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The Distance and Distribution of Galactic Supernova Remnants from the PMN Survey Sample

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Abstract. We have used the Parkes-MIT-NRAO (PMN) radio survey, at a common frequency of 4.85 GHz (λ=6 cm), to study the distribution of Galactic shell supernova remnants (SNRs). We estimate distances and distribution of the Galactic shell SNRs and find the peak of distances to be between 4 and 6 kpc. Our two-dimensional model of the distribution of Galactic shell SNRs shows a concentration between the Sagittarius and the Scutum arms.

1. Introduction

The PMN Survey, at 4.85 GHz, was undertaken with three radio telescopes: Green Bank's 91-m and 43-m telescopes were used to scan the northern sky (Condon et al. 1989, 1991), and the Parkes 64-m telescope (Condon et al. 1993), was used to scan the southern sky (at the same frequency).

The angular sizes of supernova remnants (SNRs) are taken from Green (2001) and used in the estimation of flux densities for SNRs recognized in the PMN. The surface brightness (calculated for 4.85 GHz) and diameter (in pc) for the shell SNRs was used to establish the $\Sigma - D$ relation (Shklovsky 1960). The derived distances and distribution of the shell SNRs was then considered.

2. Observations and Data Analysis

The data have been downloaded from the Australia Telescope National Facility (ATNF) and SkyView Virtual Observatory WWW pages.[1] Since the PMN survey is performed with single dish telescopes, while SNRs are mostly extended

[1]See `ftp://ftp.atnf.csiro.au/pub/data/pmn/surveys` and `http://skyview.gsfc.nasa.gov`.

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objects, we had to take special care with SNRs extended in the north-south direction. This is because applying correction in spillover temperature variation reduces the fluxes (Condon et al. 1991, 1993). The 43-m telescope observations are used only for fields not covered by Parkes.

3. Distance to Galactic Shell SNRs

For Galactic shell SNRs, with only radio observations, it is common to use the $\Sigma - D$ relation, find the power law index, β, and then estimate distances. Our calculations showed that shells concentrate between 2 and 8 kpc with a peak between 4 and 6 kpc. Leahy & Xinji (1989) also found a peak value between 4 and 6 kpc and Case & Bhattacharya (1998) estimated the peak distribution at ~ 5 kpc with a scale length of ~ 7 kpc.

Also, we have examined the height, $|z|$, of shell SNRs relative to the Galactic plane. It is clear that the highest concentration of shells is $\sim \pm 200$ pc from the plane, and that the remnants G93.3+6.9 and G55.7+3.4 have the highest values of $|z|$, 673 pc and 604 pc, respectively.

4. Galactic Distribution of the Shell SNRs

Using a Galactocentric distance of 8.5 kpc, and spiral arms as defined by Russeil (2003), we found a concentration of SNRs towards the Galactic Center (between Galactic longitudes –40 to 40 degrees), as expected. This also showed that shells in the Galaxy are largely distributed between the Sagittarius and Centaurus arms. Similarity was found between the distribution of Galactic SNRs, and that of H II regions as presented by Paladini et al. (2004).

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