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OBSERVATIONAL DATA ON GALACTIC SUPERNOVA REMNANTS: I. THE SUPERNOVA REMNANTS WITHIN $l = 0° - 90°$

O. H. Guseinov[1,2], A. Ankay[1] and S. O. Tagieva[3]

[1] *TÜBİTAK Feza Gürsey Institute 81220 Çengelköy, İstanbul, Turkey*

[2] *Akdeniz University, Department of Physics, Antalya, Turkey*

[3] *Academy of Science, Physics Institute, Baku 370143, Azerbaijan Republic*

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SUMMARY: We have collected all the available data on Galactic supernova remnants given in the literature. The data on Galactic supernova remnants located in the Galactic longitude interval l=0°–90° in all the spectral bands are presented in this work. We have established values of distance for the SNRs by examining these data. The data on various kinds on neutron stars connected to these supernova remnants are given. Not only the data, but also the comments to some of the authors and ourselves on the data and on some properties of both the supernova remnants and the point sources are given.

Key words. Catalogs – ISM: supernova remnants – Stars: neutron

1. INTRODUCTION

This is the first of a series of papers which present all the available data on Galactic supernova remnants (SNRs) from radio to gamma-ray bands, together with the data on point sources connected to these SNRs. In this work, data for the SNRs (and the related point sources) located in the Galactic longitude interval 0°–90° are given. In the other two articles, data of the SNRs (and the related point sources) in the intervals 90°–270° and 270°–360° will be presented.

A catalogue of Galactic SNRs was compiled by Green (2001). It includes 231 SNRs and about 20 SNR candidates. The data on SNRs in the radio band given in Green (2001) are: angular size, flux at 1 GHz, spectral index, morphological type of SNR, and in some cases, distance. Since angular sizes of SNRs can not be determined easily (particularly for the SNRs with low surface brightness), for many of the SNRs flux values and angular sizes are labeled by question marks. There are 179 S-type, 27 C-type and 9 F-type SNRs including roughly determined (or dubious) types (e.g. S?); for 16 of the SNRs types are given as unknown. There are some additional SNRs (together with their available data) in this work which are not present in Green (2001). The SNR types given in Green's catalogue are due to the data only in the radio band, so that, a SNR which is known to be pure S-type in the radio band may be, for example, C-type when the X-ray data are considered together with the radio data. The data in the γ-ray, X-ray, and optical bands given in the literature are not present in Green (2001), only some remarks and references about such data are provided. Our aim was to collect all the available data on Galactic SNRs, to make a preliminary analysis of the data and to adopt distances for these SNRs as precisely as possible. Since there is no catalogue other than Green's (2001), which contains data of Galactic SNRs, in this work all the data of Galactic SNRs are put together for the first time. In Whiteoak and Green (1999), radio maps of some SNRs are presented.

We have collected the radio and the X-ray data, in many cases also the infrared observations, to show the existence of molecular clouds and maser sources. In some cases the data in visual and ultraviolet bands are also given to get information about the chemical abundances and filaments of SNRs. These data can be used to examine the explosion energies, the densities of the ambient media in which the SNRs evolve, the initial masses of the progenitors, the changes in the parameters of the SNRs during their evolution, different types of point sources in the SNRs, and the mechanisms which lead to differences in the types of these point sources. The chemical abundance may give us some information about the mass of the progenitor.

As known, SNRs are the sources of cosmic rays and it is important to examine SNRs to get information about the accelerations of electrons and protons. Here, it is necessary to have information about the character of X-ray radiation and the origin of γ-ray radiation. Therefore, we also present the data about the 'hard' radiations. We have not only collected the data of SNRs which were determined directly from observations, but we have also included the data found using various models and approaches. In particular, we have used the data presented in this work to construct an improved Σ–D relation, where Σ is the surface brightness of the SNR and D is its diameter. We have adopted distances for all the Galactic SNRs with available data by considering the distances found from our Σ–D relation, together with all the distance values given in the literature and determined by various different methods, and the data related with the distance, e.g. examining the density of the environment and the locations of the star formation regions in the direction of the SNR, (Guseinov et al. 2003a; for a review of empirical Galactic and extragalactic Σ-D relations see Urošević 2002). Radio data of SNRs (morphological type, spectral index, angular size and 1 GHz flux) given in parenthesis after the name of the SNR are taken from Green (2001). Σ values, also given in the parenthesis, were calculated using the 1 GHz flux and angular size values given in Green (2001). For all the other data, except the adopted distance values and the distances found from our Σ–D relation represented in Guseinov et al. (2003a), the references are given. The abbreviations used in the text for common observed quantities of SNRs are as follows (the units are given in parenthesis):

1) **SNR type (radio):** S = Shell; F = Filled Center (Plerion); C = Composite
2) **The average angular size of the SNR:** θ (arcmin)
3) **Radio spectral indices of the shell, the plerionic part, and the whole SNR:** α
4) **Distance:** d (kpc)
5) **Column density of neutral hydrogen:** N_{HI} (cm^{-2})
6) **Interstellar optical absorption:** A_V (mag)
7) **Spectral indices for the X-ray radiation of the shell, the plerionic part, and the whole SNR:** SI
8) **Radio flux at 1 GHz:** F (Jy)
9) **Flux in X-ray band:** F_x (erg cm^{-2} s^{-1})
10) **Temperature in the shell and the plerionic part:** kT (keV)
11) **Velocity of the shock front or the expansion velocity:** V (km/s)
12) **Surface brightness (at 1 GHz):** Σ (W m^{-2} Hz^{-1} sr^{-1})
13) **Luminosity in X-ray band:** L_x (erg/s)
14) **For SNR environment density and clouds:**
a) **Molecular cloud:** MC
b) **Maser source (due to interaction of SNR with MC):** MS
c) **Dust cloud:** DS
d) **Number density of particles in front of the SNR, in the shell, in the plerionic part, or in different types of clouds and filaments:** n (cm^{-3})
15) **Kinetic energy of the shell and the plerionic part:** E_k
16) **Age of the SNR:** t (kyr)
17) **Explosion energy of the SNR:** E (erg)
18) **X-ray radiated mass:** M_x ($M_\odot$)
19) **Ejected mass:** M_{Ej} ($M_\odot$)
20) **Swept-up mass:** M_s ($M_\odot$)
21) **Magnetic field:** B (mG)

Abbreviations for data of the point sources connected to SNRs are given as:
1) **Radio pulsar:** PSR
2) **Neutron star:** NS
3) **Ratio of the angular distance of the point source from the geometric center of the SNR to the half of the average angular size of the SNR:** $\beta \equiv 2\Delta\theta/\theta$
4) **Spin period:** P (s)
5) **Time derivative of spin period:** $\dot{P}$ (s/s)
6) **Characteristic age of point source:** τ (kyr)
7) **Dispersion measure:** DM (pc/cm^3)
8) **Radio flux values at 400 MHz and 1400 MHz:** F_{400}, F_{1400}
9) **Radio luminosity at 1400 MHz:** L_{1400} (Jy kpc^2)
10) **Pulsar wind (powered) nebula:** PWN
11) **Spectral index:** SI
12) **Space velocity:** V (km/s)
13) **Visual apparent magnitude:** m_V (mag)
14) All other physical quantities of point sources are presented in the form similar to SNRs'.

2. OBSERVATIONAL DATA FOR SNRs AND POINT SOURCES

SNR G0.0+0.0 (Sgr A East, S, α=0.8?, θ=3.5×2.5, F=100?, Σ=1.72×10^{-18})
d=8.5 kpc, d=3.6 kpc (Σ-D), d=8.5 kpc adopted.
N_{HI}=5×10^{22} cm^{-2} [1]; A_V=27-31 [1]; B≅3×10^{-3} G [2]; MS [3].
Remarks: It is well known that this SNR is located at the center of the Galaxy. The medium at the center is very different compared to other parts of the Galaxy. Its spectral index is a bit larger than Cas A's spectral index, so that there may be some contribution to its luminosity from another source with a larger spectral index. The flux of this SNR has not yet been determined precisely. Because of these reasons, despite the fact that its distance is well known, this SNR can not be used as a calibrator.
[1] Predehl and Trumper 1994; [2] Koralesky et al. 1998a; [3] Yusef-Zadeh et al. 1995.

SNR G0.3+0.0 (S, α=0.6, θ=15×8, F=22, Σ=2.76×10^{-20})
d=5.1 kpc (Σ-D), d=5.4 kpc adopted.

SNR G0.9+0.1 (C, α-varies, θ=8, F=18?, Σ=4.23×10^{-20})
θ=8′ for radio shell [3]; α=0.77 (shell), α=0.12 (plerionic part) [5].
d=10 kpc [1,2], d=10±3 kpc [6], d=5.9 kpc (Σ-D), d=8 kpc adopted.
N_{HI}=10^{23} cm^{-2} [3]; SI=2 [3]; F_x=6.6×10^{-12} erg/cm^{2}s (2-10 keV) [3]; F_x <3×10^{-12} erg/cm^{2}s (2-10 keV), L<3.4×10^{34} erg/s if d=10 kpc [3]; L_x= 7.1×10^{34} erg/s [3]; t=(1-7)×10^3 yrs [2].
Remarks: Southern part of the SNR interacts with the MC [3]. The center of the plerionic part was observed to find an X-ray pulsar with a period in the range 4 ms − 4×10^4 s but nothing has been found, though theoretical calculations show that there must be a PSR at an age of about 2700 yrs [3]. PWN was found in the SNR's central region [1] and later this was observed in X-ray band [2,3]. For PWN F_x=9.6×10^{-12} erg/cm^{2}s in 2-10 keV, SI=2.3, N_{HI}=1.6×10^{23} cm^{-2}. There must be a PSR as the source of this PWN. The PWN is larger than Crab's (∼0.4 pc) and Vela's (∼0.03 pc) PWNe and it has roughly the same size of PSR B1509-58's PWN (∼1.5 pc). The reason of this may be the ambient medium being less dense, n<∼0.001 cm^{-3} [4].
[1] Helfand and Becker 1987, [2] Mereghetti et al. 1998, [3] Sidoli et al. 2000, [4] Gaensler et al. 2001, [5] La Rosa et al. 2000; [6] Crawford et al. 2002a.

SNR G1.0-0.1 (S, α=0.6?, θ=8, F=15, Σ=3.53×10^{-20})
d=6.4 kpc (Σ-D), d=6.4 kpc adopted.

SNR G1.4-0.1 (S, α=?, θ=10, F=2?, Σ=3.01×10^{-21})
d=13 kpc (Σ-D), d=13 kpc adopted. MS [1].
[1] Yusef-Zadeh et al. 1999.

SNR G1.9+0.3 (S, α=0.7, θ=1.2, F=0.6, Σ=6.27×10^{-20})
d=34 kpc (Σ-D), d=20 kpc adopted.

SNR G3.7-0.2 (S, α=0.65, θ=14×11, F=2.3, Σ=2.25×10^{-21})
d=11 kpc (Σ-D), d=11 kpc adopted.

SNR G3.8+0.3 (S?, α=?, θ=18, F=4?, Σ=1.86×10^{-21})
d=7.8 kpc (Σ-D), d=7.8 kpc adopted.

SNR G4.2-3.5 (S, α=0.6?, θ=28, F=3.2?, Σ=6.14×10^{-22})
d=6 kpc (Σ-D), d=6 kpc adopted.

SNR G4.5+6.8 (Kepler, SN 1604, S, α=0.64, θ=3, F=19, Σ=3.18×10^{-19})
d=4.8±1.4 kpc [1], 5 kpc [2], 4.5±1 kpc [3], 4.1±0.9 kpc [4], d=4.4 kpc from the historical date and d=4.8-6.4 kpc from HI [5], d=7.1 kpc (Σ-D), d=4.8 kpc adopted.
V_s=1550-2000 km/s [6], V_s=4700 km/s [9], V_s=2000-2500 km/s [10]; R∝$t^{0.93}$ [6]; kT=$3.1^{+0.5}_{-0.4}$ keV [7].
Remarks: Cas A, Kepler and Crab show a low Hα/|NII| ratio and a high density, while old, decelerated SNRs have a Hα/|NII| ratio ≅2.0 and a Hα/|SII| ratio close to the low density limit (≤100 cm^{-3}). HII regions show a Hα/|NII| ratio higher than SNRs do and a density generally lower than 1000 cm^{-3} [8].
As Kepler is about 500 pc far away from the Galactic plane the medium it is located in is not dense. For an SNR in a low density medium its surface brightness value must be much less than the surface brightness value corresponding to its diameter so that its distance value must be much less than the distance value found from the Σ-D relation.
Balmer-dominated shock has been detected in SNR Kepler [10].
[1] Reynoso and Goss 1999; [2] Borkowski et al. 1992; [3] Bandiera 1987; [4] Braun 1987; [5] Green 2001; [6] Hughes 1999; [7] Kinugasa and Tsunemi 1999; [8] Sabbadin 1976; [9] Crawford et al. 2002b; [10] Sollerman et al. 2003.

