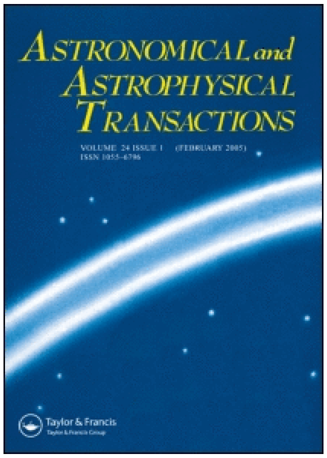

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DISTANCES AND OTHER PARAMETERS FOR 1328 RADIO PULSARS

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In this work we have collected observational data for 1328 radio pulsars (PSRs). Distances and others parameters for these PSRs were estimated. We present improved distance estimates for radio PSRs by considering the importance of their physical properties and improvement in the distribution of star formation regions in the Galaxy. For this purpose, a list of accurate calibrators was constructed and several natural criteria were established. The following values were calculated from observational data on PSRs: luminosities at 400 MHz and 1400 MHz, characteristic times, strength of magnetic field and rate of rotation energy loss. This compilation of data is mainly necessary for statistical investigations and to study the physical properties of neutron stars. All the data have been prepared and are given in a publicly accessible Web page http://www.xrbc.org/pulsar/.

Keywords: General pulsars; Neutron stars; Miscellaneous astronomical databases

1 INTRODUCTION

It is a well-known fact that no relation has been found in pulsar (PSR) parameters to estimate their distance. For ordinary distant stars, however, one can use the relations either between luminosity and spectral class or between luminosity and pulsation period to estimate their distance. In the early days of PSR astronomy, since the origin of PSRs, the mass of their progenitor and their birth rates were not well known, a homogeneous electron density distribution was assumed. However, later, PSR distances have been estimated according to the rough model of Galactic electron distribution and some natural requirements (Guseinov and Kasumov, 1981; Manchester and Taylor, 1981; Johnston *et al.*, 1992; Taylor and Cordes, 1993; Gök *et al.*, 1996). In doing this, one should also know some of the PSR distances independent of their dispersion measure (DM). The 21 cm line of neutral hydrogen was mainly used in choosing distance calibrators. However, nowadays, calibrators are chosen from members of globular clusters (GCs) or magellanic clouds (MC), PSR connected to supernova remnants (SNRs) with well-known distances and from PSRs, where their distances are known from other available data.

Irregularities were observed in the distribution of dust, molecular clouds and neutral hydrogen (H I) in the Galaxy. It is also normal to expect irregularities in the electron distribution

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where the degree of irregularity is (naturally) considerably small. Considerable variations in opacity and polarization can be observed for stars with the same distance in a very small region of sky (about 1° square) close to the Galactic plane. This is due to the very inhomogeneous distribution of dust clouds. For the hydrogen column density along the line of sight there are two surveys in which a large number of stars were studied: one with 554 stars (Diplas and Savage, 1994) and the other with 594 stars (Fruscione *et al.*, 1994). They both show that irregularities in the H I distribution are quite different form the dust and molecular cloud distribution (Ankay and Guseinov, 1998). The DM, which is connected with the electron distribution, changes also for PSRs of similar distances, and for close regions of the sky. These irregularities in electron distribution are due to contribution from both H II regions and SNRs along the line of sight, and gravitational potential and gas temperature distribution in the Galaxy. However, the irregularities in electron distribution are considerably smaller than those in other components of the interstellar medium that we have mentioned above. Even though these irregularities are small, there is no simple model for Galactic electron distribution to calculate the distance of each PSR. Moreover, constructing a complex model which requires many data for interstellar media and PSRs, (see for example Taylor and Cordes (1993)) cannot avoid large errors for individual PSRs.

In order to investigate the arm structure around the Sun within a distance of 4–5 kpc, usually objects such as OB associations and open clusters (OCs) are studied. For these objects the relative errors in estimating their distances could reach 30% (Humphreys, 1978; Efremov, 1989; Garmany and Stencel, 1992; Ahumada and Lapasset, 1995). There is no single good method to estimate the distance of all extended objects belonging to the arms (molecular clouds, neutral hydrogen clouds, SNRs and H II regions). In determining the distances to these objects using the H I 21 cm line and Galaxy rotation models, the error exceeds 30% and it increases with increasing distance and in the vicinity of longitudes $l = 0°$ and $l = 180°$. However, it is the most widely used model. For distant X-ray sources, the hydrogen column density is used as another method to estimate distances. However, the error in this method is also large. Since progenitors of PSRs are massive stars, their birthplaces are in the star formation regions (SFRs). Furthermore, even though young PSRs with a characteristic age $\tau < 5 \times 10^5$ years have high space velocities, they cannot escape from their birthplaces. Thus, if the number of young PSRs discovered increases and distances to these PSRs are well known, then arm structures farther away could be studied.

