refers to a smaller remnant than that previously catalogued with the same name. G112.0+1.2, G117.4+5.0, G152.2–1.2 and G211.7–1.1 – which were reported as SNRs by Bonsignori-Facondi & Tomasi (1979) – were removed from the 2001 December version of the catalogue, as the first three of these are not confirmed as SNRs from the Canadian Galactic Plane Survey (Roland Kothes, private communication). G10.0–0.3, which was regarded as a remnant – possibly associated with a soft-gamma repeater – was removed from the 2004 January version of the catalogue, as it is now thought to be radio nebula powered by a stellar wind (see Gaensler *et al.* 2001, Corbel & Eikenberry 2004, and references therein). G166.2+2.5 (=OA 184) was removed from the 2006 April version of the catalogue, as it was identified as an HII region by Foster *et al.* (2006). G84.9+0.5 was removed from Version VI of the catalogue, as it was identified as an HII region by Foster *et al.* (2007; see also Kothes *et al.* 2006). G16.8–1.1 was removed from the Version VII version of the catalogue (Sun *et al.* 2011; Stupar & Parker 2011).

In this version of the catalogue G192.8–1.1 has been removed. Gao *et al.* (2011) had shown this is not a SNR, and it was erroneously not removed in the Version VII version of the catalogue (see also Kang, Koo & Byun 2014).

The following objects, which have been reported as SNRs, but have not been included in any of the versions of the SNR catalogue, have subsequently been shown not to be SNRs.

- G70.7+1.2, which was reported as a SNR by Reich *et al.* (1985), but this has not been confirmed by later observations (see Green 1986; de Muizon *et al.* 1988; Becker & Fesen 1988; Caswell 1988; Bally *et al.* 1989; Phillips, Onello & Kulkarni 1993; Onello *et al.* 1995; Cameron & Kulkarni 2007).
- G81.6+1.0 a possible SNR in W75 reported by Ward-Thompson & Robson (1991). From the published data (see the observations in Wendker, Higgs & Landecker 1991) it was noted in Version IV of the catalogue that this is thermal source not a SNR, because of its thermal radio spectrum, and high infrared-to-radio emission (see also the subsequent discussion by Wendker *et al.* 1993).
- Green & Gull (1984) suggested G227.1+1.0 as a very young SNR, but subsequent observations (Channan *et al.* 1986; Green & Gull 1986) have shown that this is most likely an extragalactic source, not an SNR.
- A candidate SNR, G274.7–2.8, identified by Helfand & Channan (1989), has been shown not to be a SNR by Caswell & Stewart (1991).
- G159.6–18.5, was suggested as a SN by Pauls & Schwartz (1989), from IRAS and other observations, but is probably an HII region (see Andersson *et al.* 2000).
- G25.5+0.2, which was reported as a very young SNR by Cowan *et al.* (1989), although this identification was not certain (see White & Becker 1990; Green 1990; Zijlstra 1991). Sramek *et al.* (1992) report the detection of recombination lines from this source (also see Subrahmanyan *et al.* 1993). Becklin *et al.* (1994) identify G25.5+0.2 as a ring nebula around a luminous blue star. See also Clark, Steele & Langer (2000), and Phillips & Ramos-Larios (2008) who identified G25.5+0.2 as a possible symbiotic outflow.
- Several of the possible SNRs listed by Gorham (1990) – following up SNR candidates suggested by Kassim (1988) – have been shown not to be SNRs by Gorham, Kulkarni & Prince (1993).
- G203.2–12.3, a optical ring about 3 arcmin in diameter, was reported as a possible SNR by Winkler & Reipurth (1992), but was shown to be a Herbig–Haro object (HH 311) by Reipurth, Bally & Devine (1997).
- G247.8+4.9 was noted as a possible optical SNR by Weinberger (1995), but is listed as a probable planetary nebula (PN) in the MASH PN catalogue (see Parker *et al.* 2006).
- G359.87+0.18 was reported as a possible young SNR near the Galactic Centre by Yusef-Zadeh, Cotton & Reynolds (1998), but was shown to be a radio galaxy by Lazio *et al.* (1999).
- G104.7+2.8, a possible SNR suggested by Green & Joncas (1994), which instead appears to be an HII region, based on the improved observations by Kothes *et al.* (2006).

- G106.6+2.9, a small remnant proposed by Halpern *et al.* (2001), is incorporated into the larger catalogued remnant G106.3+2.7.
- Morris *et al.* (2006) suggested small remnant observed by Spitzer, which has subsequently instead been identified as a likely PN by Fesen & Milisavljevic (2010), see also Mizuno *et al.* (2010).
- Leahy, Tian & Wang (2008) proposed that a large radio shell, G53.9+0.2, as a possible SNR. As noted above, this feature was included, as G53.9+0.3 (part of HC40), in Version I of the catalogue, but was subsequently removed, following the discussions of Caswell (1985) who concluded is was a thermal source (see also Velusamy, Goss & Arnal 1986) – results which Leahy *et al.* did not take into account. See also Zychová & Ehlerova (2016).

Some entries in the catalogue have been renamed, due to improved observations revealing a larger true extent for the object (previously G5.3–1.0 is now G5.4–1.2; G308.7+0.0 is now incorporated into G308.8–0.1). G337.0–0.1 now refers to a small (1.5 arcmin) remnant, rather than larger supposed remnant at this position (see Sarma *et al.* 1997), and G350.0–2.0 now incorporates the previously catalogued G350.0–1.8, based on the improved observations of Gaensler (1998).

2.2 New SNRs

The following remnants were added to Version II of the catalogue: G0.9+0.1, G1.9+0.3, G5.9+3.1, G6.4+4.0, G8.7–0.1, G18.9–1.1, G20.0–0.2, G27.8+0.6, G30.7+1.0, G31.5–0.6, G36.6–0.7, G42.8+0.6, G45.7–0.4, G54.1+0.3, G73.9+0.9, G179.0+2.6, G312.4–0.4, G357.7+0.3 and G359.1–0.5.

