

The Power of the Canadian Galactic Plane Survey for Probing the Galactic Magnetic Field

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The plane of polarization of an electromagnetic wave propagating through a magnetized gas of electrons will rotate through the process of Faraday rotation. One quantitative measure of the effect of Faraday rotation on a signal is the Rotation Measure (RM). The RM depends on the signal wavelength, the electron density, and the magnetic field strength and orientation along the path of propagation. By examining radiation from polarized sources at multiple wavelengths, it is possible to obtain information about the magnetic field in the Galaxy along the line-of-sight to a source. The more sources there are with identifiable RMs, the better the sampling of the Galactic magnetic field.

As part of the Canadian Galactic Plane Survey (CGPS), the synthesis array at the Dominion Radio Astrophysical Observatory images full polarization signals (Stokes I, Q, U, V) in four closely spaced bands around 1420 MHz. Consequently, these data can be used to obtain unambiguous RMs of compact sources within the CGPS region ($-3.6^\circ \leq b \leq 5.6^\circ$, $74.2^\circ \leq l \leq 147.3^\circ$). From these data, I have determined RMs for roughly 600 extragalactic (EG) compact sources (dark symbols in figure 1). This translates to a source density of roughly one source per square degree and almost equals the number of previously published EG RMs across the entire sky (light symbols in figure 1). Using these RMs, I have been studying the magnetic field in the outer part of the Galaxy. The high source density is revealing structures and detail never before observed, and is allowing me to address unanswered questions. These include ‘How many magnetic field reversals are there beyond the solar circle?’, ‘What is the latitude dependence of the field?’, and ‘What is the relationship between the small and large-scale components of the magnetic field?’.

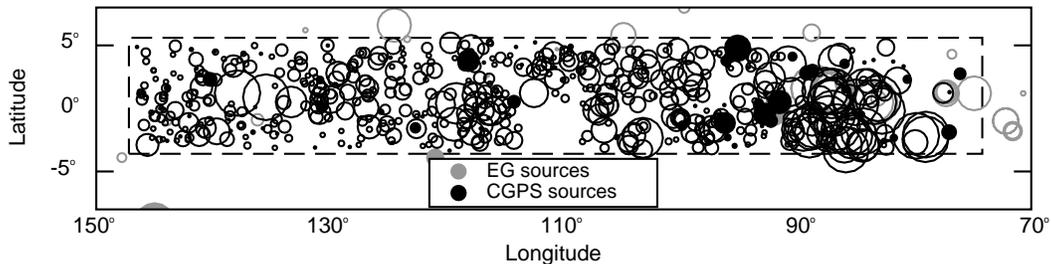


Figure 1: RMs in the CGPS (dashed box). Symbol size is proportional to the magnitude of RM (legend symbols are 250 rad m^{-2}); open circles represent negative RMs, and filled circles represent positive RMs.