Archiving radio PSR data dates back to 1981. The first full catalogue included 333 PSRs which covered discoveries up to 1980 (Manchester and Taylor, 1981). The next catalogue which plays an important role in PSR astronomy contained 706 pulsars (Taylor *et al.*, 1996). This covered both old (since 1981) and new pulsars (see for example Dewey *et al.* (1985); Stokes *et al.* (1985, 1986); Clifton *et al.* (1992); Johnston *et al.* (1992); and Taylor and Cordes (1993)). However, individual PSRs can be reached through a publicly accessible webpage.† Since 1996, several PSR surveys have been carried out (Johnston *et al.*, 1995; Manchester *et al.*, 1996, 2002; Sandhu *et al.*, 1997; D'Amico *et al.*, 1998; Lyne *et al.*, 1998, 2000; Camilo *et al.*, 2001; Edwards and Bailes, 2001a, b; Edwards *et al.*, 2001a, b; Manchester, 2001; Morris *et al.*, 2002). In addition to this, inner regions of SNRs have been scanned to search for PSRs with connections to SNRs (Gorham *et al.*, 1996; Kaspi *et al.*, 1996; Lorimer *et al.*, 1998). After 1996, PSRs with connections to SNRs or PSRs with confirmed association connections have been found and their distances were accurately determined (Table I). Furthermore, GCs have also been searched for PSRs (Lyne, 1995; Kulkarni and Anderson, 1996; Biggs and Lyne, 1996; Camilo *et al.*, 2000; D'Amico *et al.*, 2001). In NGC104 (47 Tuc) ten PSRs up to 1996 and ten more PSRs after 1996 have been found. For the other known GCs, no new PSRs were

† http://pulsar.ucolick.org/cog/pulsars/catalog/.

TABLE I PSRs for which errors is distances are not more than 30%.

Name	*l*	*b*	*d*	*DM*	n_e	*Location*	*References*
0024 − 7204W	305.9	−44.9	4.5	24.3	0.005	GC NGC 104 (47 Tuc)	Hesser *et al*. (1997), Harris (1996)
0045 − 7319	303.5	−43.8	57	105.4	0.002	SMC	Feast and Walker (1987)
0113 − 7220	300.6	−44.7	57	125.0	0.002	SMC	Crawford *et al*. (2001b)
0205 + 6449	130.7	3.1	3.2	140.7	0.044	SNR G130.7+3.1 (3C 58)	Camilo *et al*. (2002c), Murray *et al*. (2002)
0455 − 6951	281.3	−35.2	50	94.9	0.002	LMC	Crawford *et al*. (2001b)
0502 − 6617	277.9	−35.5	50	68.9	0.001	LMC	Crawford *et al*. (2001b)
0529 − 6652	277.2	−32.8	50	100.0	0.002	LMC	Crawford *et al*. (2001b)
0534 + 2200	184.6	−5.8	2	56.8	0.028	SNR G184.6-5.8 (Crab)	Trimble and Woltjer (1971)
0535 + 6935	280.1	−31.9	50	89.4	0.002	LMC	Crawford *et al*. (2001b)
0540 − 6919	279.7	−31.5	50	146.0	0.003	LMC	Taylor *et al*. (1996)
0826 + 2637	196.9	31.7	0.4	19.5	0.049	Parallax	Gwinn *et al*. (1986)
0835 − 4510	263.6	−2.8	0.45	68.2	0.152	SNR G263.9-3.3 (Vela)	Cha *et al*. (1999), Legge (2000), Guseinov *et al*. (2002)
0922 + 0638	225.4	36.4	1.21	27.3	0.020	Parallax	Fomalont *et al*. (1999), Chatterjee *et al*. (2001)
0953 + 0755	228.9	43.7	0.28	3.0	0.011	Parallax	Gwinn *et al*. (1986), Brishen *et al*. (2000)
1119 − 6127	292.2	−0.54	7.5	707.4	0.101	SNR G292.2-0.5	Crawford *et al*. (2001a), Pivovaroff *et al*. (2001), Guseinov *et al*. (2002), Kaspi and Helfand (2002)
1124 − 5916	292.0	1.8	6	330.0	0.066	SNR G292.2+1.8	Camilo *et al*. (2002)
1302 − 6350	304.2	−0.9	1.3	146.7	0.113	Sp Binary, Be	Johnston *et al*. (1994).
1312 + 1810	332.9	79.8	18.9	24.0	0.001	GC NGC 5024 (M53)	Harris (1996), Rey *et al*. (1998)
1341 − 6220	308.7	−0.4	8	730.0	0.097	SNR G308.8-0.1	Caswell *et al*. (1992), Guseinov *et al*. (2002)
1456 − 6843	313.9	−8.5	0.45	8.6	0.019	Parallax	Bailes *et al*. (1990)
1513 − 5908	320.3	−1.2	4.2	253.2	0.060	SNR G320.4-1.2	Taylor *et al*. (1996), Guseinov *et al*. (2002), Kaspi and Helfand (2002)
1518 + 0204B	3.9	46.8	7	30.5	0.004	GC NGC 5904 (MS)	Brocato *et al*. (1996b), Harris (1996), Sandquist *et al*. (1996)
1623 − 2631	350.9	15.9	1.8	629	0.035	GC NGC 6121 (M4)	Cudworth and Rees (1990), Harris (1996)
1641 + 3627B	59.8	40.9	7.7	29.5	0.004	GC NGC 6205 (Ml3)	Harris (1996), Paltrinieri *et al*. (1998)