SNR G4.8+6.2 (S, α=0.6, θ=18, F=3, Σ=1.39×10^{-21})
d=8.2 kpc (Σ-D), d=6.2 kpc adopted.

SNR G5.2-2.6 (S, α=0.6?, θ=18, F=2.6?, Σ=1.21×10^{-21})
d=8.4 kpc (Σ-D), d=8.4 kpc adopted.

SNR G5.27-0.9
Point Source PSR J1801-2451
Remarks: PSR J1801-2451 was most likely born about 15 kyr ago in or near the Crab-like remnant G5.27-0.9 (the "head") and is almost certainly unrelated to the much larger G5.4-1.2 (the "wings"). From direct interferometric proper motion measurements V=120 km/s at 5 kpc (μ∼5 mas/yr) [1].
[1] Thorsett et al. 2002.

SNR G5.4-1.2 (Milne 56, C?, α=0.2?, θ=35, F=35?, Σ=4.30×10^{-21})
d=4.5 kpc from 21 cm HI [1], d≅5 kpc [2], d>4.3

kpc from 21 cm HI [3], d=3.4 kpc (Σ-D), d=4.5 kpc adopted.
In front of the SNR $n_0>3\times10^{-3}$ cm^{-3} [4]; $M_s>8$ $M_\odot$ [4]; $t=1.4\times10^4$ yrs [2]; $V_{expa}>2000$ km/s (shell) [4].
Point Source PSR J1801-2451
SNR-PSR J1801-2451 [1]; β=0.8 [7,11], $\beta\sim1$ [8].
d=4.5 kpc [5], d=4.4 kpc [6].
P=0.1249 s [5]; $\dot{P}=1.28\times10^{-13}$ [5]; DM=289 pc/cm^3 [5]; V∼2000 km/s (from SNR G5.4-1.2–PSR J1801-2451 connection) [9]; $\tau=1.5\times10^4$ yrs [5]; log L_{1400}=1.15 [5].
Remark:There is no connection between SNRG5.4-1.2 and PSRJ1801-2451[10].
[1] Frail et al. 1994a; [2] Caswell et al. 1987; [3] Green 2001; [4] Frail et al. 1994b; [5] Guseinov et al. 2003b; [6] Taylor et al. 1996; [7] Allakhverdiev et al. 1997; [8] Lorimer et al. 1998; [9] Frail and Kulkarni 1991; [10] Thorsett et al. 2002; [11] Brazier and Johnston 1999.
SNR G5.9+3.1 (S, α=0.4?, θ=20, F=3.3?, $\Sigma=1.24\times10^{-21}$)
d=7.5 kpc (Σ-D), d=7.5 kpc adopted.
SNR G6.1+1.2 (F, α=0.3?, θ=30×26, F=4.0?, $\Sigma=7.72\times10^{-22}$)
SNR G6.4-0.1 (W28, C, α-varies, θ=42, F=310, $\Sigma=2.64\times10^{-20}$)
C-type in X-ray [6]; d=3.5-4 kpc [1], d=2.5 kpc [2], d=1.2 kpc (Σ-D), d=2.5 kpc adopted.
$N_{HI}=(7\text{-}11)\times10^{21}$ cm^{-2}, $N_{HI}=3.5\times10^{21}$ [4], $N_{HI}=4.7\times10^{21}$ cm^{-2} [5,6]; E(B-V)=1-1.3 [4]; $F_x=6.2\times10^{-11}$ erg/cm^{2}s (0.5-2.4 keV) [6]; kT=0.52 keV [5,6]; V=590 km/s [6]; $L_x=(3\text{-}9)\times10^{34}$ erg/s (1-4 keV) for d=2-6 kpc [4], $L_x=4\times10^{35}$ erg/s (0.5-2.4 keV) for d=3 kpc [6]; n_0=0.1 [4], n_0=0.23 [6] (average value in front of the SNR); $t=2.5\times10^3$ yrs [4], $t=(1\text{-}2.5)\times10^4$ yrs [6], $t=(3.5\text{-}15)\times10^4$ yrs [7,8], $t=6\times10^4$ yrs [16]; $E=10^{51}$ erg [4], $E=4\times10^{50}$ erg [6]; M_x=19-26 $M_\odot$ [4]; B=0.2 mG (in the shell) [20], B∼2 mG (in the location of the maser source) [10]; MS [9,10,15,18,19]; MC $n=10^5$ cm^{-3} [9,10], $n=2.5\times10^4$ cm^{-3} [11,12], $n_0=2.5\times10^4$ cm^{-3} [15,17,18], n_0=30 (average value in the shell) [16].
Remarks: No TeV radiation has been observed from this SNR [8]. Since, the medium is highly dense, the adopted distance is much greater than the distance value found from Σ-D relation. In this direction, there is SGR OB1 (d=1.6 kpc). A_V and N_{HI} values of this OB-association's members are, on the average, 1 mag and 2×10^{21} cm^{-2}, respectively [3]. A_V=3-4 mag and $N_{HI}>3.5\times10^{21}$ cm^{-2} so that the SNR must be at a larger distance than SGR OB1. The diameter of this remnant has reached to the average values and it is now out of the HII region which was formed by the progenitor of this remnant. As the swept up mass increased the mass of the shell very much, the expansion velocity of the shell has decreased down to about 40-80 km/s [4,13,14,15]. If the explosion energy of the SNR is 10^{51} erg, then the swept up mass must be about $\leq2\times10^4$ $M_\odot$. To sweep up such a mass average density of the medium must be $n_0\leq5$ cm^{-3}. The SNR is in a very dense medium [9,10]. Even though the medium is very dense, no H_2O maser emission has been detected. Such emission occurs in the regions with kinetic temperatures 25 K < T < 200 K and with molecular hydrogen densities 10^3 cm^{-3} < n < 10^5 cm^{-3} due to the interaction between shock wave and clouds [10]. Angular diameter of the SNR is 48′ and the surface brightness at 1 GHz is $\sim1.8\times10^{20}$ Wm^{-2}Hz^{-1}sterad^{-1}. The eastern part of the SNR interacts with a molecular cloud and this increases its radio and X-ray emission. There are many maser and HII regions. Energy of the relativistic particles is 2×10^{47} erg. The SNR is C-type also in the X-ray band. It is expanding in a very thick medium [21]. The observed gamma-ray flux is $(55.9\pm6.6)\times10^{-8}$ photons/cm^{2}s [22].
[1] Green 2001; [2] Sakhibov and Smirnov 1983; [3] Aydın et al. 1997; [4] Long et al. 1991; [5] Rho and Petre 1998; [6] Rho et al. 1996; [7] Kaspi et al. 1993; [8] Rowell et al. 2000; [9] Claussen et al. 1997; [10] Claussen et al. 1999a; [11] Wooten 1981; [12] Denoyer 1983; [13] Lozinskaya 1974; [14] Bohigas et al. 1983; [15] Frail et al 1994a; [16] Marsden et al. 2000; [17] Denoyer 1979; [18] Frail et al. 1996; [19] Reach and Rho 1998; [20] Koralesky et al. 1998b; [21] Dubner et al. 2000; [22] Esposito et al. 1996.
SNR G6.4+4.0 (S, α=0.4?, θ=31, F=1.3?, $\Sigma=2.04\times10^{-22}$)
d=6.5 kpc (Σ-D), d=6.5 kpc adopted.
SNR G7.0-0.1 (S, α=0.5?, θ=15, F=2.5?, $\Sigma=1.67\times10^{-21}$)
d=9.5 kpc (Σ-D), d=9.5 kpc adopted.
SNR G7.7-3.7 (1814-24, S, α=0.32, θ=22, F=11, $\Sigma=3.42\times10^{-21}$)
d=5.8 kpc (Σ-D), d=5.8 kpc adopted.
SNR G8.7-5.0 (S, α=0.3, θ=26, F=4.4, $\Sigma=9.80\times10^{-22}$)
d=6.0 kpc (Σ-D), d=5.2 kpc adopted.
SNR G8.7-0.1(W30, S?, α=0.5, θ=45, F=80, $\Sigma=5.95\times10^{-21}$)
d=5-6 kpc (kinematic) [1], d=6 kpc [3], d=2.3 kpc (Σ-D), d=3.5 kpc adopted.
$V=(5.3\text{-}7.5)\times10^2$ km/s [3]; n_0=0.03 (average value in front of the SNR) [3]; $t=3\times10^4$ yrs [3]; $E=(1\text{-}4)\times10^{51}$ erg [3]; M_s=200-500 $M_\odot$ [3];
Point Source PSR J1803-2137
(Radio and X-ray Pulsar)
d=3.5 kpc[4];β=0.7[2].
Remarks: In this direction, 1-2 kpc distant from the Sun, there is PSR 1800-21 in front of the SNR and there is no relation between the PSR and this SNR [2]. The age of this radio and X-ray pulsar is 1.6×10^4 yrs and log L_{1400}=2.25, log L_{400}=2.45 [4].
[1] Kassim and Weiler 1990; [2] Frail et al. 1994a; [3] Finley and Ögelman 1994; [4] Guseinov et al. 2003b.
SNR G9.8+0.6 (S, α=0.5, θ=12, F=3.9, $\Sigma=4.08\times10^{-21}$)
d=10.1 kpc (Σ-D), d=12 kpc adopted.
SNR G10.0-0.3 (?, α=0.8, θ=8?, F=2.9,

Σ=6.82×10^{-21})
F-type in X-ray, α=0.6 [2]; d=11 kpc [3], d=14.5 kpc [4], d=12.4 kpc (Σ-D), d=13 kpc adopted; MS, MC [1]; t=10^4 yrs [5].

Possible Connection to Point Source SGR 1805.7-2025

β=0.5 [5]; P=7.47 s [12]; $\dot{P}$=8.3×10^{-11} [12], $\dot{P}$=(8.1-11.7)×10^{-11} [13], $\dot{P}$=8×10^{-11} [14], $\dot{P}$=2.3×10^{-10} [15]; τ=1.96 kyr; d∼14.5 kpc [12,14,15,16], d=10 kpc [17,18], d=14.5 kpc [19]; F_x=10^{-11} erg/cm^{2}s (0.5-10 keV) [12,17], F_x=1.3×10^{-11} erg/cm^{2}s (2-10 keV) [14], F_x=2×10^{-11} erg/cm^{2}s (0.5-10 keV) [15]; L_x=2×10^{35} erg/s (2-10 keV) [12], L_x∼10^{35} erg/s (2-10 keV) at d=10 kpc [17], L_x=4×10^{35} erg/s (2-10 keV) at d=15 kpc [14], L_x=10^{35} erg/s (0.5-10 keV) [18]; N_{HI}=6×10^{22} cm^{-2} [18,20], N_{HI}=5.6×10^{22} cm^{-2} [17], N_{HI}=6×10^{22} cm^{-2} [14]; SI=2.2 (in quiescent state) [17,18], SI=2.25 [14], SI=2-3.2 [21]; V=800 km/s [5], V=500 km/s [6].

Remarks: If the adopted distance is true then the diameter of this SNR is 28 pc. This SNR, with such a large diameter and with α=0.6-0.8, may be C-type. There may be a connection between the SNR and the SGR, but the probability of the connection to be real is not as high as in the case of anomalous X-ray pulsars [7]. The SNR nature of G10.0-0.3 is uncertain [8]. Jet has been observed from this source [9,10]. A cyclotron feature at 5.0 keV has been observed. If this is a proton cyclotron line, then B≅10^{15} Gauss [11]. The pulse fraction values of this SGR are: ∼23% and ∼7.4% [15].