The following remnants were added to Version III of the catalogue: G4.2–3.5, G5.2–2.6, G6.1+1.2, G8.7–5.0, G13.5+0.2, G15.1–1.6, G16.7+0.1, G17.4–2.3, G17.8–2.6, G30.7–2.0, G36.6+2.6, G43.9+1.6, G59.8+1.2, G65.1+0.6, G68.6–1.2, G69.7+1.0, G279.0+1.1, G284.3–1.8 (=MSH 10–53), G358.4–1.9 and G359.0–0.9 (although, as noted above, G358.4–1.9 was subsequently removed).

The following remnants were added to Version IV of the catalogue: G59.5+0.1, G67.7+1.8, G84.9+0.5, G156.2+5.7, G318.9+0.4, G322.5–0.1, G343.1–2.3 and G348.5–0.0 (although, as noted above, G84.9+0.5 was subsequently removed).

The following remnants were added to 1995 July version of the catalogue: G1.0–0.1, G1.4–0.1, G3.7–0.2, G3.8+0.3, G28.8+1.5, G76.9+1.0, G272.2–3.2, G341.2+0.9, G354.1+0.1, G355.6–0.0, G356.3–0.3, G356.3–1.5 and G359.1+0.9.

The following remnants were added to the 1996 August version of the catalogue: G13.3–1.3, G286.5–1.2, G289.7–0.3, G294.1–0.0, G299.2–2.9, G299.6–0.5, G301.4–1.0, G308.1–0.7, G310.6–0.3, G310.8–0.4, G315.9–0.0, G317.3–0.2, G318.2+0.1, G320.6–1.6, G321.9–1.1, G327.4+1.0, G329.7+0.4, G342.1+0.9, G343.1–0.7, G345.7–0.2, G349.2–0.1, G351.7+0.8, G351.9–0.9 and G354.8–0.8.

The following remnants were added to the 1998 September version of the catalogue: G0.3+0.0, G32.1–0.9, G55.0+0.3, G63.7+1.1 and G182.4+4.3.

The following remnants were added to the 2000 August version of the catalogue: G7.0–0.1, G16.2–2.7, G29.6+0.1, G266.2–1.2 and G347.3–0.5.

The following remnants were added to the 2001 December version of the catalogue: G4.8+6.2, G28.6–0.1, G85.4+0.7, G85.9–0.6, G106.3+2.7, G292.2–0.5, G343.0–6.0, G353.9–2.0, G356.2+4.5 and G358.0+3.8.

G312.5–3.0 was added to Version V of the catalogue.

The following remnants were added to the 2006 April version of the catalogue: 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, G21.5–0.1, G32.4+0.1, G96.0+2.0, G113.0+0.2 and G337.2+0.1.

The following remnants were added to Version VI of the catalogue: G83.0–0.3, G108.2–0.6, G315.1+2.7, G332.5–5.6, G327.2–0.1, G350.1–0.3, G353.6–0.7, G355.4+0.7, G358.1+1.0 and G358.5–0.9. Note that G358.1+1.0 was in Versions VI and VII with the wrong name, G358.1+0.1, which has been corrected in this revision.

The following remnants were added to Version VII of the catalogue: G21.6–0.8, G25.1–2.3, G35.6–0.4, G38.7–1.3, G41.5+0.4, G42.0–0.1, G64.5+0.9, G65.8–0.5, G66.0–0.0, G67.6+0.9, G67.8+0.5, G152.4–2.1, G159.6+7.3, G178.2–4.2, G190.9–2.2, G213.0–0.6, G296.7–0.9, G306.3–0.9, G308.4–1.4, G310.6–1.6 and G322.1+0.0.

The following two remnants have been added to this version of the catalogue.

- G351.0–5.4, identified by de Gasperin *et al.* (2014) from radio and other observations.
- A new, very high latitude remnant, G70.0–21.5, identified from optical observations by Fesen *et al.* (2015). Previously Boumis *et al.* (2002) had noted optical filaments in this region, which they suggested were indicative of one or more SNRs.

2.3 Possible and probable SNRs not listed in the catalogue

The following are possible or probable SNRs for which further observations are required to confirm their nature or parameters.