(*continued*)

TABLE I Continued.

Name	*l*	*b*	*d*	*DM*	n_e	*Location*	*References*
1701 − 30	353.6	7.3	5	114.4	0.023	GC NGC 6266 (M62)	Brocato *et al*. (1996a), Harris (1996), D'Amico *et al*. (2001)
1721 − 1936	4.9	9.7	9	71.0	0.008	GC NGC 6342	Harris (1996), Heitsch and Richtler (1999)
1740 − 53	338.2	−11.9	2.3	71.8	0.031	GC NGC 6397	Alcaino *et al*. (1987), Harris (1996), D'Amico *et al*. (2001)
1748 − 2021	7.7	3.8	6.6	220.0	0.033	GC NGC 6440	Harris (1996), Ortolani *et al*. (1994)
1748 − 2445B	3.85	1.7	7	205.0	0.029	Ter 5	Harris (1996), Ortolani *et al*. (1996)
1801 − 2451	5.2	−0.9	4.5	289.0	0.064	SNR G5.4-1.2	Thorsett *et al*. (2002)
1803 − 2137	8.4	0.1	3.5	233.9	0.067	SNR G8.7-0.1	Frail *et al*. (1994), Finley and Oegalman (1994), Allakhverdiyev (1997), Guseinov *et al*. (2002), Kaspi and Helfand (2002)
1804 − 0735	20.8	6.8	7	186.4	0.027	GC NGC 6539	Harris (1996), Armandroff (1998)
1807 − 2459	5.8	−2.2	2.6	134.0	0.052	GC NGC 6544	Kaspi *et al*. (1994), Harris (1996), D'Amico *et al*. (2001)
1823 − 3021B	2.8	−7.9	8	87.0	0.011	GC NGC 6624	Sarajedini and Norris (1994), Harris (1996)
1824 − 2452	7.8	−5.6	5.7	119.8	0.021	GC NGC 6626 (M28)	Rees and Cudworth (1991), Harris (1996)
1856 + 0113	34.6	−0.5	2.8	96.7	0.035	SNR G34.7-0.4	Kaspi (2000), Guseinov *et al*. (2002), Kaspi and Helfand (2002)
1910 − 59	336.5	−25.6	4	34.0	0.009	GC NGC 6752	Buonanno *et al*. (1986), Harris (1996), D'Amico *et al*. (2001)
1910 + 0004	35.2	−4.2	6.5	201.5	0.031	GC NGC 6760	Harris (1996), Heitsch and Richtler (1999)
1930 + 1852	54.1	0.27	5	308.0	0.062	SNR G54.1+0.3	Camilo *et al*. (2002a)
1932 + 1059	47.4	−3.9	0.17	3.2	0.019	Parallax	Salter *et al*. (1979), Weisberg *et al*. (1980), Backer and Sramek (1982), Campbell (1995)
1952 + 3252	68.8	2.8	2	45.0	0.022	SNR G69.0+2.7	Taylor *et al*. (1996), Allakhverdiyev *et al*. (1997), Guseinov *et al*. (2002), Kaspi and Helfand (2002)
2022 + 5154	87.9	8.4	1.1	22.6	0.021	Parallax	Campbell *et al*. (1996)
2129 + 1209H	65.1	−27.3	10	67.2	0.007	GC NGC 7078 (M15)	Taylor *et al*. (1996)
2337 + 6151	114.3	0.2	2.8	58.4	0.021	SNR G114.3+0.3	Furst *et al*. (1993), Guseinov *et al*. (2002), Kaspi and Helfand (2002)