[1] Frail et al. 1996; [2] Vasisht et al. 1995; [3] Corbel et al. 1999; [4] Green 2001; [5] Marsden et al. 2000; [6] Vasisht and Gotthelf 1997; [7] Tagieva and Ankay 2003; [8] Gaensler et al. 2001; [9] Thompson and Duncan 1995; [10] Kulkarni et al. 1994; [11] Ibrahim et al. 2002; [12] Kouveliotou et al. 1998; [13] Woods et al. 2000; [14] Mereghetti et al. 2000; [15] Kaplan et al. 2002; [16] Corbel et al. 1997; [17] Sonobe et al. 1994; [18] Murakami et al. 1994; [19] Eikenberry 2003; [20] Marsden et al. 1996; [21] Gogus et al. 2002.

SNR G11.2-0.3 (SN386?, C, α=0.49, θ=4, F=22, Σ=2.07×10^{-19})
d=5 kpc (21 cm HI line) [1,10,16], d=6.3 kpc (Σ-D), d=5 kpc adopted.
α=0.56 [16]; N_{HI}≅10^{22} cm^{-2} [3], N_{HI}=1.38×10^{22} cm^{-2} [4], N_{HI}=(1.70-2.36)×10^{22} cm^{-2} [16]; SI=1.4 [4]; kT=0.73 keV (for the whole SNR) [4], kT=2 keV (for the shell) [3], kT=0.73 keV [2], kT=0.553-0.595 keV [16]; F(1 GHz)=2.0 Jy [16], F_x=(3.70±0.03)×10^{-12} erg/cm^{2}s (0.7-8 keV) [16]; L_x∼10^{36} erg/s (0.6-3.3 keV) for d=5 kpc [2], L_x=4.9×10^{34} erg/s (1-10 keV) [6]; E∼10^{48}-2.4×10^{49} erg [2]; t∼2000 yrs [8]; M_s=3-4 $M_\odot$ [3,4]; α=0.50 (integrated) [9], α∼0.57 (for the shell) [9], α∼0.25 (for the plerionic part from VLA observations) [16].

Remarks: Flat spectrum core, composite type, polarization 2%, transient phase from free to adiabatic expansion [9]. Mass of the ejecta should be considerably larger than the mass of the swept up material. A supernova type II explosion of a B1-type star would fit all observations [9]. There is no indication for a stellar wind bubble around the SNR from the HI data [11]. G11.2-0.3 is a remarkably spherical young SNR plausibly associated with the historical event of 386 A.D. [16]. A Sedov age estimate less than or approximately equal to 2000d_5 yr is close to the historical age t=1615 yr [16]. The pulsar has a hard spectrum with no sign of a thermal component probably because of the high level of absorption [16].

Point Source AX J1811-1926 (X-ray Pulsar)

β≅0 [12]; d=5 kpc [5]; P=65 ms [6], initial period P_0∼62 ms [7], P=0.064678 s [13]; For the PSR close to the center $\dot{P}$=4.4×10^{-14} ss^{-1} [7], $\dot{P}$=4.22×10^{-14} ss^{-1} [13]; τ=2.4×10^4 yrs [7,13]; F_x∼4×10^{-12} erg/cm^{2}s (total pulsed flux) [6], F_x=1.18±0.36×10^{-12} erg/cm^{2}s (2-10 keV) [13], F_x∼4.2×10^{-12} erg/cm^{2}s (1-10 keV, unabsorbed) [16], F_x(pulsar)=3.29±0.14×10^{-12} erg/cm^{2}s (1-10 keV) [16], F_x(PWN)=4.44±0.12×10^{-12} erg/cm^{2}s (1-10 keV) [16], F_x(soft 'PWN')=0.37±0.01×10^{-12} erg/cm^{2}s (0.7-8 keV) [16]; L_x=5×10^{33} erg/s [6], L_x=2.81±0.86×10^{32} erg/s (2-10 keV) [13], log L_x(NS)=33.9 (0.2-10 keV) [14], log L_x(PWN)=34.2 (0.2-10 keV) [14]; B=1.7×10^{12} G [7]; $\dot{E}$=6.4×10^{36} erg/s [6]; $\dot{E}$=6.1×10^{36} erg/s [13]; N_{HI}=2.36×10^{22} cm^{-2} [13], N_{HI}(pulsar)=(1.75-3.19)×10^{22} cm^{-2} [16], N_{HI}(PWN)=(2.04-2.25)×10^{22} cm^{-2} [16], N_{HI}(soft 'PWN') =(2.03-2.27)×10^{22} cm^{-2} [16]; SI=1.78±0.74 [13], SI(averaged, PWN)=1.28±0.15 [14,15], SI(NS, pulsed+unpulsed)=0.63±0.12 [14,15], SI(pulsed)=0.60±0.60 [14,15], SI∼1.3 [16], SI=1.00-1.48 (pulsar) [16], SI=1.54-1.90 (PWN) [16]; kT=0.517-0.691 keV (soft 'PWN') [16].

Remarks: SNR G11.2-0.3 harbors a hard X-ray plerion powered by a fast millisecond pulsar [6]. If the SNR is historical then the τ value of the PSR and the age of the SNR are inconsistent. The possibility of a genetic relation between the radio quiet pulsar and the SNR was discussed in [8]. The X-ray and radio emission is asymmetric around the pulsar [16]. The separation of the PWN from the surrounding shell in both the X-ray and the radio images suggests that the reverse shock has not yet reached the PWN [16]. Pulsed fraction is nearly 100% [16].

[1] Green 2001; [2] Bandiera et al. 1996; [3] Reynolds et al. 1994; [4] Vasisht et al. 1996; [5] Kaspi 2000; [6] Torii et al. 1997; [7] Torii et al. 1999; [8] Roberts et al. 2000; [9] Kothes and Reich 2001; [10] Radhakrishnan et al. 1972; [11] Braunsfurth and Rohlfs 1984; [12] Kaspi et al. 2001; [13] Gavriil et al. 2003; [14] Gotthelf and Olbert 2002; [15] Gotthelf 2003; [16] Roberts et al. 2003.

SNR G11.4-0.1 (S?, α=0.5, θ=8, F=6, Σ=1.41×10^{-20})
d=9.2 kpc (Σ-D), d=9.2 kpc adopted.

SNR G12.0-0.1 (?, α=0.7, θ=7?, F=3.5,

$\Sigma=1.08\times10^{-20}$)
d=11.7 kpc (Σ-D), d=12 kpc adopted.
SNR G13.3-1.3 (S?, α=?, θ=70×40, F=?, Σ=?)
d=2-4 kpc [3], d=3 kpc adopted.
A_v=0.5 [2]; $F_x=1.3\times10^{-11}$ erg/cm^{2}s (0.1-2.4 keV), $L_x=3\times10^{34}$ erg/s if d=3.3 kpc [2]
Remarks: This SNR was found by ROSAT but it has not yet been investigated in the radio band. For this newfound SNR d=2 kpc (kinematic) [1]. Taking into account the large uncertainty in the kinematic distance value and the interaction between the SNR and the CO molecular clouds d=2-4 kpc. The adopted distance value is 3.3 kpc [2].
[1] Clemens 1985; [2] Seward et al. 1995; [3] Green 2001.
SNR G13.5+0.2 (S, α=1.0?, θ=5×4, F=3.5?, $\Sigma=2.63\times10^{-20}$)
d=12.8 kpc (Σ-D), d=13 kpc adopted.
SNR G15.1-1.6 (S, α=0.8?, θ=30×24, F=5.5?, $\Sigma=1.15\times10^{-21}$)
d=5.7 kpc (Σ-D), d=5.7 kpc adopted.
SNR G15.9+0.2 (S?, α=0.6?, θ=7×5, F=5, $\Sigma=2.15\times10^{-20}$)
d=10.4 kpc (Σ-D), d=11 kpc adopted.
SNR G16.2-2.7 (S, α=0.5, θ=17, F=2, $\Sigma=1.04\times10^{-21}$)
d=9.1 kpc (Σ-D), d=8.8 kpc adopted.
SNR G16.7+0.1 (C, α=0.6, θ=4, F=3.0, $\Sigma=2.82\times10^{-20}$)
C-type [2]; d=10 kpc [5], d=14.1 kpc (Σ-D), d=10 kpc adopted.
MC [1], MS [1,3]; SI=1.17±0.29 (for the X-ray core) [5]; $N_{HI}=(4.74\pm0.98)\times10^{22}$ cm^{-2} (for the X-ray core) [5], $N_{HI}=1.56\times10^{22}$ cm^{-2} [5]; F_x(core)=1.9×10^{-12} erg/cm^{2}s (0.5-10 keV, unabsorbed) [5]; L_x(core)=$2.3\times10^{34}d^2_{10kpc}$ erg/s (0.5-10 keV) [5], L_x(SNR)=$1.1\times10^{34}d^2_{10kpc}$ erg/s (0.2-4 keV) [5], L(PWN)=10^{33} erg/s (radio) [5].
Remarks: Jet-like morphology [4]. This composite radio remnant has a core radio flux density of only 100 mJy. The core-to-shell flux ratio at 6 cm is typical of the composite remnants [5]. If d=10 kpc and R=135″ for the SNR shell then the radius is 6.5 pc and for R=45″ the core has a radius of 2.2 pc [5]. Assuming that the SNR is in the free expansion phase with $V_{exp}\cong3\times10^3$ km/s G16.7+0.1 must roughly be 2100 yr old [5].
[1] Reynoso and Mangum 2000; [2] Whiteoak 1992; [3] Green et al. 1997; [4] Frail and Moffett 1993; [5] Helfand et al. 2003b.
SNR G16.8-1.1 (?, α=?, θ=30×24?, F=2?, $\Sigma=4.18\times10^{-22}$)
d=6.7 kpc (Σ-D), d=6.7 kpc adopted.
SNR G17.4-2.3 (S, α=0.8?, θ=24?, F=4.8?, $\Sigma=1.25\times10^{-21}$)
d=6.3 kpc (Σ-D), d=6.3 kpc adopted.
SNR G17.8-2.6 (S, α=0.3?, θ=24, F=4.0?, $\Sigma=1.05\times10^{-21}$)
d=6.4 kpc (Σ-D), d=6.4 kpc adopted.

