# GALACTIC DISTRIBUTION AND GENESIS OF PULSARS

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At the end of 1978 the results of the second pulsar survey at the Molonglo Observatory (Manchester et al., 1978) and of a new survey of the northern hemisphere made at Green Bank (Damashek et al., 1978) were published. More than 80% of the celestial sphere were thus searched for pulsars in a careful and homogeneous manner. As a result of these surveys 172 new pulsars were discovered and parameters of 95 previously known pulsars were improved. Recently two new pulsars were discovered in the Pushino Observatory (Alekseyev et al., 1979), bringing the grand total of known pulsars to 325.

With such a volume of uniform data statistical analysis of the galactic distribution of pulsars is possible. However, numerous effects, known to be present in the collected parameters of pulsars, must be carefully studied and, where necessary, re-adjusted. The most important parameter which can be derived is the electron density ($n_e$) in the line of sight. To calculate the distance parameters (distance from the Sun r, distance from the galactic centre R, and the distance above the galactic plane z) we must use the correct values of $n_e$. To choose the correct value of $n_e$ for a particular pulsar we must consider many other data (e.g. the distribution of HI, $H_2$, HII regions, $H_2O$ masers, associations and open clusters). In addition, the derivations of $n_e$ by other observational means (e.g. HI line studies, ultraviolet observations of stars, etc.) must be considered.

While making final estimates of $n_e$ for each pulsar, we tried to satisfy four requirements of phenomenological character from the previous investigations: (a) the agreement of radio pulsar distribution with that of giant HII regions; (b) a slight dependence of the average z distance of pulsars with the distance from the Sun and the identity of this dependence in different longitudinal sectors; (c) minimization of anomalous pulsars (anomaly in parameters R, L, z, etc.); (d) the identity of the luminosity law of pulsar distribution with the increase in volume. All this allowed us to calculate the main parameters of a statistically uniform sample of pulsars (224 objects included in the Molonglo survey) and to construct the radial distribution of pulsars in



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the Galaxy. Then the luminosity function was determined, evolution of luminosity with age and birth-rate was found and the genesis of pulsars was discussed. The investigation of these problems leads to the following results:

1. The radial distribution of pulsars to the centre of the Galaxy has an annular structure with a thickness of 8 kpc. The distribution of the surface pulsar density (in projection on the galactic plane) inside the ring shows a slight gradient to the centre and maximum at $5.2 \pm 0.4$ kpc.

2. The pulsar luminosity function of the last Molonglo survey may be approximated by a power law $\log(dN/dL) = c_1 - \gamma \log L$ $(1.6 \leqq \gamma \leqq 1.9)$ with L extending from $L_o = 3 \cdot 10^{26}$ erg/s up to the highest observed luminosity. For $L < L_o$ a decrease in growth of the number of pulsars is observed and points to the disappearance of the radio luminosity at the age of $\sim 10^7$ years.

3. The evolution of pulsar luminosity with age has been investigated and was found to be equal to $\log L = c_2 - \mu \log t$, where $c_2 = 35.2 \pm 0.7$ and $\mu = 1.34 \pm 0.09$, t is expressed in years and L in erg/s. Proceeding from this one could estimate the real age of pulsars (with $L \geqq 3 \cdot 10^{26}$ erg/s) as equal to $(3.6 \pm 0.4) \cdot 10^6$.

4. The total number of pulsars with luminosity $3 \cdot 10^{26} \leqq L \leqq 3 \cdot 10^{29}$ erg/s and their birth-rate $\nu_p = 0.027 \pm 0.009$ yr$^{-1}$ was obtained. This value is the upper limit and in good accordance with the frequency of the historic SN explosions.

5. Pulsars are the product of the evolution of massive stars ($M > 5\ M_\odot$) and are connected genetically with SN explosions. The probability of their formation due to a "quiet collapse" is rather small. Thus the hypothesis of pulsar formation from objects of the extremely flat disk of the Galaxy (Tammann, 1974; Guseinov and Kasumov, 1974) has acquired new evidence based on more complete and statistically homogeneous data.

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