found. However, in each of NGC 6266, NGC 6342, NGC 6397, NGC 6544 and NGC 6752, one PSR has been found after 1996 (Table I).

In the early days of PSR observations a basic frequency of around 400 MHz was used in the search. Since DM values of distant pulsars are high, 1400 MHz was used in surveys and in the search for PSRs in SNRs and GCs. As expected, the newly discovered pulsars are generally in the direction of the Galactic centre. After 1996, several new PSRs have been found in MCs. However, the number of PSRs in GCs and number of millisecond PSRs with known ages ($P < 0.1$ s and $\dot{P} < 10^{-16}$ s s^{-1}) increased about 1.5 and 1.4 times respectively. There is a considerable increase in the number of PSRs found with low fluxes owing to the increase in both the sensitivity of instrumentation used in PSR surveys and the number of detailed surveys. For example, in Arecibo's survey window ($40° \leq l \leq 65°$; $|b| \leq 2.5°$), 12 new PRSs were found. In this article our aim is to combine both old and new observational PSR data and to calculate their parameters.

2 PULSAR DISTANCES

Between 1970 and 1980, both the number of PSRs and the number of PSRs connected with an object having a well-known distance (e.g. MCs, some GCs and SNRs) were lower. In addition to this, since at that time there was insufficient knowledge concerning the Galactic electron distribution, it was difficult to find a good distance value using the DM value of PSRs. Thus, PSRs with distances estimated using the H I line are used as an extra distance calibrator. It is known that it is impossible to calculate an object's distance using the H I line at 21 cm if the object's radial velocity component of Galactic rotational velocity is small. In addition to this, in the direction of the Galactic centre and distances the suitable distance to the shift of the 21 cm line would be 2 instead of 1. Uncertainty in calculating the distance with this method is not less than 30–50%. Thus, in recent years, in determining calibrators for PSRs, distance estimates calculated using the 21 cm line are not accepted as a rule. For this reason it was not possible to find a distance estimate independent of a DM value for PSRs in certain directions and distances.

In estimating PSR distances, the model of the Galactic electron distribution by Taylor and Cordes (1993) has been widely used in recent years. However, in estimating the PSR distances, the approach of Gök *et al*. (1996) gave smaller distances than those calculated using the model of Taylor and Cordes (1993) for PSRs farther than 4 kpc and with Galactic latitudes greater than about 10°. To form a new model electron distribution, Gómez *et al*. (2001) have published a huge PSR list which could be used for calibrators. We have decided to revise the values of their distances to use them as calibrators. In Table I we present 39 PSRs for which errors in distances should not be higher than 30%. Since distances of PSRs from the same GC are the same, only one PSR from each GC and two PSRs for each MC have been included in the table. Instead of presenting a long table, the PSR table has been prepared in a publicly accessible web page (see Section 3). In this table, the total number of PSRs having distances independent of the DM value is 68. In Table I the number of PSRs is considerably smaller than that in the calibrator list of Gómez *et al*. (2001). In this table, one of the most interesting calibrators is PSR J0835-4510 (in Vela SNR). The distance for this PSR has been adopted as 0.45 kpc, which was given as 0.25 kpc by Gómez *et al*. (2001). This huge discrepancy needs some more explanation.

