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A MODEL FOR THE GALACTIC FREE-ELECTRON DISTRIBUTION

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A smooth model for the distribution of Galactic free electrons was obtained from the set of 70 pulsars with known distance. Although a more complex model incorporating spiral arms might be possible (see Taylor & Cordes 1993), it is not well constrained by the pulsar data alone, so we choose to use a simpler and probably more robust functional form.

We fitted two kinds of models, with functional forms:

$$n_{\rm e} = \sum_{i=1,2} n_i \, f(z/z_i) \, f(r/r_i) \Big/ f(r_\odot/r_i), \qquad (1)$$

where $f(x)$ is either $\mathrm{sech}^2(x)$ or $\exp(-x)$. The fit was achieved using a procedure similar to a χ^2 fit, adding a scatter parameter A similar to that of Savage, Edgar, & Diplas (1990), although we get a smaller value (see Table). The exponential scale height obtained is consistent with the value quoted in Reynolds (1996).

After analyzing the residuals of the fit, we found evidence for two regions of enhanced electron density at 2 and 5 kpc in the direction of the Galactic center, which may be associated with spiral arms with pitch angles of roughly 22° and 27°.

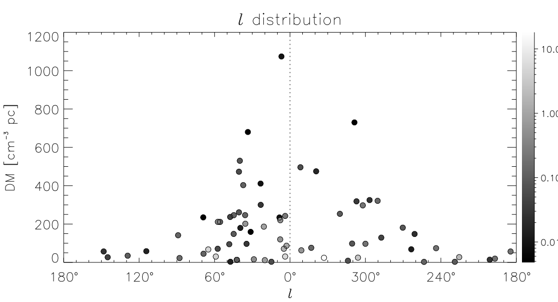

Fig. 1. Dispersion measure of pulsars of known distance as a function of latitude. Since there is no clear asymmetry in this data, we have chosen to use an axisymmetric model. In addition, the arm/interarm contrast of the midplane density was found to be smaller than the scatter.

TABLE 1

BEST FIT PARAMETERS

	n_i(cm^{-3})	z_i (kpc)	r_i (kpc)	A
$\mathrm{sech}^2(x)$	1.98×10^{-2}	1.04	152	0.30
	0.34×10^{-2}	0.067	1.97	
$\exp(-x)$	2.15×10^{-2}	0.94	14.3	0.31
	0.36×10^{-2}	0.053	1.00	

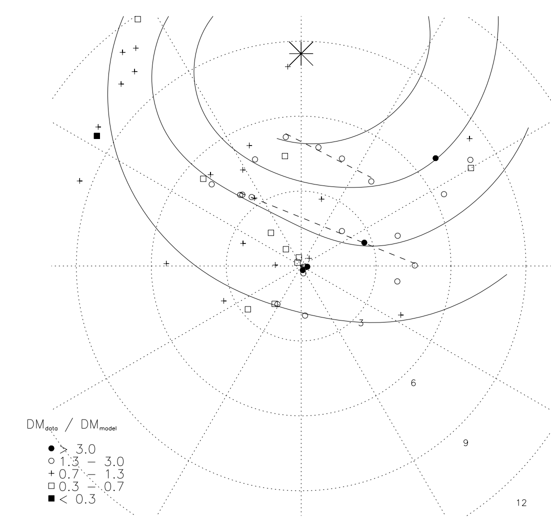

Fig. 2. $\mathrm{DM_{data}/DM_{model}}$ for pulsars with $|z| < 300$ pc. The grid circles are labeled with distance from the Sun, and the star marks the center of the galaxy. Notice lines of high $\mathrm{DM_{data}}$ at ≈ 2 and 5 kpc towards the Galactic center, with regions of fair fit between. The first line coincides with the location of one of the Galactic arms (shown) of the Taylor & Cordes (1993) model.

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