

MODELLING THE GALACTIC CONTRIBUTION TO THE FARADAY ROTATION OF RADIATION FROM EXTRA-GALACTIC SOURCES

B.J. Brett

Department of Mathematics, Statistics & Computing, Plymouth Polytechnic, Drake Circus, Plymouth PL4 8AA, Devon, UK

Faraday rotation occurs in the Galaxy according to the formula:

$$RM = k \int_L n_e H_{||} d\ell$$

where: RM is the rotation measure
 n_e density of electrons
 $H_{||}$ component of the magnetic field parallel to line of sight
L distance travelled through interstellar medium
k constant depending on units.

We have taken a collection of rotation measures of 552 extra-galactic sources, compiled by Simard-Normandin, Kronberg and Button (Preprint, 1980) and modelled them over the sphere using spherical harmonics. We hope in this way to model the dependence on galactic co-ordinates which will be due to the structure of our Galaxy (position of free electrons and direction and strength of the magnetic field).

The spherical harmonic functions are the solutions of Laplace's equation expressed in spherical polar co-ordinates and are the fitting functions for data on the surface of a sphere. We used a least-squares fitting procedure, starting with first-order harmonics, and extending to second, third, fourth and fifth. (The mean of the data, as a constant 'function', gives a zero-order model.)

We found that the first, second and fourth-order models were statistically most significant, and illustrate the first and second-order models here. The first-order model (Fig. 1) is a significant improvement over the mean model at 0.001 level, using the F-test. The second-order model (Fig. 2) is a significant improvement over the first-order model at 0.001 level using the F-test.

These are preliminary results, more detailed investigations are still in progress. The first-order harmonics support a simple model of a linear field in the solar neighbourhood, parallel to the plane of the

Galaxy, and having a direction from $\ell^{\text{II}} = 112^\circ$ to $\ell^{\text{II}} = 292^\circ$. Higher-order models indicate large-scale deviations from this model.

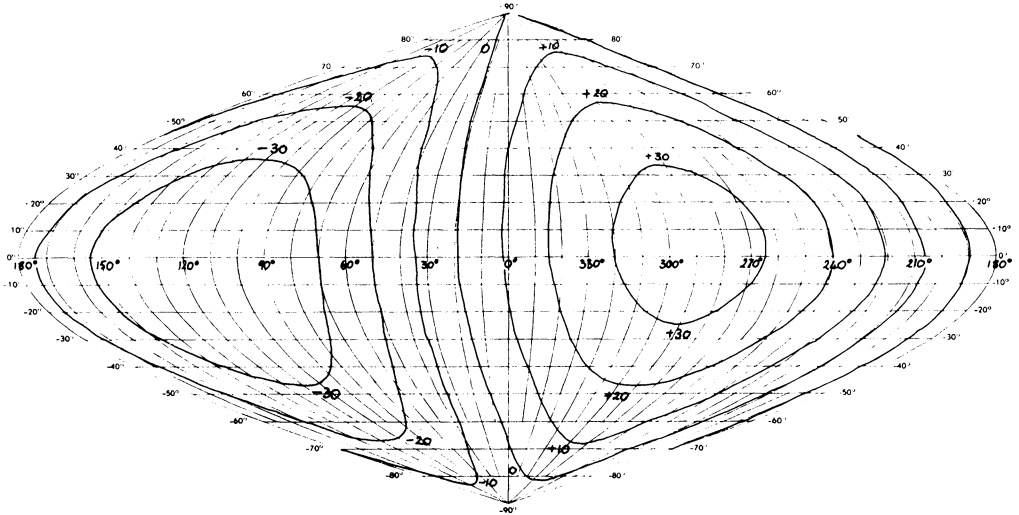


Figure 1: Rotation Measures, First-Order Harmonic Model

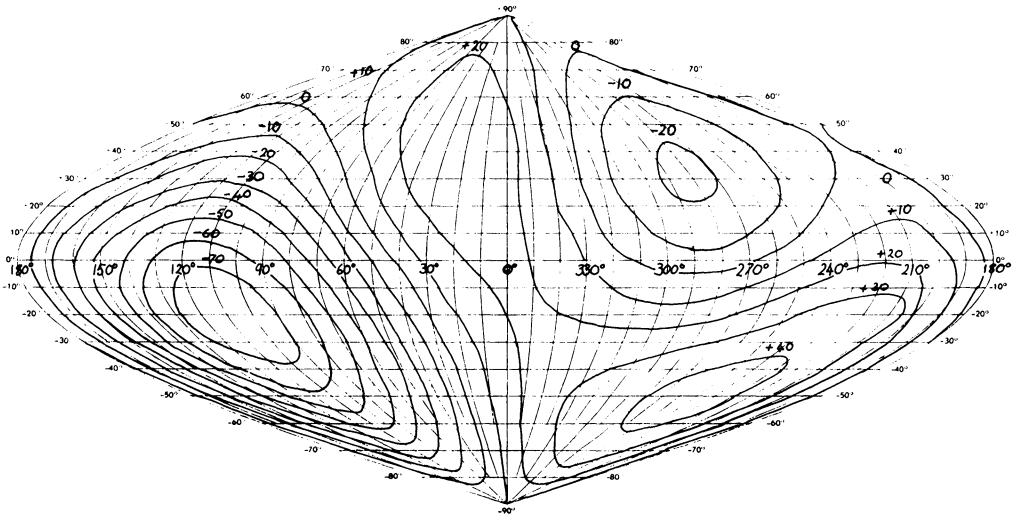


Figure 2: Rotation Measures, Second-Order Harmonic Model