Recent estimates of Vela SNR are as follows. $d = 0.25$ kpc (Oegelman *et al*., 1989), $d = 0.25 \pm 0.03$ kpc (Cha *et al*., 1999), $d \approx 0.28$ kpc (Bocchino *et al*., 1999) and $d = 0.25 \pm 0.03$ kpc (Danks, 2000). In estimating the distance, one should also consider that Vela SNR expands in a dense environment. Its magnetic field is $B \approx 6 \times 10^5$ G (de Jager *et al.*, 1996) and its explosion energy is $(1-2) \times 10^{51}$ erg (Danks, 2000). Of course these values have really large errors; however, they are themselves large too. If we take into account all these values, then it is not acceptable to have Vela at the same position with SNR G327.6+14.6 in the $\Sigma - D$ diagram (remnant of Ia type supernova explosion at 500 pc above the Galactic plane (Hamilton *et al.*, 1997)), which expands in a dense environment of low matter density. Thus, Vela must be close to other SNRs, which expand in a dense environment.

In the direction of the Vela remnant, none of the young OCs and OB associations have distances as small as 0.25 kpc (Efremov, 1989; Berdnikov and Efremov, 1993; Aydin *et al.*, 1997). The distance of OC Pismis 4 ($l = 262.7$ and $b = -2.4$) which belongs to the nearest Vela OB2 association and is in the direction of Vela, is 0.6 kpc (Ahumada and Lapasset, 1995). Since the progenitors of SNRs (or PSRs) are massive stars, one would expect the Vela remnant to be closer to the SFR instead of a distance value of 0.25 kpc.

If the distance value of 0.45 kpc is accepted for Vela, then the average electron density along the line of sight would be $n_e = 0.153\,\mathrm{cm}^{-3}$. The PSR with the second largest n_e value (about $0.113\,\mathrm{cm}^{-3}$) is for PSR J1302-6350 ($l = 304.2$ and $b = -0.9$; companion is a B_e-type star; $d = 1.3$ kpc; variable wind in the environment). The next largest n_e value ($0.107\,\mathrm{cm}^{-3}$) is for PSR J1644-4569 ($l = 339.2$ and $b = -0.2$). Since luminosity of PSR J1644-4569 at 1400 MHz is higher than that of any other known PSR, we could estimate its distance as no more than 4.5 kpc. The average value of n_e for the rest of the PSRs is around 0.04. So, it is impossible to accept a value of 0.25 kpc for Vela PSR and Vela SNR. We could only reduce our initial distance estimate of 0.45 kpc to 0.4 kpc at the most.

For PSR J1701-30 ($l = 353.6$ and $b = 7.3$), D'Amico *et al.* (2001) and Gómez *et al.* (2001) adopted a distance value of 6.7 kpc and they believed that the PSR is inside the GC 6266 (M62). If such a high distance value is adopted for the PSR, then the electron number density along the line of sight should be considerably lower than the values for the PSRs in the same direction and approximately at the same distance. It is much more realistic to accept a distance value of 5 kpc for this PSR. The space density of both H II regions in the direction of the Galactic centre and SNRs, and a higher value of n_e in the direction line of sight do not allow the PSRs to have a very different n_e value in the same direction and at approximately the same distance. Thus a question mark is added for PSR J1701-30 while accepting it as a calibrator owing to doubts concerning its distance value. The distance values of PSRs in other GCs are within the error limits of those given by Gómez *et al.* (2001). The distances of PSRs connected with SNRs have been studied by Guseinov *et al.* (2002). Thus, their accurate distance values have been listed in Table I. Among the PSRs that were used as calibrators and were a member of a GC, those with the most varying distances were PSR J1748-2445A and B, J1804-0735 and J1910+0004 in GCs Ter 5, NGC 6539 and NGC 6760 respectively. These variations arise because new distances of these GCs are more than twice the estimates before 1996.