2.3.1 Radio

- A possible SNR near the Galactic centre reported by Ho *et al.* (1985) from radio observations (see also Coil & Ho 2000; Lu, Wang & Lang 2003; Senda, Murakami & Koyama 2003, Zhang *et al.* 2014, and references therein).
- Gosachinskiĭ (1985) reported evidence for non-thermal radio emission, presumably from SNRs, associated with several bright, thermal Galactic sources. Some of these sources have been included in the catalogue, following improved observations (but also see Odegard 1986, who questions the reliability of some of Gosachinskiĭ's results, and also suggest another possible SNR, G7.6–0.6).
- G300.1+9.4, a possible SNR nearly 2° in diameter reported by Dubner, Colomb & Giacani (1986).
- Routledge & Vaneldik (1988) report a possible faint radio shell SNR nearly 2° in diameter, near the young pulsar PSR 1930+22 – see also Gómez-González & del Romero (1983), who report a smaller (about 40 arcmin) possible SNR (G57.1+1.7) associated with this pulsar, and see Caswell, Landecker & Feldman (1985) and Kovalenko (1989).
- Gorham (1990) lists many SNR candidates from the Clark Lake 30.9 MHz survey of the first quadrant, following Kassim (1988), although several have been shown not to be SNRs by Gorham, Kulkarni & Prince (1993). Gorham *et al.* do report a poorly defined possible remnant G41.4+1.2. See also Aharonian *et al.* (2008a) for observations of γ- and X-ray emission possibly associated with one of the candidates (G44.6+0.1) listed by Gorham.
- Four possible remnants (G45.9–0.1, G71.6–0.5, G72.2–0.3 and G85.2–1.2) of the eleven reported by Taylor, Wallace & Goss (1992) from a radio survey of part of the Galactic plane (see also Kothes *et al.* 2006). (Five of the other possible SNRs reported by Taylor *et al.*, are included in the catalogue as G55.0+0.3, G59.5+0.1, G63.7+1.1, G76.9+1.0 and G83.0–0.2, following improved observations which have confirmed their nature.)
- G356.6+0.1, G357.1–0.2, G358.7+0.7, G359.2–1.1, G3.1–0.6 and G4.2+0.0, which are among the possible SNRs listed by Gray (1994b) from radio observations near the Galactic centre. See also Roy & Pramesh Rao (2002) who present additional observations of G356.6+0.1, G357.1–0.2 and G3.1–0.6 which they consider as possible SNRs, and Bhatnagar (2002) for additional observations of G4.2+0.0 which appears to be a thermal source.
- Duncan *et al.* (1995) and Duncan *et al.* (1997) list several large-scale (1.5 to 10 degree), and smaller, low radio surface-brightness candidate SNRs from the Parkes 2.4-GHz survey of $270° < l < 360°$. Several of these candidates have been confirmed as SNRs by subsequent, improved observations, and are included in the catalogue. See also: Walker & Zealey (1998) for details of an optical shell around the Coalsack Nebula (near $l = 300°$, $b = 0°$) which overlaps one of these candidates; Camilo *et al.* (2004), Chang *et al.* (2012) and Danienko *et al.* (2012) for further observations of another, G309.8–2.6, which is near a young pulsar; and Russeil *et al.* (2005), who detected optical filaments from a third.
- Whiteoak & Green (1996), from their radio survey of much of the southern Galactic plane, list many possible SNRs, several of which have been included in the catalogue, following improved observations, while most (G317.5+0.9, G319.9–0.7, G320.6–0.9, G322.7+0.1, G322.9–0.0, G323.2–1.0, G324.1+0.1, G325.0–0.3, G331.8–0.0, G337.2+0.1, G339.6–0.6, G345.1+0.2, G345.1–0.2, and G348.8+1.1) have not. See also Hui & Becker (2007) for X-ray observations of G319.9–0.7.
- Several candidate SNRs reported by Combi & Romero (1998), Combi, Romero & Arnal (1998), Combi, Romero & Benaglia (1998), Punsly *et al.* (2000) and Combi *et al.* (2001).

- A possible SNR, near l = 313°, which is close to an unidentified Galactic plane γ-ray source (see Roberts *et al.* 1999), and to a pulsar (Roberts, Romani & Johnston 2001). See also Aharonian *et al.* (2006).
- G359.07–0.02, a possible SNR noted by LaRosa *et al.* (2000), see also Nakashima *et al.* (2010).
- A possible SNRs near G6.4–0.1 (=W28) noted by Yusef-Zadeh *et al.* (2000). (A second possible remnant noted by Yusef-Zadeh *et al.* has been included in the catalogue, as G6.5–0.4, following the improved observations of it by Brogan *et al.* 2006).
- Gaensler *et al.* (2000), in a search for pulsar wind nebulae, found a small shell of radio emission near PSR B1356–60 – which they designate G311.28+1.09 – which may be a supernova remnant.
- A possible SNR, G328.6–0.0, noted by McClure-Griffiths *et al.* (2001) in the test region of the Southern Galactic Plane Survey.
- G346.5–0.1, an arc of radio emission observed by Gaensler *et al.* (2001), which is potentially part of a SNR, but requires further observations to confirm its nature.
- Giacani *et al.* (2001) presented observations of a pulsar wind nebula around PSR J1709–4428, which may be part of the catalogued remnant G343.1–2.3, or may represent another object.
- Several possible SNRs reported by Trushkin (2001), which were identified from Galactic radio surveys (one of which, G6.1+0.5, is included in the catalogue, due to improved subsequent observations).
- Two possibles SNRs (G336.1–0.2 and G352.2–0.1) discussed briefly by Manchester *et al.* (2002).
- G282.8–1.2, a possible young SNR noted by Misanovic, Cram & Green (2002).
- G43.5+0.6, one of three possible SNRs identified by Kaplan *et al.* (2002); the other two are included in the catalogue as subsequent observations have shown they have non-thermal radio spectra.
- Two candidate large SNRs (diameters of approximately 3° and 1°.6) are reported from radio surveys in the Galactic anticentre by Reich (2002), although their coordinates are not given. See also Soberski, Reich & Wielebinski (2005).
- G107.5–1.5, a probable remnant identified at by Kothes (2003), but the full extent of which is not well defined at present (see also Kothes *et al.* 2006; Jackson, Safi-Harb & Kothes 2014).
- Zhang (2003) identified four candidate SNRs from radio surveys. One of these – called G41.9+0.04 by Zhang – overlaps G42.0–0.1. A second – G74.8+0.63 – which Zhang identified as a possible remnant partly on the basis of its non-thermal radio spectrum, actually has a flat, thermal radio spectrum, an has long been identified as an HII region (e.g. Weiler & Shaver 1978; Pineault & Chastenay 1990). Another of the sources – G47.8+2.03 – also may have a thermal radio spectrum, given its published 2.7-GHz flux density (Fürst *et al.* 1990b).
- Brogan *et al.* (2006) identify 35 new SNRs in the region $4°.5 < l < 22°$, $|b| < 1°.25$, of which the 31 which are classed as 'I' or 'II' (i.e. those thought to be very or fairly confidently identified as SNRs) were included in the 2006 version of the catalogue. Four other possible SNRs – labelled G5.71–0.08, G6.31+0.54, G15.51–0.15 and G19.13+0.90 – which comprise Brogan *et al.*'s class 'III', are not included in the catalogue, as further observations are required to confirm their nature and better define their parameters (see also Aharonian *et al.* 2008b and Hewitt & Yusef-Zadeh *et al.* 2009).
- Helfand *et al.* (2006) list many SNR candidates in the region $5° < l < 32°$, $|b| < 0°.8$ from MAGPIS. Many of these correspond to sources in Brogan *et al.*, and several are included in the catalogue, with the others requiring further observations. One of these candidates, G29.07+0.45, is known planetary nebula (Abell 1955, 1966; see also Todt *et al.* 2013, Frew *et al.* 2014). See also Johanson & Kerton (2009).
- Martí *et al.* (2007), report extended radio emission near the X-ray source KS 1741–295 near the Galactic centre which may be a SNR (see also Cherepashchuk 1994).
- A poorly defined possible SNR, near l = 151°, b = 3° has been reported by Kerton, Murphy & Patterson (2007).
- Roberts & Brogan (2008) propose a new SNR, G7.5–1.7, from non-thermal radio emission near an pulsar wind nebula, although currently the extent of the remnant is not well defined.