SNR candidate G18.0-0.7
$N_{HI}\sim1.2\times10^{22}$ cm^{-2} [1]; SI≅2.3 [1]; kT∼3.5 keV [1].
Remarks: G18.0-0.7 is a PWN [1]. The X-ray emission results from the interaction between the relativistic pulsar wind and its environment [1]. G18.0-0.7 is distinctly onesided: most of its emission is distributed in a region of extent 5′ restricted to the southern side of the pulsar [1]. The reverse shock interaction between a PWN and its surrounding SNR is expected to occur 10-20 kyr after the supernova explosion suggesting that many Vela-like pulsars might be in this phase of evolution [1].
Point Source PSR J1826-1334
d=3.4 kpc [2], d=3.9±0.4 kpc [3]; P=101 ms [1]; $\dot{P}=7.5\times10^{-14}$ s/s [1]; $\dot{E}=2.8\times10^{36}$ erg/s [1]; τ=21.4 kyr [1]; $N_{HI}=(1.0\pm0.2)\times10^{22}$ cm^{-2} [1]; SI=$1.6^{+0.1}_{-0.2}$; $L_x\cong9\times10^{32}$ erg/s (unabsorbed, 0.5-10 keV, for d=4 kpc) [1]; B∼10μG [1].
Remarks: XMM-Newton observations of the Vela-like PSR J1826-1334 [1]. Non-detection of any PWN at radio wavelengths [4,5].
[1] Gaensler et al. 2003; [2] Guseinov et al. 2003b; [3] Cordes and Lazio 2002; [4] Braun et al. 1989; [5] Gaensler et al. 2000.
SNR G18.8+0.3 (Kes 67, S, α=0.4, θ=17×11, F=33, $\Sigma=2.66\times10^{-20}$)
d=9.5-19 kpc (21 cm HI line) [1], d=8 kpc [2], d=4.1 kpc (Σ-D), d=8 kpc adopted.
[1] Green 2001; [2] Allakhverdiev et al. 1986.
SNR G18.95-1.1 (C?, α-varies, θ=33, F=37, $\Sigma=5.11\times10^{-21}$)
d=2 kpc [2], d=3.4 kpc (Σ-D), d=2.5 kpc adopted.
kT=0.95±0.05 keV [1,2]; $N_{HI}=(3.4\pm1.5)\times10^{21}$ cm^{-2} [1,2]; $F_x(N_{HI})=1.48\times10^{-11}$ erg/cm^{2}s [2], $F_x(N_{HI}=0)=4.16\times10^{-11}$ erg/cm^{2}s [2]; L_x(d=2 kpc)=2.0×10^{34} erg/s [2]; V_s=900 km/s [2], V_s=1350 km/s [3]; t=0.41×10^4 yr [2], t=0.28×10^4 yr [3]; n_0=0.04 cm^{-3} [2], n_0=0.01 cm^{-3} [3]; M_s=4.2 $M_\odot$ [2], M_x=5.3 $M_\odot$ [3]; $E_0=4.7\times10^{49}$ erg [2], $E_0=1.0\times10^{50}$ erg [3].
Remarks: SNR G18.95-1.1 was detected in X-rays by ROSAT (0.1-2.4 keV) in the all sky survey. A total of 498 counts at a rate of 0.78±0.07 counts/s have been found to be associated with the remnant. There is a shell-like structure (∼33 arcmin) with a temperature of kT=0.4 keV and $N_{HI}=3.4\times10^{21}$ cm^{-2}. No centrally peaked emission comparable [1]. ROSAT (0.1-2.4 keV) 1991 March 30-31 observation has substantially longer exposure time, the new data are of higher sensitivity than the previous observations. From the new data, the X-ray analogue of the radio bar is partly detected. A point-like X-ray source appears at l = 18°.793, b = -0°.985 or α_{2000} = 18^h 28^m 48^s, δ_{2000} = -13° 00′ 55″, which has not yet been identified [2]. Low ambient density of a few 0.01 cm^{-3}, indicating that G18.95-1.1 is expanding in a previously created stellar wind bubble [2]. Effelsberg 100-m telescope results confirm the previous radio spectral index of α = -0.28 ($S_\nu \propto \nu^\alpha$) for the integrated flux densities. The integrated

radio polarization at 10.55 GHz is about 6%, peak values reach 30% [2]. For the diffuse component the spectral index is α= 0.14±0.03. For the central bar α=0.22±0.07 and for the prominent northern arc α=0.36±0.04. For all the other small scale structures α=0.45±0.2 [2]. In the case of G18.95-1.1, the pulsar search at 1.61 GHz using the Effelsberg 100-m telescope was not successful [4].

[1] Aschenbach et al. 1991; [2] Furst et al. 1997; [3] White and Long 1991; [4] Furst et al. 1989.

SNR G20.0-0.2 (F, α=0.0, θ=10, F=10, $\Sigma=1.51\times10^{-20}$)

SNR G21.5-0.9 (C in radio and X-ray, α=0.0, θ=4, F=6?, $\Sigma=6.27\times10^{-19}$)

d=4.7 kpc [1,2], d=5.5 kpc (21 cm HI line) [3], d=5.3-9.3 kpc (21 cm HI line) [4], d=5.5±0.5 kpc [8], d=4.0 kpc (Σ-D), d=5.5 kpc adopted.

$N_{HI}=1.4\times10^{22}$ cm^{-2} [4], $N_{HI}=2\times10^{22}$ cm^{-2} (∼0.1-10 keV) Chandra X-ray observations [5], N_{HI}=(7-10)$\times10^{21}$ cm^{-2} (1.2-17.3 keV) [7], $N_{HI}=2.3\times10^{22}$ cm^{-2} [9]; SI=0.91 [5], SI=1.88 (1.2-17.3 keV) [7]; kT=15.4 keV [7]; $F_x=6.5\times10^{-11}$ erg/cm^{2}s (2-10 keV) [4], $F_x=7\times10^{-11}$ erg/cm^{2}s [5]; $L_x=2.4\times10^{35}$ erg/s at d=5.5 kpc [4], $L_x=2.1\times10^{35}$ erg/s [5]

Remarks: For the faint halo of this SNR in the X-ray band SI=1.56, kT=2.8 keV, $F_x=1.2\times10^{-11}$ erg/cm^{2}s [5]. Shell of the SNR is very weak and α=0.4-0.7 in the radio band [5]. If the SNR is at 5 kpc its radio luminosity must be $L=1.8\times10^{34}$ erg/s. This SNR's radio and X-ray luminosities are 9 and 100 times less than Crab's luminosity, respectively [5]. For the shell kT=2.8 keV. The flux coming from the shell is roughly 10^{-11} erg/cm^{2}s and the flux coming from the plerionic part is 7×10^{-11} erg/cm^{2}s in the 0.5-10 keV band (Chandra) [5]. In the 0.5-10 keV band the X-ray flux from the plerionic part is 7.5×10^{-11} erg/cm^{2}s, SI=1.4. The flux from the shell is 1.7×10^{-11} erg/cm^{2}s, $N_{HI}=2\times10^{22}$ cm^{-2} [6].

Angular radius of the plerionic part is 30′ and in the X-ray band SI=0.9. For Crab and 3C58, in the X-ray band, spectral index is ∼0.5. There must be a NS inside the plerionic part,but no pulsed radiation was observed, pulse fraction is less than 40% [5]. Pulse fraction of radiation of the NS expected to be found within the SNR is <40% [5].

A non-thermal X-ray halo extending well beyond the boundaries of the radio emitting plerion has been detected [9]. This is the opposite of what observed in other plerions as well as of what standard models of plerions would predict [10]. The observed X-ray halo is just an effect of dust scattering in the foreground medium [10].

[1] Braun et al. 1989; [2] Allakhverdiev et al. 1986; [3] Green 2001; [4] Davelaar et al. 1986; [5] Slane et al. 2000; [6] Safi-Harb et al. 2000a; [7] Asaoka and Koyama 1990; [8] Crawford et al. 2002a; [9] Warwick et al. 2001; [10] Bandiera and Bocchino 2003.

SNR G21.8-0.6 (Kes 69, S, α=0.5, θ=20, F=69, $\Sigma=2.60\times10^{-20}$)

d=11.2 kpc [1], d>6.3 kpc [2], d=2.9 kpc (Σ-D), d=6 kpc adopted.

Incomplete shell [2]; MS [1].

Remark: The distance must be considerably larger than the value found from the Σ-D dependence because of the shell being incomplete.

[1] Green et al. 1997; [2] Green 2001.

SNR G22.7-0.2 (S?, α=0.6, θ=26, F=33, $\Sigma=7.35\times10^{-21}$)

d=3.7 kpc (Σ-D), d=3.7 kpc adopted.

SNR G23.3-0.3 (W41, S, α=0.5, θ=27, F=70, $\Sigma=1.45\times10^{-20}$)

d=2.7 kpc (Σ-D), d=2.8 kpc adopted.

SNR G23.6+0.3 (?, α=0.3, θ=10?, F=8?, $\Sigma=1.20\times10^{-20}$)

d=7.8 kpc (Σ-D), d=8 kpc adopted.

SNR G24.7-0.6 (S?, α=0.5, θ=15?, F=8, $\Sigma=5.35\times10^{-21}$)

d=7.2 kpc (Σ-D), d=9 kpc adopted.

SNR G24.7+0.6 (C?, α=0.2?, θ=30×15, F=20?, $\Sigma=6.69\times10^{-21}$)

d=4.7 kpc (Σ-D), d=5 kpc adopted.

SNR G27.4+0.0 (4C-04.71, Kes 73, S, α=0.68, θ=4, F=6, $\Sigma=5.64\times10^{-20}$)

d=6-7.5 kpc (21 cm HI line) [1], d=6.5 kpc [2], d=7 kpc [3], d=10.6 kpc (Σ-D), d=7 kpc adopted (since the medium around the SNR has a low density).

$N_{HI}=5\times10^{21}$ cm^{-2} [2], N_{HI}=(5-20)$\times10^{21}$ cm^{-2} [3], N_{HI}=(1.6-2.3)$\times10^{22}$ cm^{-2} [10]; kT∼0.86 keV [3]; $L_x=2\times10^{35}$ erg/s (0.3-4 keV) [2]; t≤3$\times10^3$ yrs [2,3], t≤2$\times10^3$ yrs [4].

Point Source AXP 1E1841-045

β=0.1-0.2 [2,4], β=0.1 [6], β<0.25 [7]; P=11.77 s [4,8]; $\dot{P}=4.1\times10^{-11}$ [8]; d=6-7.5 kpc [2], d=7 kpc [3,7,14]; $N_{HI}=3\times10^{22}$ cm^{-2} [9], $N_{HI}=1.5\times10^{22}$ cm^{-2} [3], $N_{HI}=2.2\times10^{22}$ cm^{-2} [11]; kT=0.55 keV (blackbody) [12]; $\tau=4.7\times10^3$ yrs; SI=3.4 (0.1-2.4 keV) [10], SI=3.4 (1-10 keV) [11]; V<500 km/s [5], V=200 km/s [6]; $F_x=1.3\times10^{-11}$ erg/cm^{2}s (0.5-10 keV) [4], $F_x=1.2\times10^{-11}$ erg/cm^{2}s (1-10 keV) [11]; $L_x=10^{35}$ erg/s (2-10 keV) [3], $L_x\sim4\times10^{35}$ erg/s (0.1-12 keV) [8], $L_x=2.3\times10^{35}$ erg/s [11]; F_{1400}<0.25 mJy [11], F_{1400}<0.07 mJy [11], F_{1400}<0.6 mJy [7]; Log L_{1400}<1.5 [7].

Remark: SNR Kes 73 harbors an anomalous X-ray pulsar [4]. The pulse fraction values of this AXP are: ∼35% [13], ∼15% [4,10].

[1] Green 2001; [2] Sanbonmatsu and Helfand 1992; [3] Helfand et al. 1994; [4] Vasisht and Gotthelf 1997; [5] Gaensler 2000; [6] Marsden et al. 2000; [7] Gaensler et al. 2001; [8] Gotthelf et al. 1999; [9] Mereghetti et al. 2000; [10] Gotthelf and Vasisht 1997; [11] Mereghetti et al. 2002a; [12] Nagase 1998; [13] Mereghetti 2001a; [14] Guseinov et al. 2003c.

SNR G27.8+0.6 (F, α-varies, θ=50×30, F=30, $\Sigma=3.01\times10^{-21}$)

d=3.2 kpc adopted.