It is a well-known fact that dynamic equilibrium could be achieved within the old populations (both halo and disc; the characteristic time is about 10^{10} years). However, these populations are not in dynamic equilibrium with each other. The total mass of stars and gas which belongs to Galactic arms is about 1% of the total mass of the Galaxy and the parameters of the arm structure changes with time. The characteristic time of these changes is about 10^9 years. On the other hand, SFRs which are far from dynamic stability have ages an order of magnitude smaller than the characteristic time of arm structures. Therefore, one should not expect any coincidence between the geometric plane of arms and the Galactic plane throughout the whole Galaxy. SFRs might be found either below or above the Galactic plane. Optical observations of Cepheids with high luminosities (variables with long pulse periods) and red supergiants at a distance of about 5–10 kpc from the Sun in the direction of $l \approx 200$–$330°$ have shown that SFRs lie about 300 pc below the Galactic plane. Similarly, at the same distance and in the direction of $l \approx 70$–$100°$, SFRs lie about 400 pc above the Galactic plane. Finally, between 3 and 5 kpc distance and in the direction of 270–320°, massive Cepheids and red supergiants have been located about 150 pc below the Galactic plane (Berdnikov, 1987).

In Figure 1, we present the $l-b$ distribution of pulsars with a characteristic time of $\tau \leq 5 \times 10^5$ years. As can be seen from the figure, in the direction of $l \approx 260$–$290°$, some young PSRs are located below the Galactic plane. The distance of these PSRs show that their locations coincide with the location of Cepheids and red supergiants. For PSRs with distances $d > 5$ kpc, the average distance from the Galactic plane is about -135 pc. From Figure 1 we see a similar deviation from the Galactic plane in the direction of $l \approx 50$–$80°$. These PSRs have an average Z of about 150 pc and they probably belong to the Perseus arm. In the distance estimation of PSRs we take into account all these facts.

We discussed the fact that Galactic arms (SFRs) deviate from the Galactic plane in the outer parts of the Galaxy. However, for the inner part of the Galaxy (closer than the Sun distance, i.e. about 8.5 kpc to the centre) there is no evidence that the deviation from the Galactic plane is larger than 100 pc. Therefore PSRs with the same age should have the same distance from the Galactic plane because the average space velocity of PSRs do not depend on the environmental conditions of a PSR.

It is normal to neglect the influence of deviation from the Galactic plane for PSRs older than about 5×10^6 years owing to typical high average space velocities of PSRs (250 km s^{-1} (Allakhverdiev *et al.*, 1997)). On the other hand, the space velocity of some PSRs reaches 1000 km s^{-1}, for example PSR J1801-2451 (Frail and Kulkarni, 1991). However, since the number of these types of PSRs are few, old PSRs with the same age must have the same average value of $|Z|$ in all parts of the Galaxy, except the young parts.

Radio luminosity of PSRs should not depend on their birthplace and should not considerably exceed luminosities of the strongest PSRs (e.g. Crab with a very well-known distance and

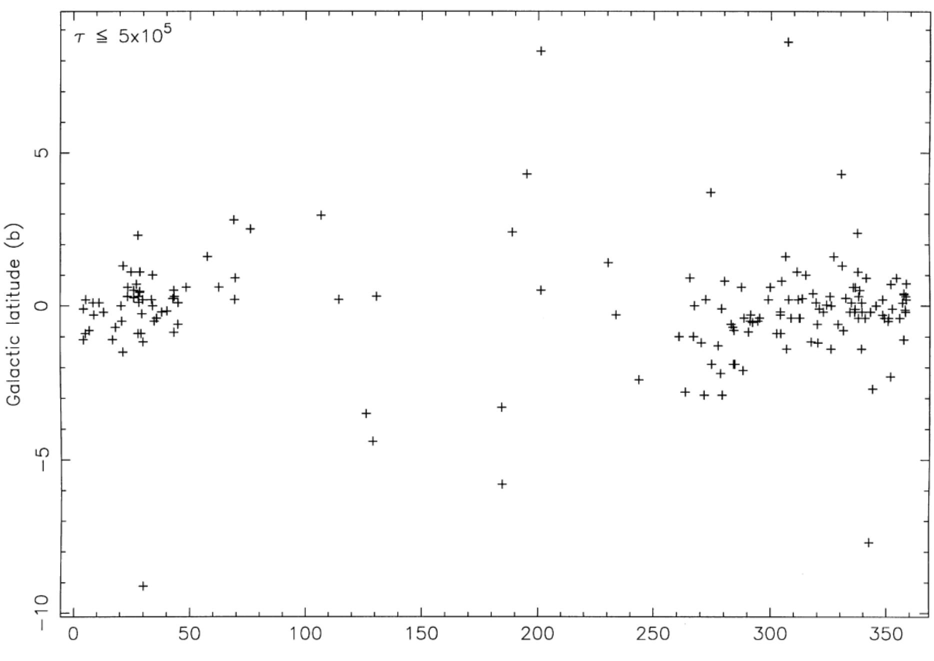

FIGURE 1 Galactic longitude versus latitude distribution for PSRs with $\tau \leq 5 \times 10^5$.