- Anderson *et al.* (2012) report extended radio emission near a magnetar which may be a SNR designated G333.9+0.0 (see also Kijak *et al.* 2013).
- G354.4+0.0 a possible small remnant reported by Roy & Pal (2013) from radio observations.
- Five candidate remnants, G108.5+11.0, G128.5+2.6, G149.5+3.2, G150.8+3.8 and G160.1–1.1, are identified from radio surveys by Gerbrandt *et al.* (2014). One of these, G150.8+3.8, is part of larger candidate SNR G150.3+4.5 identified by Gao & Han (2014).
- Sidorin *et al.* (2014) note that there is possibly non-thermal radio emission near $l = 51\fdg0$, $b = 0\fdg0$), overlapping GLIMPSE bubble N107, which may indicate a SNR.
- Kothes *et al.* (2014) report the discovery of a new PWN, G141.2+5.0, which lies within an HI cavity, which might be an indication of remnant. See also Reynolds & Borkowski (2016).
- Green, Reeves & Murphy (2014) list over twenty candidate SNRs identified in the second epoch Molonglo Galactic Plane Survey. Two of these, G296.7–0.9 and G308.4–1.4 were added in Version VII of the catalogue, based on other available observations. Several of the others are previously reported candidate SNRs (e.g. Whiteoak & Green 1996; Duncan *et al.* 1997).
- A region of non-thermal radio emission, NGC 6334D (near $l = 351\fdg6$, $b = 0\fdg2$) is suggested as a possible SNR by Demetroullas *et al.* (2015). However, existing higher resolution observations (e.g. the SGPS, Haverkorn *et al.* 2006) resolve this into a double source, which makes the remnant identification unlikely. (Also note the coordinates of some figures in Demetroullas *et al.* are in error.)
- Bihr *et al.* (2016) present radio observations in the regions $l = 14\fdg0$–$37\fdg9$ and $l = 47\fdg1$–$51\fdg2$, $|b| \leq 1\fdg1$, which includes many of the candidates in Helfand *et al.* (2006).
- A sample of 'giant radio sources' identified in the Northern VLA Sky Survey (NVSS, Condon *et al.* 1998) is presented by Proctor (2016). One of these sources, NVGRC J205051.1+312728, is labelled 'SNR?', but is actually part of the Cygnus Loop (=G74.0–8.5). Several other of these sources also correspond to known SNRs, including other parts of the Cygnus Loop.

2.3.2 UV/Optical/Infra-red

- Winkler *et al.* (1989) report a possible small (4 arcmin) SNR within the Puppis A remnant, from optical observations. This has not been detected at radio wavelengths (see Dubner *et al.* 1991).
- A possible SNR (G32.1+0.1) reported from optical spectroscopy by Thompson, Djorgovski & de Carvalho (1991), following up radio and infrared observations of Jones, Garwood & Dickey (1988), although this appears to have a thermal radio spectrum.
- G75.5+2.4, a possible large (about 2°) old SNR in Cygnus suggested by Nichols-Bohlin & Fesen (1993) from infra-red and optical observations (see also Dewdney & Lozinskaya 1994; Marston 1996; Esipov *et al.* 1996; Kothes *et al.* 2006).
- Two possible SNRs, G340.5+0.7 and G342.1+0.1, identified by Walker, Zealey & Parker (2001) from filaments seen in Hα survey observations.
- A probable SNR which was identified by Bally & Reipurth (2001) – which they label as G110.3+11.3 – from optical filaments (and which is also associated with a large HI and CO cavity, and soft X-ray enhancement). See also Rector & Schweiker (2013).
- A possible remnant, near $l = 70°$, $b = 2°$ noted by Mavromatakis & Strom (2002), for which Kothes *et al.* (2006) do not find any radio counterpart.
- A possible remnant identified from optical filaments to the NE of the known SNR G116.5+1.1, as observed by Mavromatakis *et al.* (2005).
- Russell *et al.* (2007) report a small (about 7 arcmin in extent) optical ring, which is very faint at radio wavelengths, just to the NW of Cyg X-1, which may be a SNR if it is not associated with Cyg X-1 (see also Gallo *et al.* 2005).
- Stupar, Parker & Filipović (2008) report several SNRs identified from Hα observations, several of which correspond to SNR candidates first suggested by Duncan *et al.* (1995, 1997) from radio observations. The full extent of most of these are not well defined, but two are currently included in the main catalogue (G315.1+2.7, and G332.5–5.6).
- Mavromatakis *et al.* (2009) report a candidate SNR, G70.5+1.9, from optical observations.
- Optical filaments indicating a possible new SNR, G304.4–3.1 are presented by Stupar, Parker & Filipović (2010).
- Stupar, Parker & Filipović (2011) report a possible new SNR, G310.5–0.8, identified from optical filaments and associated radio emission.