SNR G28.6-0.1 (S, α=?, θ=13×9, F=3?, $\Sigma=3.86\times10^{-21}$)

d=11.5 kpc (Σ-D), d=10 kpc adopted.
kT=5.4 keV [1]; SI=2.1 [1]; N_{HI}=(2.4-4.0)×10^{22} cm^{-2} (which probably places this source in the Scutum arm) [1]; n_0=0.2 cm^{-3} [1]; t=2.7 kyr [1]; E=9×10^{51} erg [1]; M_s=20 $M_\odot$ [1]; Σ=9.7×10^{-22} $Wm^{-2}Hz^{-1}ster^{-1}$ at 1 GHz (30 cm) [1]; D∼20 pc [1]; L_x=3×10^{34} erg/s (0.7-10 keV) at d=7 kpc [1].
Remarks: ASCA discovered an extended source in the constellation Scutum, AX J1843.8-0352. Mean diameter is about 10′ [1]. AX J1843.8-0352 predominantly emits synchrotron X-rays from the shells [1]. Best-fit thermal model temperature values for SNRs SN1006 and G347.3-0.5 (typical SNRs of nonthermal X-rays) are 7-10 keV [2] and 3.8±0.3 keV [3], respectively, and the best-fit non-equilibrium ionization temperature of 5.4 keV is higher than any other young SNR, such as Cas A, Tycho, Kepler and W49B (2.56±0.05 keV [4], 2.3±0.3 keV [5], $3.1^{+0.5}_{-0.4}$ keV [6] and 2.2-2.7 keV [7], respectively) [1]. The gain (acceleration) rate of electrons is proportional to the magnetic field strength (B), while the synchrotron energy loss of electrons is proportional to B^2. Therefore, high-energy electrons responsible for the synchrotron X-rays are likely to exist in a shell with a rather weak B, where the radio flux should be faint, because the flux is proportional to B^2 [1].
[1] Bamba et al. 2001; [2] Ozaki et al. 1994; [3] Koyama et al. 1997; [4] Bleeker et al. 2001; [5] Decourchelle et al. 2001; [6] Kinugasa and Tsunemi 1999; [7] Hwang et al. 2000.
<u>SNR G28.8+1.5</u> (S?, α=0.4?, θ=100?, F=?, Σ=?)
<u>SNR G29.6+0.1</u> (S, α=0.5?, θ=5, F=1.5?, Σ=9.03×10^{-21})
α=0.4-0.7 [1]; d=12 kpc [2], d=17.4 kpc (Σ-D), d=11 kpc adopted (since the SNR is expanding in a low density medium).
t≤8×10^3 yrs [3], t<8×10^3 yrs [1], t=10^4 yrs [2].
<u>Point Source AXP candidate (or binary) AX J1845.0-0300</u>
β=0.1 [2], β=0.1-0.2 [1], β<0.25 [5]; P=6.97 s [6]; d∼8.5 kpc [6], d=15 kpc [8], d∼10 kpc [1], d=8 kpc [9]; N_{HI}=4.6×10^{22} cm^{-2} [6,7,9], N_{HI}=9×10^{22} cm^{-2} [6], N_{HI}=10^{23} cm^{-2} [1,8]; kT=0.7 keV (blackbody) [6,9], kT∼0.6 keV (blackbody) [11], kT=0.65 keV (blackbody) [8]; SI=4.6 (0.1-2.4 keV) [6]; F_x<2×10^{-13} erg/cm^2s (2-10 keV) [6,7,9], F_x=4.2×10^{-12} erg/cm^2s (2-10 keV) [6,7,9]; V<500 km/s [4], V=200 km/s [2]; L_x=5×10^{34} erg/s (2-10 keV) [9], L_x=7.4×10^{34} erg/s (1-10 keV) for d=8 kpc [10]; m_V<0.13 [10], m_V<0.07 [10].
Remarks: The pulsar characteristic of this AXP is uncertain [5]. The pulse fraction for this AXP is ∼50% [9].
[1] Gaensler et al. 1999; [2] Marsden et al. 2000; [3] Gotthelf et al. 2000; [4] Gaensler 2000; [5] Gaensler et al. 2001; [6] Torii et al. 1998; [7] Mereghetti 2001b; [8] Gotthelf and Vasisht 1998; [9] Mereghetti 2001a; [10] Mereghetti et al. 2002a; [11] Vasisht et al. 2000.
<u>SNR G29.7-0.3</u> (Kes 75, C, α=0.7, θ=3, F=10, Σ=1.67×10^{-19})
d=19 kpc [1], d=9.3 kpc (Σ-D), d=9 kpc adopted.
N_{HI}=3.1×10^{22} cm^{-2} [1], N_{HI}=3.1×10^{22} cm^{-2} (3-20 keV) [2]; SI=2.18 [2]; V_s∼8000 km/s [3]; F_x=1.8×10^{-11} erg/cm^2s (total, 3-20 keV) [2]; kT=0.5 keV [1]; L_x=10^{35} erg/s from the shell [1], L_x=9.6×10^{35} erg/s from the core [1]; t∼10^3 yrs [1].
<u>Point Source X-ray Pulsar J1846-0258</u> [2]
β∼0 [7]; d=5.7 kpc [2], d∼19 kpc [4]; P=0.32456 s [2,4]; $\dot{P}$=7.097×10^{-12} ss^{-1} [2,4]; τ=723 yrs [2,7]; SI=1.1 [2], SI(pulsar+nebula)=2.16±0.15 [7]; kT=0.35-0.53 keV [7]; F_x=9.6×10^{-13} erg/cm^2s (3-10 keV) [2], F_x(pulsar+nebula) ∼3.9×10^{-11} erg/cm^2s (2-10 keV) [7], F_x(thermal)=(3.0-24.4)×10^{-10} erg/cm^2s (0.1-2 keV) [7], F_x(non-thermal)=(7.9-12.0)×10^{-11} erg/cm^2s (0.1-2 keV) [7], F_x(thermal)=(1.6-13.0)×10^{-12} erg/cm^2s (2-10 keV) [7], F_x(non-thermal)=(2.7-4.1)×10^{-11} erg/cm^2s (2-10 keV) [7]; $\dot{E}$=7.9×10^{36} erg/s [4]; $L_x/\dot{E}$(pulsar)∼0.016 [4], $L_x/\dot{E}$(PWN)∼0.065 [4], log L_x(NS)=35.2 [5], L_x(PWN)=36.0 [5]; N_{HI}∼4×10^{22} cm^{-2} [4], N_{HI}(pulsar+nebula)=(4.7±0.8)×10^{22} cm^{-2} [7]; SI(pulsar)∼1.4 [4], SI(PWN)∼1.9 [4], SI(averaged, PWN)=1.88±0.04 (0.2-10 keV) [5,6], SI(pulsed+ unpulsed)=1.13±0.11 (0.2-10 keV) [5,6], SI(pulsed)=1.10±0.30 (0.2-10 keV) [5,6]; B=5×10^{13} G [2,4]; braking index = 1.86-2.48 [4], braking index = 1.8-2.5 or n>1.89 [7].
Remarks: PWN has been observed both in radio and X-ray [4]. No radio detection of pulsar J1846-0258 has been reported with an upper limit of ∼0.1 mJy at 1.5 GHz [7]. The pulsar is located at the geometrical center of the 3.5′ diameter shell and is powering a bright radio/X-ray nebula that gives the composite morphology to this SNR [7].
[1] Blanton and Helfand 1996; [2] Gotthelf et al. 2000; [3] Crawford et al. 2002b; [4] Helfand et al. 2003a; [5] Gotthelf and Olbert 2002; [6] Gotthelf 2003; [7] Mereghetti et al. 2002b.
<u>SNR G30.7-2.0</u> (?, α=0.7?, θ=16, F=0.5?, Σ=2.94×10^{-22})
d=11.9 kpc (Σ-D), d=12 kpc adopted.
<u>SNR G30.7+1.0</u> (S?, α=0.4, θ=24×18, F=6, Σ=2.09×10^{-21})
d=6.6 kpc (Σ-D), d=6.6 kpc adopted.
<u>SNR G31.5-0.6</u> (S?, α=?, θ=18?, F=2?, Σ=9.29×10^{-22})
d=8.8 kpc (Σ-D), d=8.8 kpc adopted. N_{HI}=8×10^{21} cm^{-2} [1].
Remarks: Optical investigations using interference filters Hα 6563 A, Hβ 4861 A, $[S_{II}]$ 6716 A and 6731 A, and $[O_{III}]$ 5007 A. Weak sulfur line emission [1].
[1] Mavromatakis et al. 2001.
<u>SNR G31.9+0.0</u> (3C391, S, α=0.55, θ=7×5, F=24, Σ=1.03×10^{-19})
d=8.5 kpc (21 cm HI line) [1], d=7.2 kpc [2], d=7.2

kpc (21 cm HI line) [3,4], d=9 kpc [3,4], d=5.5 kpc (Σ-D), d=8.5 kpc adopted.
$N_{HI}=2.4\times10^{22}$ cm^{-2} (0.1-2.4 keV) [3,4]; kT=0.5 keV [3,4]; T∼100-1000 K [5]; V_s=650-690 km/s [4]; SNR is expanding in a dense medium [2]; MC [2]; $n_0\sim5$-10 cm^{-3} (average value in front of the SNR) [4], $n_0\sim2\times10^5$ cm^{-3} (average value behind the SNR) [5]; $M_x\cong$44-74 $M_\odot$ [4]; $M_{total}\cong700\ M_\odot$ [4].
Remarks: X-ray flux from the SNR in the 0.1-2.4 keV band is $F_x=3.9\times10^{-12}$ erg/cm^{2}s and $F_x=1.9\times10^{-10}$ erg/cm^{2}s (taking into account the absorption). From the observed $F_x=3.9\times10^{-12}$ erg/cm^{2}s $L_x=1.7\times10^{36}$ erg/s. SNR 3C391 is similar to SNRs W44 and W28 [4].
[1] Green 2001; [2] Frail et al. 1996; [3] Radhakrishnan et al. 1972; [4] Rho and Petre 1998; [5] Reach and Rho 1998.
SNR G32.0-4.9 (3C396.1, S?, α=0.5?, θ=60?, F=22?, $\Sigma=9.20\times10^{-22}$)
d=2.6 kpc (Σ-D), d=2.7 kpc adopted.
SNR G32.1-0.9 (C?, α=?, θ=40?, F=?, Σ=?)
d∼4.6 kpc [1], d=4.6 kpc adopted.
kT∼0.8 keV [1]; $n_0\sim0.05$ cm^{-3} [1]; $N_{HI}\sim2.3\times10^{21}$ cm^{-2} [1]; t∼12 kyr if E=10^{51} erg [1]; $F_x=2\times10^{-11}$ erg/cm^{2}s [1]; $L_x\sim8\times10^{34}$ erg/s (0.1-2 keV) [1].
Remarks: SNR G32.1-0.9 approximately has an angular size of 30×30 arcmin^2 and an irregular X-ray morphology with brightening towards the center and SNR G32.1-0.9 is probably composite type with a diameter ∼40 arcmin [1]. High ratio of X-ray to radio surface brightness [1]. At the coordinates of SNR G32.1-0.9, there appears to be a 'plateau' of low surface brightness radio emission, with a surface brightness in the range (2-6)×10^{-22} Wm^{-2}Hz^{-1}ster^{-1} at 11 cm (∼2.7 GHz) [1]. There are no CO or HII clouds at the position of this object [1].
[1] Folgheraiter et al. 1997.
SNR G32.8-0.1 (Kes 78, S?, α=0.2?, θ=17, F=11?, $\Sigma=5.73\times10^{-21}$)
d=5.5-7.1 kpc (21 cm HI line) [1], d=6.2 kpc (Σ-D), d=6.3 kpc adopted.
MC [1]; OH MS [1], B≅1.5±0.3 mG [1].
[1] Koralesky et al. 1998a.
SNR G33.2-0.6 (S, α-varies, θ=18, F=3.5, $\Sigma=1.63\times10^{-21}$)
d=8.0 kpc (Σ-D), d=8 kpc adopted.
SNR G33.6+0.1 (Kes 79, S, α=0.5, θ=10, F=22, $\Sigma=3.31\times10^{-20}$)
d≅10 kpc (21 cm HI line) [1], d=10±2 kpc (21 cm HI line) [2], d=5.2 kpc (Σ-D), d=7 kpc adopted.
$L_x\sim10^{36}$ erg/s [3]; t=(6-12)×10^3 yr [3]; E=5×10^{50} erg [3]; $N_{HI}=(1.75\pm0.07)\times10^{22}$ cm^{-2} [3].
Remarks: If the distance is 10 kpc and the best-fit temperature of the shocked gas is 1.3 keV (or 1.5×10^7 K), then the initial energy release was ∼5×10^{50} erg, the age is 6000 yr, and the remnant contains ∼50 $M_\odot$ [2]. If Kes 79 were closer (for example at 5 kpc) then the energy release would be ∼10^{50} erg, the remnant would contain ∼10 $M_\odot$, and the age would be ∼3000 yr [2]. Thermal spectrum with strong lines from Mg, Si and S [3].
Point Source
$\alpha=4.2\pm0.25$ [3]; $L_x=7\times10^{33}$ erg/s (0.3-8.0 keV) [3]; $N_{HI}\cong1.8\times10^{22}$ cm^{-2} [3].
Remarks: An unresolved source at the center of the SNR has been detected (Chandra observation) [3]. There is no evidence for a surrounding PWN [3]. The central source spectrum is softer than expected from an AGN (α∼1.7) or from a PWN (α∼1.5-2.5) [3]. No pulsations were observed above a level of 0.7 mJy at 1420 MHz [3].
[1] Green 2001; [2] Frail and Clifton 1989; [3] Seward et al. 2003.
SNR G34.7-0.4 (W44, C, α=0.30, θ=35×27, F=230, $\Sigma=3.66\times10^{-20}$)
Plerion in X-ray [1,2,3].
d=2.6 kpc [5], d=2.5 kpc [6], d=2.5 kpc (21 cm HI line) [7], d=1.6 kpc (Σ-D), d=2.8 kpc adopted.
$N_{HI}=(1.6-2.1)\times10^{22}$ cm^{-2} [6], $N_{HI}=1.65\times10^{22}$ cm^{-2} [20], $N_{HI}\sim10^{22}$ cm^{-2} [23]; $L_x=1.3\times10^{33}$ erg/s for d=3 kpc [11], $L_x=3\times10^{35}$ erg/s for d=2.6 kpc [5]; T=6×10^6 K for the central part [6]; V=150 km/s [6,23], V=120 km/s [18]; $E_k\sim8\times10^{44}$ erg [23]; kT=0.5 keV [20,6]; $L_{total}=8\times10^{36}$ erg/s [6]; Not a H_2O MS [13]; n_0=6 cm^{-3} (average value in front of the SNR) [6], n_0=1 cm^{-3} [6], n∼3-6 cm^{-3} (density of the ambient medium) [23]; MC [4,11,12,21]; t=2×10^4 yrs [6,23], t=10^4 yrs [2]; E≅10^{51} erg [6,19,23], E=(7-9)×10^{50} erg [18]; M=10^3 $M_\odot$ [6]; B=0.2 mG [14].
Remarks: α=0.4, plerionic part constitutes 2.5×10^{-3} times the area of the SNR and the flux of the plerionic part is equal to 10^{-3} times the flux of the whole remnant [4]. The observed gamma-ray flux of SNR W44 is (50.0±8.0)×10^{-8} photons/cm^{2}s [22]. Strong [SII] and [NII] emission relative to Hα and moderate [OI]6300A emission [23].
Point Source PSR J1856+0113
d=2.8 kpc [8,9], d=3.3 kpc [10]; β=0.51 [16], β=0.6 [17]; DM=96.7 pc/cm^3; $\tau=2\times10^4$ yrs [9]; P=0.2674 s [9]; $\dot{P}=2.08\times10^{-13}$ [9]; Log L_{1400}=0.894 [9].
Remark: PWN was observed around this pulsar and these 3 objects (SNR, PSR, PWN) are positionally coincident with the EGRET source [15].
[1] Smith et al. 1985; [2] Rho et al. 1994; [3] Fesen et al. 1997; [4] Giacani et al. 1997; [5] Braun et al. 1989; [6] Cox et al. 1999; [7] Green 2001; [8] Kaspi 2000; [9] Guseinov et al. 2003b; [10] Taylor et al. 1996; [11] Frail et al. 1996; [12] Denoyer 1979; [13] Claussen et al. 1999b; [14] Koralesky et al. 1998a; [15] Roberts et al. 2001; [16] Lorimer et al. 1998; [17] Allakhverdiev et al. 1997; [18] Harrus et al. 1997; [19] Chevalier 1999; [20] Rho and Petre 1998; [21] Claussen et al. 1997; [22] Esposito et al. 1996; [23] Mavromatakis et al. 2003.
SNR G36.6-0.7 (S?, α=?, θ=25?, F=?, Σ=?)
SNR G36.6+2.6 (S, α=0.5?, θ=17×13?, F=0.7?, $\Sigma=4.77\times10^{-22}$)