being the strongest PSR in MCs). The luminosities of Crab are 2.6×10^3 mJy kpc^2 and 56 mJy kpc^2 for 400 MHz and 1400 MHz respectively. The luminosity of the strongest PSR in MCs (PSR J0529-6652) is 1.6×10^3 mJy kpc^2 at 400 MHz and 7.5×10^2 mJy kpc^2 at 1400 MHz. In the SMC the luminosity of PSR J0045-7319 is 9.5×10^3 mJy kpc^2 at 400 MHz and 1.3×10^3 mJy kpc^2 at 1400 MHz. Therefore the upper limit for the luminosities of PSRs might be close to the values of 1.5×10^4 mJy kpc^2 and 3×10^3 mJy kpc^2 for 400 MHz and 1400 MHz respectively (spectral indices of PSRs have also been taken into account). In our list of 1328 PSRs the strongest is PSR J1644-4559 with luminosities of 7.58×10^3 mJy kpc^2 and 6.29×10^3 mJy kpc^2 for 400 MHz and 1400 MHz respectively.

Since PSRs on the Galactic plane were born in the Galactic plane and surveys have scanned the Galactic plane many times, most PSRs, especially the farthest, have small Galactic latitudes ($|b| < 5°$). As can be seen in our calibrator table (Table I), for 12 PSRs $|b| > 30°$, for ten PSRs $30° > |b| > 7°$, for six PSRs $7° > |b| > 3°$, and for only 11 PSRs $|b| < 3°$. Thus, the calibrators in MCs, GCs and calibrators with known trigonometric parallaxes becomes insignificant for PSRs with small $|b|$. Only three from our calibrator list belong to $|b| < 3°$ and have distances greater than 5 kpc. Therefore, for the PSRs with large distance and low $|b|$ values there are almost no calibrators. In addition to this, for such distances it is quite difficult to judge the electron density value.

Considering the reasons given above in adopting distances for PSRs, the following criteria become very important:

(i) In the direction of $40° < l < 320°$ we see the strongest PSRs throughout the Galaxy.
(ii) For all Galactic longitudes l, PSRs with equal characteristic times τ must have, on the average, similar $|Z|$ values except PSRs with $\tau \leq 5 \times 10^6$ years in the regions where SFRs are considerably above or below the Galactic plane.
(iii) PSRs with $\tau < 5 \times 10^5$ years must still be near to their birthplaces, that is in the SFRs.
(iv) The PSR luminosity does not depend on l and d, and it should not exceed the luminosity of known strongest PSRs at 400 and 1400 MHz.

TABLE II Description of columns in the PSR table in the Web page http://www.xrbc.org/pulsar/. Catalogue columns with logarithmic values are indicated with (L) in the description.

Column	*Notation*	*Description*
1	Name	Name of the PSR
2	l	Galactic longitude
3	b	Galactic latitude
4	Location	MCs, GCs, SNRs
	Properties	Binary (B), triplet (T), Glitch (G)
5	DM	Dispersion measure
6	d	Distance
7	n_e	Average value of electron density along the line of sight
8	F_{1400}	Flux at 1400 MHz
9	L_{1400}	(L) Corresponding luminosity for F_{1400}
10	F_{400}	Flux at 400 MHz
11	L_{400}	(L) Corresponding luminosity for F_{400}
12	P	Spin period
13	$\dot{P}$	Derivative of P
14	$\dot{E}$	(L) Rate of rotation energy loss
15	B	(L) Magnetic field
16	τ	(L) Characteristic time

(v) The electron density in the Galaxy must be correlated with the number density of H II regions and OB associations, and it must increase as one approaches the Galactic centre.
(vi) PSR distances must be arranged in such a way that their value should correspond to a suitable distance value of PSRs in Table I (the value of DM and the direction of the PSR have to be taken into account).

3 PULSAR DATA

All the collected parameters (both observational and calculated) for 1328 PSRs are given separately in a publicly accessible Web page: http://www.xrbc.org/pulsar/. The description of each column is given in Table II.

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