2.3.3 X-ray/γ-ray

- H1538–32 a large X-ray source in Lupus, near l = 307°, b = +20° (Riegler, Agrawal & Gull 1980; see also Colomb, Dubner & Giacani 1984; Gahm *et al.* 1990) which is a possible old SNR.
- G189.6+3.3, a faint, possible SNR overlapping G189.1+3.0 (=IC443) identified by Asaoka & Aschenbach (1994) from ROSAT X-ray observations (see also Lee *et al.* 2008).
- G117.7+0.6, a faint shell of soft X-ray emission near G116.9+0.2 (=CTB 1), which contains a pulsar (Hailey & Craig 1995; see also Craig, Hailey & Pisarski 1997, Esposito *et al.* 2008 and Kothes *et al.* 2006).
- A possible SNR identified in X-rays around the pulsar B1828–13 suggested by see Finley, Srinivasan & Park (1996), see also Braun, Goss & Lyne (1986) and Pavlov, Kargaltsev & Brisken (2008).
- A possible, large SNR, G69.4+1.2, identified as an X-ray shell by Yoshita, Miyata & Tsunemi (1999, 2000). See also Mavromatakis, Boumis & Paleologou (2002) and Kothes *et al.* (2006).
- Schaudel *et al.* (2002) report 14 candidate SNRs identified in the ROSAT All-Sky Survey, and provided images for 3 of these (all of which have been included in this version of the catalogue – as G38.7–1.3, G296.7–0.9 and G308.4–1.4 – following improved observations of them, see Section 2.2).
- G0.570–0.018 a small ring of X-ray emission near the Galactic Centre, which has been proposed as a very young remnant by Senda, Murakami & Koyama (2002, 2003), see also Renaud *et al.* (2006).
- Senda *et al.* (2003) also identify two other possible SNRs near the Galactic Centre from their X-ray emission (see also Mori *et al.* 2008 for further observations of one of these, G359.79–0.26).
- Several possible SNRs reported by Bamba *et al.* (2003) and Ueno *et al.* (2005, 2006), two of which have been included in the catalogue (as G28.6–0.1 and G32.4+0.1), as additional observations confirm their nature. One of the proposed remnants is called G11.0+0.0, but is larger than the currently catalogued G11.0–0.0. The nature of a second, G25.5+0.0, has been questioned by Kargaltsev *et al.* (2012), who also proposed another, smaller possible SNR, G25.25+0.28, which corresponds to one of the candidates listed by Helfand *et al.* (2006). For a third source, G23.5+0.1, Kargalstev *et al.* prefer a pulsar wind nebula interpretation (see also Yamauchi, Sumita & Bamba 2016).
- An excess of Fe X-ray line emission in Sgr B, near l = 0°.61, b = 0°.01 may be from a SNR (Koyama *et al.* 2007).
- Nobukawa *et al.* (2008) report a region of X-ray emission, G0.42–0.04, near the Galactic centre, which may be part of a SNR.
- An extended region of X-ray emission, near l = 356°.8, b = –1°.7 is reported as a possible SNR by Tomsick *et al.* (2009).
- Henley & Shelton (2009) report a possible large (∼ 10°) SNR at high Galactic latitudes, from the ROSAT All-Sky Survey.
- A candidate SNR in the Sagittarius C region, designated G359.41–0.12, was identified in X-rays by Tsuru *et al.* (2009).
- Sawada *et al.* (2009) propose a possible SNR, G1.2–0.0, from X-ray observations (see also Law, Yusef-Zadeh & Cotton 2008 for radio observations).
- Brief details a possible new SNR identifed from the Swift X-ray Galactic Plane Survey are reported by Reynolds *et al.* (2012).
- Heard & Warwick (2013) report on X-ray emission which may be the core of a SNR, which they designate G0.13–0.12.
- The TeV γ-ray source MGRO J2019+37 is discussed by Saha & Bhattcharjee (2014) as either a PWN or SNR. (Note that declination for the source given by Saha & Bhattcharjee is wrong.)
- XMM-Newton observations near the Galactic Centre (Ponti *et al.* 2015) include several candidate SNRs.
- Nobukawa *et al.* (2015) present Suzaku observations which indicate a likely SNR near l = 26°.4, b = –0°.2.

2.3.4 Other

- G287.8–0.5, which is associated with η Carinae, was listed in Version I as a SNR, but was removed from the catalogue in Version II as its parameters are uncertain (see Jones 1973; Retallack 1984; Tateyama, Strauss & Kaufmann 1991; and the discussion in Version II).
- G359.2–0.8 (the 'mouse'), near the Galactic centre, which has been suggested as being analogous to the central region of G69.0+2.7 (=CTB 80) by Predehl & Kulkarni (1995), i.e. a pulsar powered nebula (see also Camilo *et al.* 2002).