d=11.9 kpc (Σ-D), d=11.6 kpc adopted.

SNR G39.2-0.3 (3C 396, S, α=0.6, θ=8×6, F=18, $\Sigma=5.64\times10^{-20}$)

d=7.7 kpc (21 cm HI line) [1], d=7.7-11.3 kpc [3], d=6.0 kpc (Σ-D), d=7.7 kpc adopted.

SI=2.53 [5]; B=0.2 mG [2]; $N_{HI}=2\times10^{22}$ cm^{-2} [4], $N_{HI}=4.65\times10^{22}$ cm^{-2} [5]; kT=0.62 keV (0.2-10 keV) [5]; t=7 kyr [5].

[1] Green 2001; [2] Koralesky et al. 1998b; [3] Caswell et al. 1975; [4] Becker and Helfand 1987; [5] Harrus and Slane 1999.

SNR G39.7-2.0 (W50, ?, α=0.7?, θ=120×60, F=85?, $\Sigma=1.78\times10^{-21}$)

d=5 kpc [1]; d=1.7 kpc (Σ-D), d=5 kpc adopted.

Remarks: It is not clear whether W50 is a SNR or not. There is the well known compact source (SS433) in the center of the SNR [1]. If W50 actually is a SNR, then it is a very unusual SNR which does not show 'normal' SNR properties. W50 is powered by SS433 (which is a binary system) that its diameter is 124 pc (for d=5 kpc) which is a very large value compared to other SNRs.

[1] Green 2001.

SNR G40.5-0.5 (S, α=0.5, θ=22, F=11, $\Sigma=3.42\times10^{-21}$)

d=5.8 kpc (Σ-D), d=5.7 kpc adopted.

SNR G41.1-0.3 (3C 397, S, α=0.48, θ=4.5×2.5, F=22, $\Sigma=2.94\times10^{-19}$)

C-type in X-ray [1,3]; d=10 kpc [1,2], d>6.4 kpc (from HI absorption measurements) [4], d<12.8 kpc [3], d=6.4 kpc (Σ-D), d=8 kpc adopted.

t=2 kyr [1]; $F_x=2.6\times10^{-11}$ erg/cm^{2}s (1-9 keV) [1]; $L_x=4\times10^{36}$ erg/s (1-9 keV) for d=10 kpc [1]; t=1 kyr [2]; V=1600 km/s [2]; n=4 cm^{-3} (density behind the shock front from which X-ray radiation was observed) [2]; Polarization 1.5%±0.1% at 6 cm [2]; D=12 pc [2]; $F_x=3\times10^{-12}$ erg/cm^{2}s (0.4-2 keV) [2]; $N_{HI}=3.2\times10^{22}$ cm^{-2} [2]; S-type in X-ray [2]; $L_x\sim10^{36}$ erg (0.4-2 keV) for d=2 kpc [2]; $F_x=(5\text{-}10)\times10^{-11}$ erg/cm^{2}s (taking into account the absorption) [2]; kT∼1.7 keV (ROSAT) [6,7].

Remarks: There must be a neutron star having $L=10^{34}$ erg/s in the SNR [2]. Combined ROSAT and ASCA imaging shows that the SNR is highly asymmetric [3]. The hard-band images obtained with ASCA show that much of the hard X-ray emission arises from the western lobe, associated with the SNR shell, with little hard X-ray emission associated with the central hot spot [3]. The temperatures from the soft and hard components are ∼0.2 keV and ∼1.6 keV, respectively [3]. SNR 3C 397 has no optical counterpart and is not observed in the ultraviolet [3]. The SNR was not identified in the far infrared [5]. The derived age (a few thousand years) and the presence of a central X-ray source makes 3C 397 similar to the young SNRs G11.2-0.3, Kes 73, and RCW 103 [3].

[1] Safi-Harb et al. 1999; [2] Dyer and Reynolds 1999; [3] Safi-Harb et al. 2000b; [4] Caswell et al. 1975; [5] Saken et al. 1992; [6] Rho 1995; [7] Rho and Petre 1998.

SNR G42.8+0.6 (S, α=0.5?, θ=24, F=3?, $\Sigma=7.84\times10^{-22}$)

d=5-10 kpc [1], d=11±3 kpc (kinematic) [2,3], d=6.8 kpc (Σ-D), d=7.5 kpc adopted.

$F_x<10^{-13}$erg/cm^{2}s (ROSAT) [1]; t=10^4 yr [1].

Remark: A patch of OH absorption which comes from a MC that is most likely interacting with the SNR has been observed just below the rim of the SNR [2,3]. The SNR may be connected to PSR J1907+0918 [2,3]. Distance of this PSR must be ∼7.7 kpc [4,5]. There are no observational data which give basis for a large luminosity value for the SNR. Therefore, both the SNR and the PSR are probably located in the Orion arm with d∼7.5 kpc. On the other hand, as the PSR is located outside the SNR, a physical connection between them is not so likely.

[1] Vasisht et al. 1994; [2] Chomiuk et al. 2002; [3] Stanimirović et al. 2003; [4] ATNF 2003; [5] Guseinov et al. 2003b.

SNR G43.3-0.2 (W49B, S, α=0.48, θ=4×3, F=38, $\Sigma=4.77\times10^{-19}$)

F-type in X-ray [3,4]; d=8.5 kpc [1], d=12.5-14 kpc (21 cm HI line) [2], d=5.3 kpc (Σ-D), d=9 kpc adopted.

$N_{HI}=4\times10^{22}$ cm^{-2} (0.5-10 keV) [4]; kT=2 keV [4], kT=2.2-2.7 keV [6]; t∼10^3 yrs [4].

Remark: X-ray observations show that the environment of the SNR is very dense [5].

[1] Braun et al. 1989; [2] Green 2001; [3] Pye et al. 1984; [4] Fujimoto et al. 1995; [5] Hwang et al. 1999; [6] Hwang et al. 2000.

SNR G43.9+1.6 (S?, α=0.2?, θ=60?, F=8.6?, $\Sigma=3.60\times10^{-22}$)

S-type [1]; d=3.1 kpc (Σ-D), d=3.1 kpc adopted.

$F_x<10^{-13}$ erg/cm^{2}s (0.1-2.4) [1].

Remark: No reliable data for this SNR [1].

[1] Vasisht et al. 1994.

SNR G45.7-0.4 (S, α=0.4?, θ=22, F=4.2?, $\Sigma=1.31\times10^{-21}$)

d=6.8 kpc (Σ-D), d=6.7 kpc adopted.

SNR G46.8-0.3 (HC 30, S, α=0.5, θ=17×13, F=14, $\Sigma=9.53\times10^{-21}$)

d=6.8-8.8 kpc (21 cm HI line) [1], d=5.8 kpc (Σ-D), d=7 kpc adopted.

[1] Green 2001.

SNR G49.2-0.7 (W51, S?, α=0.3?, θ=30, F=160?, $\Sigma=2.68\times10^{-20}$)

α=0.26 in radio [3]; d=4.1 kpc (21 cm HI line) [1], d=4 kpc [2], d=5.6 kpc (from ROSAT data) [3], d=1.9 kpc (Σ-D), d=4 kpc adopted.

$N_{HI}=(7\text{-}8)\times10^{21}$ cm^{-2} [4], $N_{HI}=2.1\times10^{22}$ cm^{-2} [3]; MS [6]; T∼3×10^6 K [3]; V∼500 km/s [3]; t=30 kyr [3].

Remarks: Optical investigations using interference filters Hα 6563 A, Hβ 4861 A, [S_{II}] 6716 A, 6731 A, and [O_{III}] 5007 A [5]. The SNR is located in the same place with 2 strong HII regions [3]. Because of this fact, there may be significant contributions from the HII regions to the radio flux of the SNR, so that it is difficult to identify which part of the radio flux actually belongs to the SNR alone. If this is a normal S-type SNR, then α must be about 0.5.

[1] Green 2001; [2] Allakhverdiev et al. 1986; [3] Koo et al. 1995; [4] Moon and Koo 1994; [5] Mavromatakis et al. 2001; [6] Green et al. 1997.

SNR G53.6-2.2 (3C 400.2, S, α=0.75, θ=33×28, F=8, $\Sigma=1.30\times10^{-21}$)

d=6.7 kpc (from optical data) [1], d=2.3 kpc (21 cm HI line) [1], d=6 kpc [8], d=6.7±0.6 kpc [9], d=4.9 kpc (Σ-D), d=6 kpc adopted.

C-type [3]; N_{HI}=(7-11)×10^{21} cm^{-2} [2], N_{HI}=7.8×10^{21} cm^{-2} [8]; E(B-V)≅1-1.3 [2]; T∼4×10^6 K [2], kT=0.8 keV [3], kT=0.27 keV [8], T=4.4×10^6 K [8], T=3.1×10^6 K. [8]; L_x∼9×10^{34} erg/s (1-4 keV) at d=6 kpc [2], L_x=1.3×10^{36} erg/s (0.4-2.4 keV) at d=6 kpc [8]; M_x∼260-540 $M_\odot$ [2], M_x=38 $d_{5kpc}^{-5/2}$ $M_\odot$ [3]; n_e=0.05 $d_{5kpc}^{-1/2}$ cm^{-3} [3], n_e=0.15 cm^{-3} [8], n_e=0.20 cm^{-3} [8]; Thermal Energy=5.6×10^{49} $d_{5kpc}^{-5/2}$ erg [3]; M_x=260 $M_\odot$ [8], M_x=350 $M_\odot$ [8].