It should also be noted: (a) Some large radio continuum, HI or CO loops in the Galactic plane (e.g. Berkhuijsen 1973) may be parts of very large, old SNRs, but they have not been included in the catalogue. See also Grenier *et al.* (1989), Combi *et al.* (1995), Maciejewski *et al.* (1996), Kim & Koo (2000), Normandeau *et al.* (2000), Woermann, Gaylard & Otrupcek (2001), Stil & Irwin (2001), Uyanıker & Kothes (2002), Olano, Meschin & Niemela (2006), Borka (2007), Kang, Koo & Salter (2012), Xiao & Zhu (2014), Cichowolski *et al.* (2014), Sallmen *et al.* (2015). Gao & Han (2013) discuss the nature of the Origem Loop – a large radio loop – which has at times been regarded as a remnant. Also Koo, Kang & Salter (2006) and Kang & Koo (2007) identify faint Galactic HI features at forbidden velocities as indicators of old, otherwise undetectable SNRs. (b) Some large ($> 10°$) regions of X-ray emission that are indicative of a SNR are not included in the catalogue; e.g. the Monogem ring, near $l = 203°$, $b = +12°$ (see Nousek *et al.* 1981, Plucinsky *et al.* 1996, Thorsett *et al.* 2003, Amenomori *et al.* 2005, Plucinsky 2009, and references therein, plus Weinberger, Temporin & Stecklum 2006, for observations of optical filaments); in the Gum Nebula near $l = 250°$, $b = 0°$ (see Leahy, Nousek & Garmire 1992, and also see Reynolds 1976, Dubner *et al.* 1992, Duncan *et al.* 1996, Reynoso & Dubner 1997, Heiles 1998, Pagani *et al.* 2012, Purcell *et al.* 2015); in Eridanus near $l = 200°$, $b = –40°$ (see Naranan *et al.* 1976, Burrows *et al.* 1993, Snowden *et al.* 1995, Heiles 1998, Boumis *et al.* 2001, Ryu *et al.* 2006); a large approximately 24° diameter, X-ray and optical loop in Antlia (see McCullough, Fields & Pavlidou 2002, Shinn *et al.* 2007). (c) The distinction between filled-centre remnants and pulsar wind nebulae (PWNe) is not clear, and isolated, generally faint, pulsar wind nebulae are also not included in the catalogue. See the catalogue of PWNe by Kaspi, Roberts & Harding (2006) (also `http://www.physics.mcgill.ca/~pulsar/pwncat.html`), and the high-energy SNR and PWNe catalogue noted at the end of Section 1.

2.4 Questionable SNRs listed in the catalogue

As noted in Versions II and IV of the catalogue, the following sources are listed as SNRs, although, as discussed in each case, the identifications are not certain: G5.4–1.2, G39.7–2.0 (=W50), G69.0+2.7 (=CTB 80), G318.9+0.4 and G357.7–0.1. The nature of G76.9+1.0 (an unusual radio source similar to G65.7+1.2), and of G354.1+0.1 (which may be similar to G357.7–0.1 (=MSH 17–3*9*)) are also uncertain (see Landecker, Higgs & Wendker 1993 and Frail, Goss & Whiteoak 1994). Also, Pinheiro Gonçalves *et al.* (2011) suggest that G23.6+0.3, and possibly G14.3+0.1 may be HII regions, rather than SNRs.

There are also some objects that have been identified as SNRs and are listed in the catalogue, although they have been barely resolved in the available observations, or are faint, and have not been well separated from confusing background or nearby thermal emission, and their identification as SNRs, or at least their parameters remain uncertain.

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l	*b*	RA (J2000.0) (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	0.5	
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	
11.2	–0.3	18 11 27	–19 25	4	C	22	0.5	
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?	

l	*b*	RA (J2000.0) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
14.1	–0.1	18 16 40	–16 41	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?	0.0?	
15.4	+0.1	18 18 02	–15 27	15×14	C?	5.6	0.62	
15.9	+0.2	18 18 52	–15 02	7×5	S?	5.0	0.63	
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	2.5	0.4	
16.4	–0.5	18 22 38	–14 55	13	S	4.6	0.3?	
16.7	+0.1	18 20 56	–14 20	4	C	3.0	0.6	
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	5	0.5?	
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	5	0.5	
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	0.46	Kes 67
18.9	–1.1	18 29 50	–12 58	33	C?	37	0.39	
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	0.1	
20.4	+0.1	18 27 51	–11 00	8	S?	9?	0.1?	
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	5	C	7	varies	
21.5	–0.1	18 30 50	–10 09	5	S	0.4	0.5	
21.6	–0.8	18 33 40	–10 25	13	S	1.4	0.5?	
21.8	–0.6	18 32 45	–10 08	20	S	65	0.56	Kes 69
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?	
25.1	–2.3	18 45 10	–08 00	80×30?	S	8	0.5?	
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	0.63	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	25	varies	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

l	*b*	RA (J2000.0) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
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	20	0.51	Kes 79, 4C00.70, HC13
34.7	–0.4	18 56 00	+01 22	35×27	C	240	0.37	W44, 3C392
35.6	–0.4	18 57 55	+02 13	15×11	S?	9	0.5	
36.6	–0.7	19 00 35	+02 56	25?	S?	1.0	0.7?	
36.6	+2.6	18 48 49	+04 26	17×13?	S	0.7?	0.5?	
38.7	–1.3	19 06 40	+04 28	32×19?	S	?	?	
39.2	–0.3	19 04 08	+05 28	8×6	C	18	0.34	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	0.4	
41.1	–0.3	19 07 34	+07 08	4.5×2.5	S	25	0.50	3C397
41.5	+0.4	19 05 50	+07 46	10	S?	1?	?	
42.0	–0.1	19 08 10	+08 00	8	S?	0.5?	?	
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	0.46	W49B
43.9	+1.6	19 05 50	+10 30	60?	S?	9.0	0.5	
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	17	0.54	(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	0.50	3C400.2, NRAO 611
54.1	+0.3	19 30 31	+18 52	12?	C?	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?	0.3?	
57.2	+0.8	19 34 59	+21 57	12?	S?	1.8	0.62	(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?	?	1.5	0.0	
63.7	+1.1	19 47 52	+27 45	8	F	1.8	0.24	
64.5	+0.9	19 50 25	+28 16	8	S?	0.15?	0.5	
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?	42	0.6	
65.7	+1.2	19 52 10	+29 26	22	F	5.1	varies	DA 495
65.8	–0.5	19 59 20	+28 38	10×6?	S	?	?	
66.0	–0.0	19 57 50	+29 03	31×25?	S	?	?	
67.6	+0.9	19 57 45	+30 53	50×45?	S	?	?	
67.7	+1.8	19 54 32	+31 29	15×12	S	1.0	0.61	
67.8	+0.5	20 00 00	+30 51	7×5	?	?	?	
68.6	–1.2	20 08 40	+30 37	23	?	1.1	0.2	
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	
70.0	–21.5	21 24 00	+19 23	330×240	S	?	?	
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	C	2?	?	

l	*b*	RA (J2000.0) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
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	0.45	3C434.1
96.0	+2.0	21 30 30	+53 59	26	S	0.35	0.6	
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	0.45	CTB 109
111.7	–2.1	23 23 26	+58 48	5	S	2400	0.77	Cassiopeia A, 3C461
113.0	+0.2	23 26 50	+61 26	40×17?	?	4	0.5?	
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	0.57	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	0.58	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
152.4	–2.1	04 07 50	+49 11	100×95	S	3.5?	0.7?	
156.2	+5.7	04 58 40	+51 50	110	S	5	0.5	
159.6	+7.3	05 20 00	+50 00	240×180?	S	?	?	
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
178.2	–4.2	05 25 05	+28 11	72×62	S	2	0.5	
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	0.5	0.4	
184.6	–5.8	05 34 31	+22 01	7×5	F	960	0.30	Crab Nebula, 3C144, SN1054
189.1	+3.0	06 17 00	+22 34	45	C	165	0.36	IC443, 3C157
190.9	–2.2	06 01 55	+18 24	70×60	S	1.3?	0.7?	
205.5	+0.5	06 39 00	+06 30	220	S	140	0.4	Monoceros Nebula
206.9	+2.3	06 48 40	+06 26	60×40	S?	6	0.5	PKS 0646+06
213.0	–0.6	06 50 50	–00 30	160×140?	S	21	0.4	
260.4	–3.4	08 22 10	–43 00	60×50	S	130	0.5	Puppis A, MSH 08–44
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	

l	*b*	RA (J2000.0) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
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?	?	
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
296.7	–0.9	11 55 30	–63 08	15×8	S	3	0.5	
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
306.3	–0.9	13 21 50	–63 34	4	S?	0.16?	0.5?	
308.1	–0.7	13 37 37	–63 04	13	S	1.2?	?	
308.4	–1.4	13 41 30	–63 44	12×6?	S?	0.4?	?	
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	–1.6	14 00 45	–63 26	2.5	C?	?	?	
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	

l	*b*	RA (J2000.0) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
322.1	+0.0	15 20 49	–57 10	8×4.5?	S?	?	?	
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?	?	
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	8	C?	2.5?	0.3?	
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?	30?	?	RX J1713.7–3946
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	

l	*b*	RA (J2000.0) (h m s)	Dec (° ′)	size /arcmin	type	Flux at 1 GHz/Jy	spectral index	other name(s)
350.0	–2.0	17 27 50	–38 32	45	S	26	0.4	
350.1	–0.3	17 21 05	–37 27	4?	?	6?	0.8?	
351.0	–5.4	17 46 00	–39 25	30	S	?	?	
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	–1.5	17 42 35	–32 52	20×15	S	3?	?	
356.3	–0.3	17 37 56	–32 16	11×7	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	+1.0	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?	?	

γ Cygni SNR	G78.2+2.1
1156–62	G296.8–0.3
1814–24	G7.7–3.7
3C10	G120.1+1.4
3C58	G130.7+3.1
3C144	G184.6–5.8
3C157	G189.1+3.0
3C358	G4.5+6.8
3C391	G31.9+0.0
3C392	G34.7–0.4
3C396	G39.2–0.3
3C396.1	G32.0–4.9
3C397	G41.1–0.3
3C400.2	G53.6–2.2
3C434.1	G94.0+1.0
3C461	G111.7–2.1
4C–04.71	G27.4+0.0
4C00.70	G33.6+0.1
(4C21.53)	G57.2+0.8
4C(T)55.38.1	G93.3+6.9
CTA 1	G119.5+10.2
CTB 1	G116.9+0.2
(CTB 33)	G337.0–0.1
CTB 37A	G348.5+0.1
CTB 37B	G348.7+0.3
CTB 80	G69.0+2.7
CTB 87	G74.9+1.2
CTB 104A	G93.7–0.2
CTB 109	G109.1–1.0
Cassiopeia A	G111.7–2.1
Crab Nebula	G184.6–5.8
Cygnus Loop	G74.0–8.5
DA 495	G65.7+1.2
DA 530	G93.3+6.9
DA 551	G93.7–0.2
DR4	G78.2+2.1

HB3	G132.7+1.3
HB9	G160.9+2.6
HB21	G89.0+4.7
HC13	G33.6+0.1
HC24	G39.2–0.3
(HC30)	G46.8–0.3
(HC40)	G54.4–0.3
IC443	G189.1+3.0
Kepler	G4.5+6.8
Kes 17	G304.6+0.1
Kes 20A	G310.6–0.3
Kes 20B	G310.8–0.4
Kes 27	G327.4+0.4
Kes 32	G332.4+0.1
Kes 40	G337.3+1.0
Kes 41	G337.8–0.1
Kes 67	G18.8+0.3
Kes 69	G21.8–0.6
Kes 75	G29.7–0.3
Kes 78	G32.8–0.1
Kes 79	G33.6+0.1
Lupus Loop	G330.0+15.0
MSH 08–4*4*	G260.4–3.4
MSH 10–5*3*	G284.3–1.8
MSH 11–5*4*	G292.0+1.8
MSH 11–6*1*A	G290.1–0.8
(MSH 11–6*2*)	G291.0–0.1
(MSH 14–5*7*)	G316.3–0.0
MSH 14–6*3*	G315.4–2.3
MSH 15–5*2*	G320.4–1.2
MSH 15–5*6*	G326.3–1.8
(MSH 15–5*7*)	G328.4+0.2
MSH 16–5*1*	G332.4+0.1
MSH 17–3*9*	G357.7–0.1
Milne 56	G5.4–1.2
Monoceros Nebula	G205.5+0.5