Remarks: The SNR must be in the inner Galactic arm which is the nearest arm. G53.6-2.2 is a single SNR rather than two overlapping SNRs. It is the remnant of a supernova explosion occurred near the edge of an interstellar cloud [3]. There are two shells that overlap each other [4,5,6,7]. Centrally condensed X-ray morphologies have been seen [8]. The SNR has been observed by ROSAT (0.1-2.4 keV) [8].

[1] Green 2001; [2] Long et al. 1991; [3] Yoshita et al. 2001; [4] Dubner et al. 1994; [5] Nishiuchi et al. 2001; [6] Rosado et al. 1990; [7] Yoshita et al. 2000; [8] Saken et al. 1995; [9] Rosado 1983.

SNR G54.1+0.3 (F, α=0.1, θ=1.5, F=0.5, $\Sigma=3.34\times10^{-20}$)

α=0.1±0.1 [1]; d=10 kpc [1], d=5 kpc [2], d=6 kpc adopted.

SI=0.8 (0.1-2.4 keV) [1], SI=1.35 [2]; N_{HI}=1.6×10^{22} cm^{-2} [2]; F_x=10^{-12} erg/cm^{2}s [1]; F_x=1.7×10^{-12} erg/cm^{2}s (2-10 keV) [2]; N_{HI}=1.23×10^{22} cm^{-2} [1], N_{HI}=2.6×10^{22} cm^{-2} [2]; L_x=3.2×10^{33} erg/s (0.1-2.4 keV) for d=10 kpc [1]; X-ray jet, Crab-like SNR [1].

Remark: The SNR has a flat spectrum and shows significant polarization [4,5].

Point Source X-ray and radio pulsar

J1930+1852 [3]

d=6 kpc [8]; P=0.136 s [3]; $\dot{P}$=7.506×10^{-13} [3]; DM=308 cm^{-3}pc [3]; τ=2900 yr [3]; $\dot{E}$=1.7×10^{37} erg/s [3]; B=10^{13} G [3]; F_{1180}=0.060 mJy [3]; L_{1400}≅1 mJy kpc^2 (at d=5 kpc) [3,7]; L_x≅0.002 $\dot{E}$ [3]; SI(PWN)=1.64±0.18 [6], SI(pulsed+unpulsed)=1.09±0.09 [6], SI(pulsed)=-1.06±0.86 [6]; X-ray pulsed fraction (2-10 keV)≅27% [3].

Remarks: Chandra observations found no evidence for any thermal plasma emission that would correspond to shocked interstellar medium or ejecta. A pulsar wind nebula driven by a combination of equatorial and polar outflows from the putative pulsar represented by the pointlike X-ray source [2]. The source CXOU J193030.13+185214.1 most likely represents the pulsar that powers SNR G54.1+0.3 [2]. No pulsed radiation has been found in the X-ray band 0.1-2.4 keV nor at 4.8 GHz [2].

[1] Lu et al. 2001; [2] Lu et al. 2002; [3] Camilo et al. 2002; [4] Reich et al. 1985; [5] Velusamy and Becker 1988; [6] Gotthelf 2003; [7] ATNF 2003; [8] Guseinov et al. 2003b.

SNR G54.4-0.3 (HC 40, S, α=0.5, θ=40, F=28, $\Sigma=2.63\times10^{-21}$)

d=3.3 kpc [1], d=3.3 kpc (Σ-D), d=3.3 kpc adopted.

There are MC and OB associations [1]; n_0=30 cm^{-3} (for the MC) [1]; M_s≅5×10^4 $M_\odot$ [1].

[1] Junkes et al. 1992.

SNR G55.0+0.3 (S, α=0.5?, θ=20×15?, F=0.5?, $\Sigma=2.51\times10^{-22}$)

d=14 kpc (from the association with HI features) [1], d=11.3 kpc (Σ-D), d=11.3 kpc adopted.

[1] Green 2001.

SNR G55.7+3.4 (S, α=0.6, θ=23, F=1.4, $\Sigma=3.98\times10^{-22}$)

d=7.9 kpc (Σ-D), d=7 kpc adopted.

SNR G57.2+0.8 (4C21.53, S?, α=?, θ=12?, F=1.8?, $\Sigma=1.88\times10^{-21}$)

d=11.7 kpc (Σ-D), d=11.7 kpc adopted.

SNR G59.5+0.1 (S, α=?, θ=5, F=3?, $\Sigma=1.81\times10^{-20}$)

d=13.2 kpc (Σ-D), d=11 kpc adopted.

SNR G59.8+1.2 (?, α=0.5, θ=20×16?, F=1.6, $\Sigma=7.53\times10^{-22}$)

d=9.1 kpc (Σ-D), d=9.1 kpc adopted.

SNR G63.7+1.1 (F, α=0.3, θ=8, F=1.8, $\Sigma=4.23\times10^{-21}$)

SNR G65.1+0.6 (S, α=0.6, θ=90×50, F=6, $\Sigma=2.01\times10^{-22}$)

d=3.0 kpc (Σ-D), d=3 kpc adopted.

SNR G65.3+5.7 (S?, α=0.6?, θ=310×240, F=52?, $\Sigma=1.05\times10^{-22}$)

d=0.8 kpc (from optical data) [1], d=0.8 kpc (Σ-D), d=0.8 kpc adopted.

[1] Green 2001.

SNR G65.7+1.2 (DA 495, ?, α=0.6, θ=18, F=5.1, $\Sigma=2.37\times10^{-21}$)

d=7.5 kpc (Σ-D), d=7.5 kpc adopted.

SNR G67.7+1.8 (S, α=0.3, θ=9, F=1.4, $\Sigma=2.60\times10^{-21}$)

d=14.8 kpc (Σ-D), d=14 kpc adopted.

N_{HI}∼10^{22} cm^{-2} [1]; V∼400-500 km/s (blast wave) [1]; kT=0.2-0.3 keV [1]; E=10^{50}-10^{51} erg [1]; n=3-11 cm^{-3} (for the clouds in front) [1].

Remarks: Optical investigations using interference filters Hα 6563 A, Hβ 4861 A, [S_{II}] 6716 A, 6731 A, and [O_{III}] 5007 A. Intensivities of O_{II} and O_{III} lines are about (3-5)×10^{-17} erg/s cm^{2}arcsec^2. Intensivity

of Hα+[N_{II}] is 6-7 times larger. The shock velocity is not greater than 100 km/s, it may be 70 km/s [1].
[1] Mavromatakis et al. 2001.
SNR G68.6-1.2 (?, α=0.0?, θ=28×25?, F=0.7?, $\Sigma=1.51\times10^{-22}$)
d=8.1 kpc (Σ-D), d=8 kpc adopted.
SNR G69.0+2.7 (CTB 80, ?, α-varies, θ=80?, F=120?, $\Sigma=2.82\times10^{-21}$)
d=1.3 kpc [1]; d=1.6 kpc (Σ-D), d=2 kpc adopted.
SI=2 [2,3], A_V=2.6 [10,11]; $N_{HI}=3\times10^{21}$ cm^{-2} [2,3]; $L_x=7\times10^{33}$ erg/s [1], $L_x=0.8\times10^{35}$ erg/s [12], $L_x=0.1\times10^{35}$ erg/s (0.1-2.4 keV) [2]; kT$\sim$0.86 keV [2,3]; t$\leq10^5$ yrs [1,6,9]; E=10^{51} erg [2,9].
Remarks: Optical proper motions indicate possible velocities of $\sim$700 km/s at a distance of 2 kpc [13]. The data of radial kinematics of the core of CTB 80 show that the radial velocity is found to extend between -130 km/s and 95 km/s [14].
Point Source PSR J1952+3252 [4,5]
d=2.5 kpc [2,3,5], d=2 kpc [4]; β=0.14 [7], β=0.15 [8]; DM=44.98 pc/cm^3 [4]; P=39.5 ms [4]; $\dot{P}=5.84\times10^{-15}$ [4]; pulsed fraction $\sim$ 35%; $L_x=4\times10^{33}$ erg/s (0.1-2.4 keV), $L_x=2\times10^{33}$ erg/s [2,3]; $\tau=1.07\times10^5$ yrs [5]; $m_V>23^m.3$ [6]; Log L_{1400}=0.602 [4].
[1] Braun et al. 1989; [2] Safi-Harb et al. 1995; [3] Ögelman and Buccheri 1987; [4] Guseinov et al. 2003b; [5] Taylor et al. 1996; [6] O'Sullivan et al. 1998; [7] Lorimer et al. 1998; [8] Allakhverdiev et al. 1997; [9] Koo et al. 1990; [10] Blair et al. 1984; [11] Hester and Kulkarni 1989; [12] Becker et al. 1982; [13] Strom and Blair 1985; [14] Greidanus and Strom 1990.
SNR G69.4+1.2 (AX J2001+3235)
$\theta=16'$ [1]; α=0.8 [1]; d=2.5 kpc [1]; D=44 pc [1]; $N_{HI}\sim2\times10^{21}$ cm^{-2} [1]; kT=0.4 keV [1]; t=3.7×10^4 yrs [1]; E=2.6×10^{49} erg [1].
Remarks: This source is definitely not G69.7+1 [1]. In optical and radio bands shell was observed around the X-ray bright part [1].
[1] Yoshita et al. 2000.
SNR G69.7+1.0 (S, α=0.8, θ=16, F=1.6, $\Sigma=9.41\times10^{-22}$)
d=9.8 kpc (Σ-D), d=9.5 kpc adopted.
SNR G73.9+0.9 (S?, α=0.3?, θ=22?, F=9?, $\Sigma=2.80\times10^{-21}$)
d=1.3 kpc [1], d=5.9 kpc (Σ-D), d=3 kpc adopted.
Remark: the SNR is located in the outer arm.
[1] Lozinskaya et al. 1993.
SNR G74.0-8.5 (Cygnus Loop, S, α-varies, θ=230×160, F=210, $\Sigma=8.59\times10^{-22}$)
d=0.8 kpc [1], d=0.7 kpc [2], d=1.4 kpc [4], d=460 pc [5], d=1.3$\pm$0.7 kpc (kinematic) [3], d=440^{+130}_{-100} pc (using the velocity and the proper motion of the shock wave) [6], d=0.8 kpc (Σ-D), d=0.8 kpc adopted.
E(B-V)=0.08^m [3,15,23]; $N_{HI}=(7.3\text{-}9)\times10^{20}$ cm^{-2} [13], $N_{HI}=4\times10^{20}$ cm^{-2} [20,21]; kT=0.51$\pm$0.01 keV [18]; V=400 km/s [8], V=300-400 km/s [28]; t=8000 yr [24], t=(5-10)$\times10^3$ yrs [10]; E=1.7×10^{49} erg [10]; V_s=300-365 km/s (from spectral observations in the optical band) [10], V_s=350-400 km/s [11], $V_s\sim$400 km/s (from soft X-ray observations) [12], V_s=130 km/s [16], V_s=210 km/s and 170 km/s [25]; n$\sim$2 cm^{-3} (preshock density) [25].
Remarks: In the direction of this SNR, there is even not an open cluster. Reddening due to the interstellar medium in this direction for the interval d=0.8-1.5 kpc is almost constant [7]. Cygnus Loop consists of two separate SNRs. Secondary SNR exists in the south with a recently detected neutron star close to its center [9]. In [14] far ultraviolet images were given and these images were compared with optical H_α and [OIII] images and ROSAT HRI X-ray images. The presence of high-ionization species O VI (λ=1037 A), N V (λ=1242 A), and C IV (λ=1551 A) indicates a shock-velocity near 170 km/s while other diagnostics indicate $V_s\cong$140 km/s [17]. Flux measurements of Si VIII (λ=1443 A) suggest a hot component in the region at just below 10^6 K [17]. The Cygnus Loop is a cavity explosion 5000-10000 yr old [17]. Si and S emission lines originated from a high kT_e and low-ionization plasma, whereas O and most of the continuum emission arose from a low kT_e and high-ionization plasma. Si and S emitting gases are present at the interior of the Loop, while the O lines and continuum emission mainly arise from the shell region [18]. The abundances of Si, S, and Fe are 4$\pm$1, 6$\pm$2, and $1.3^{+0.6}_{-0.3}$ times higher than those of the cosmic abundances, respectively [18]. Some of the crude ejecta must be left at the center portion of the Cygnus Loop. The low abundance of Fe relative to Si and S suggests a type-II supernova with a massive progenitor star as the origin of the Cygnus Loop [18]. kT_e gradually increases toward the center from the vicinity of the limb [18]. The mass of the swept-up interstellar medium is $\sim$100 $M_\odot$ and the average density of the interstellar medium is 0.2 cm^{-3} [19]. Individual shocks in the cloud of density n$\cong$15 cm^{-3} having velocity $V_s\cong$170 km/s were identified and also the morphologically unusual diffuse Balmer-dominated emission of faster shocks in a lower density region were found [22]. The brightest lines detected in the 1118-1716 A bandpass were N V (λ1240), C IV (λ1549), and He II (λ1640) [26]. The oxygen lines O II (λ=3729 A) and O III (λ=5007 A) in the medium immediately beyond Cygnus Loop were observed [27]. There is marginal (but significant) evidence that the degree of ionization is larger around Cygnus Loop. The energy necessary to ionize this large bubble of gas could have been supplied by an O8 or O9 type progenitor, or by the particles heated by the expanding shock front [27]. The Cygnus Loop is at the southern edge of the extremely rich and complex region known as the Cygnus superbubble . The superbubble has seven OB associations containing 48 O type stars and about 70 B type stars. With the exception of Cyg OB4 and Cyg OB7, all of these are at a distance of 1.2 kpc or more [27]. The mean particle

density in the medium where the remnant evolved at least until recently is ~0.1-0.2 cm^{-3} [27]. Mass of the progenitor would have been between 20-25 $M_\odot$. Such a star would spend most of its lifetime as a blue giant and only ~1% of its existence (~10^5 yr) as a red supergiant. This is substantially less than the recombination time (~$10^5/N_{HI}$ yr). Thus, an O8 or O9 progenitor surrounded by a pervasive low-density medium can account for the observations [27].
Balmer-dominated shock has been observed in Cygnus Loop [28].

[1] Minkowski 1958; [2] Braun et al. 1989; [3] Greidanus and Strom 1992; [4] Sakhibov and Smirnov 1983; [5] Braun and Strom 1986; [6] Blair et al. 1999; [7] Neckel and Klare 1980; [8] Levenson et al. 1997; [9] Uyaniker et al. 2002; [10] Ghavamian et al. 2001; [11] Shull and Hippelein 1991; [12] Levenson et al. 1999; [13] Miyata and Tsunemi 2001; [14] Danforth et al. 2000; [15] Fesen et al. 1982; [16] Raymond et al. 1980; [17] Danforth et al. 2001; [18] Miyata et al. 1998; [19] Ku et al. 1984; [20] Inoue et al. 1979; [21] Kahn et al. 1980; [22] Levenson and Graham 2001; [23] Parker 1967; [24] Levenson et al. 1998; [25] Raymond et al. 1983; [26] Sankrit et al. 2000; [27] Bohigas et al. 1999; [28] Sollerman et al. 2003.

SNR G74.9+1.2 (CTB 87, F, α-varies, θ=8×6, F=9, $\Sigma=2.82\times10^{-20}$)
d=12 kpc [1], d=10 kpc adopted.
t≅3000-5000 yrs [1]; E≅(3-5)×10^{49} erg [1]; kT=6.2±3.7 keV(1.2-16.2 keV) [2]; SI=2.48±0.56(1.2-16.2 keV) [2]; N_{HI}=(3-10)×10^{21} cm^{-2}(1.2-16.2 keV) [2].

[1] Wallace et al. 1997; [2] Asaoka and Koyama 1990.

SNR 76.9+1.0 (?, α=0.6, θ=12×9, F=2, $\Sigma=2.79\times10^{-21}$)
α=0.6 [1]; d=12.6 kpc (Σ-D), d=12.6 kpc adopted.

[1] Landecker et al. 1997.

SNR G78.2+2.1 (DR4, S, α=0.5, θ=60, F=340, $\Sigma=1.42\times10^{-20}$)
d=1.2 kpc [1], d=1.5 kpc [2,3,4,5,6], d=1.2 kpc (Σ-D), d=1.5 kpc adopted.
kT=1.3 keV (in the shell) [1]; V=1000 km/s [9]; MC [2]; $n_0\geq4$ [2]; $E_k=1.7\times10^{49}$ erg (for the shell) if d=1.5 kpc [2]; t=10^4 yrs [7,8], t=(5-6)×10^3 yrs [9]; $M_x=10^2$ $M_\odot$ [9].
Remarks: The SNR is probably expanding inside a cavity [9]. In the direction of the SNR (l=76°.8, b=1°.44), at d=1.37 kpc, there is Cygnus OB1 association which contains many massive stars [10]. The gamma-ray flux, E>100 MeV, from the region of SNR γ Cyg (DR4) is (12.6±0.7)×10^{-7} photons/cm^{2}s [11].
Point Source DRQNS RX J2020.2+4026 (γ-ray source) [8]
β=0.03 [8]; d=1.5 kpc [5]; $\tau=10^4$ yrs; SI=2 [5]; F_{1400}<0.35 mJy [8]; $F_x=4\times10^{-14}$ erg/cm^{2}s (0.1-2.4 keV) [5,8]; V=60 km/s [8]; $L_x=9\times10^{32}$ erg/s (0.1-2.4 keV) for d=1.5 kpc; Log L_{1400}<-0.1.

[1] Braun et al. 1989; [2] Landecker et al. 1980; [3] Green 1989; [4] Huang and Thaddeus 1985; [5] Brazier et al. 1996; [6] Lorimer et al. 1998; [7] Tuohy and Garmire 1980; [8] Brazier and Johnston 1999; [9] Lozinskaya et al. 2000; [10] Melnik and Efremov 1995; [11] Esposito et al. 1996.

SNR G82.2+5.3 (W63, S, α=0.5?, θ=95×65, F=120?, $\Sigma=2.92\times10^{-21}$)
d=1.4 kpc [1], d=1.6 kpc [2], d>2 kpc [3], d=1.7 kpc (Σ-D), d=1.7 kpc adopted.
$[NII](\lambda\lambda6548+6584)/H\alpha$ = 0.68±0.13 [5], [SII]($\lambda\lambda$6717+6731)/Hα = 0.6±0.1 [5], [SII]$\lambda\lambda(\frac{6717}{6731})$ = 0.8±0.2 [5].
Remarks: Expansion velocities of some optical filaments are 35±12 km/s and 70±30 km/s [4]. As pointed out by [6] a well defined evolutionary effect exists between the line intensity ratios Hα/|NII| and 6717/6731 and the diameter of the Galactic supernova remnants. By using the results of [6] and adopting a diameter of 33-39 pc, we obtain theoretical values for Hα/|NII| and 6717/6731 ratios as 1.1-1.5 and 1.2-1.3, respectively, consistent with the observed ratios of W63 [7].

[1] Ilovaisky and Lequeux 1972; [2] Milne 1979; [3] Wendker 1971; [4] Rosado and Gonzalez 1981; [5] Lozinskaya et al. 1976; [6] Daltabuit et al. 1976; [7] Sabbadin 1976.

SNR G84.2-0.8 (S, α=0.5, θ=20×16, F=11, $\Sigma=5.17\times10^{-21}$)
d=4.5 kpc (21 cm HI line and CO molecular lines) [1], d=6.2 kpc (Σ-D), d=5 kpc adopted.
Remark: the SNR is interacting with with a CO cloud as seen from the CO molecular lines and the 21 cm HI line [1].

[1] Feldt and Green 1993.

SNR G84.9+0.5 (S, α=0.4, θ=6, F=0.8, $\Sigma=3.34\times10^{-21}$)
d=21 kpc (Σ-D), d=10 kpc adopted.
SNR G85.4+0.7 (S, α=0.5?, θ=24, F=?, Σ=?)
d=3.8 kpc [1]; $\theta\sim24'$ [1]; $F_{1.420}$≅450 mJy [1]; Σ(1 GHz)≅10^{-22} Wm^{-2}Hz^{-1}sr^{-1} if α=0.5 [1].
Remarks: It is located within a large HI bubble. The diameter of the HI bubble is about 100 pc. The total mass is about 16000 $M_\odot$. A mean density of 1.2 cm^{-3} [1].

[1] Kothes et al. 2001.

SNR G85.9-0.6 (S, α=0.5?, θ=24, F=?, Σ=?)
d=5 kpc [1]; D~35 pc [1]; $\theta\sim24'$ [1]; $F_{1.4}$~900 mJy [1]; Σ(1 GHz)≅2×10^{-22} Wm^{-2}Hz^{-1}sr^{-1} if α=0.5 [1].
Remark: The SNR may lie in the low-density region between the local and Perseus spiral arms [1].

[1] Kothes et al. 2001.

SNR G89.0+4.7 (HB21, S, α=0.4, θ=120×90, F=220, $\Sigma=3.07\times10^{-21}$)
d=0.8 kpc (from the association of the SNR with Cyg OB7) [1,2,3,4], d=1.2 kpc (Σ-D), d=0.9 kpc adopted.
F-type in X-ray [5]; $N_{HI}=8.7\times10^{21}$ cm^{-2} [3]; kT=0.20 keV [3]; $F_x=0.28\times10^{-10}$ erg/cm^{2}s (un-

absorbed) [3], $F_x=0.21\times10^{-10}$ erg/cm^{2}s (absorbed) [3]; $L_x=2.5\times10^{35}$ erg/s [3]; t=19000 yr [3]; $n_e=0.23$ cm^{-3}d$^{-1/2}$ (d in kpc) [3], n=0.084 cm^{-3} [3], n=(3.1-7)$\times10^3$ cm^{-3} (for the H_2 clouds)[4]; $M_x=150\ M_\odot$[3]; $V_s\leq20$ km/s[4].
Remarks: Most of the emission from the SNR HB21 is above 0.5 keV and below 1.2 keV [3]. Along the eastern boundary, where the SNR was considered to be interacting with molecular clouds in previous studies, no strong evidence has been found for the interaction. Instead, broad (20-40 km/s) CO emission lines were detected in the northern and southern parts of the SNR [4]. On a large scale, HB21 appears to be in contact with a giant molecular cloud along its eastern boundary [1,2].
[1] Huang and Thaddeus 1986; [2] Tatematsu et al. 1990; [3] Leahy and Aschenbach 1996; [4] Koo et al. 2001; [5] Rho and Petre 1998.

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ПОСМАТРАЧКИ ПОДАЦИ О ГАЛАКТИЧКИМ ОСТАЦИМА ЕКСПЛОЗИЈА СУПЕРНОВИХ ЗВЕЗДА: I. ОСТАЦИ СУПЕРНОВИХ ЗА $l = 0^\circ - 90^\circ$

О. Х. Гусеинов[1,2], А. Анкај[1] и С. О. Тагиева[3]

[1] *TÜBİTAK Feza Gürsey Institute 81220 Çengelköy, İstanbul, Turkey*

[2] *Akdeniz University, Department of Physics, Antalya, Turkey*

[3] *Academy of Science, Physics Institute, Baku 370143, Azerbaijan Republic*

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Стручни рад

Сакупили смо све расположиве податке из литературе о Галактичким остацима експлозија супернових звезда. У овом раду смо представили податке из свих спектралних опсега, о остацима супернова који се налазе у интервалу Галактичке лонгитуде од 0° до 90°. Установили смо вредности растојања до остатака супернових испитујући одговарајуће даљине. Подаци за различите типове неутронских звезда повезаних са остацима супернова су такође приказани. Осим што су приказани подаци, дати су и коментари других аутора, као и наши сопствени, а у вези података и неких особина остатака супернова и тачкастих извора.