NRAO 593	G39.2–0.3
NRAO 611	G53.6–2.2
PKS 0646+06	G206.9+2.3
PKS 1209–51/52	G296.5+10.0
PKS 1459–41	G327.6+14.6
Puppis A	G260.4–3.4
R5	G127.1+0.5
RCW 86	G315.4–2.3
RCW 89	G320.4–1.2
RCW 103	G332.4–0.4
RCW 114	G343.0–6.0
RX J0852.0–4622	G266.2–1.2
RX J1713.7–3946	G347.3–0.5
S147	G180.0–1.7
SN1006	G327.6+14.6
SN1054	G184.6–5.8
SN1181	G130.7+3.1
SN1572	G120.1+1.4
SN1604	G4.5+6.8
SS433	G39.7–2.0
Sgr A East	G0.0+0.0
Tycho	G120.1+1.4
Vela (XYZ)	G263.9–3.3
VRO 42.05.01	G166.0+4.3
W28	G6.4–0.1
(W30)	G8.7–0.1
W41	G23.3–0.3
W44	G34.7–0.4
W49B	G43.3–0.2
W50	G39.7–2.0
(W51)	G49.2–0.7
W63	G82.2+5.3

Journals

AcASn	Acta Astronomica Sinica
AdSpR	Advances in Space Research
A&A	Astronomy & Astrophysics
A&AS	Astronomy & Astrophysics Supplement
AJ	Astronomical Journal
AN	Astronomische Nachrichten
ApJ	Astrophysical Journal
ApJS	Astrophysical Journal Supplement
ApL	Astrophysical Letters
ApS&S	Astrophysics & Space Science
ARep	Astronomy Reports
AstL	Astronomy Letters
ATel	The Astronomer's Telegram
AuJPA	Australian Journal of Physics Astrophysical Supplement
AuJPh	Australian Journal of Physics
BASI	Bulletin of the Astronomical Society of India
BSAO	Bulletin of the Special Astrophysics Observatory
ChJAA	Chinese Journal of Astronomy & Astrophysics
CSci	Current Science
JApA	Journal of Astrophysics & Astronomy
JKAS	Journal of Korean Astronomical Society
JPhCS	Journal of Physics Conference Series
MNRAS	Monthly Notices of the Royal Astronomical Society
NuPhS	Nuclear Physics B Proceedings Supplements
OAP	Odessa Astronomical Publications
PASA	Proceedings of the Astronomical Society of Australia
PASJ	Publications of the Astronomical Society of Japan
PASP	Publications of the Astronomical Society of the Pacific
P&SS	Planetary and Space Science
RMxAA	Revista Mexicana de Astronomía y Astrofísica
SerAJ	Serbian Astronomical Journal
SvA	Soviet Astronom
SvAL	Soviet Astronomy Letters

Proceedings etc.

ASPC Astronomical Society of the Pacific (ASP) Conference Series

EFXU is *'Suzaku-MAXI 2014: Expanding the Frontiers of the X-ray Universe'*, eds Ishida M., Petre R. & Mitsuda K., 2014.

IAUCo International Astronomical Union (IAU) Colloquium

IAUS International Astronomical Union (IAU) Symposium

ICRC International Cosmic Ray Conference

LNP Lecture Notes in Physics

NSPS is *'Neutron Stars, Pulsars, and Supernova Remnants'*, (MPE Report 278), eds Becker W., Lesch H. & Trümper J., (Max-Plank-Institut für extraterrestrische Physik, Garching bei München), 2002.

XRRC is *'X-Ray and Radio Connections'*, eds Sjouwerman L. O. & Dyer K. K., (available at `http://www.aoc.nrao.edu/events/xraydio/`), 2005.

Radio Telescopes/Surveys

ATCA	Australia Telescope Compact Array
BIMA	Berkeley–Illinois–Maryland Array
GGPS	Canadian Galactic Plane Survey
DRAO	Dominion Radio Astrophysical Observatory
FIRST	Fleurs Synthesis Telescope
GBT	Green Bank Telescope
LOFAR	Low-Frequency Array
MOST	Molonglo Observatory Synthesis Telescope
NRAO	National Radio Astronomy Observatory
NRO	Nobeyama Radio Observatory
SGPS	Southern Galactic Plane Survey
TPT	Clark Lake Teepee-Tee telescope
VGPS	VLA Galactic Plane Survey
VLA	Very Large Array
WSRT	Westerbork Synthesis Radio Telescope

Satellites

Optical/IR: Akari, Herschel (also sub-mm), HST (Hubble Space Telescope), ISO (Infrared Space Observatory), IRAS (Infrared Astronomical Satellite), Spitzer, WISE (Wide-field Infrared Survey Explorer).

X-/γ-ray: ASCA (Advanced Satellite for Cosmology and Astrophysics), BeppoSAX, Chandra, Einstein, EXOSAT (European X-ray Observatory Satellite), Fermi, Ginga, INTEGRAL (International Gamma-Ray Astrophysics Laboratory), NuSTAR (Nuclear Spectroscopic Telescope Array), ROSAT (Röntgensatellit), RXTE (Rossi X-ray Timing Explorer), Suzaku, Swift, XMM-Newton (X-ray Multi-Mirror).