EXTENDED POLARIZED EMISSION STRUCTURES IN THE GALACTIC PLANE AT 11CM WAVELENGTH

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ABSTRACT. Data from the Effelsberg Galactic plane survey at 11 cm wavelength have been used to produce a survey of polarized intensity in the first Galactic quadrant. Besides polarized sources (Supernova remnants and extragalactic objects) extended polarized emission features are visible, which are not connected to distinct radio sources. To decide whether these features reflect characteristics of the local field or the distant spiral structure of the Galaxy we performed an integration of polarized intensities as a function of Galactic longitude. An anticorrelation with the thermal background component suggests a distance of more than 6 kpc for some components of the polarized emission. This enables us to derive an upper limit for the uniform component of the Galactic magnetic field.

1. The Survey

A sensitive radio continuum survey of the Galactic plane has been carried out with the Effelsberg 100-m telescope [1]. The observations are made with a three-channel receiver, simultaneously giving total intensity and Stokes parameters U and Q which are used to calculate linearly polarized intensity and polarization angle. The scans were observed in galactic latitude for $|b| < 1\overset{\circ}{.}5$. Linear fits have been made before combining the U and Q maps to define a relative baselevel and to remove large-scale foreground polarization. To increase the signal-to-noise ratio, the polarization data were slightly convolved to 6' HPBW. The maps for the first quadrant of the Galactic plane are presented in [2].

2. Results

The survey data have been used to identify extended sources and to list polarization properties of small diameter sources and SNRs in the observed field. Four of the newly found extended polarized sources were established as SNRs by additional information (radio spectral index, infrared-to-radio flux ratio) [3]. However, due to Faraday rotation most well-known SNR are significantly depolarized at 11 cm wavelength.

The survey maps show that most of the polarized emission along the Galactic plane is not associated with sources, but is distributed in a rather patchy way. This indicates that polarization from the diffuse background emission is visible. We performed integrations of the polarized

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intensity as a function of galactic coordinates to find out whether this reflects the characteristics of the local field or the far distant spiral structure of the Galaxy. The averaged polarized surface brightness is shown as a function of Galactic longitude in Fig. 1.

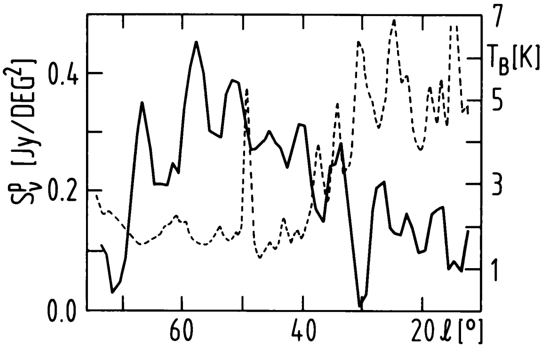

Figure 1: *Polarized emission component at 2695 MHz (full line) and thermal emission at 1420MHz taken from [4] (dashed line). The data have been averaged for* $|b| \le 0°.7$.

The minimum of the integrated polarized emission for $l > 70°$ may be due to local depolarization of thermal material near Cygnus X. Fig. 1 shows an anticorrelation of the polarized emission with the thermal component of the radio continuum emission. We conclude that depolarization of thermal material in the foreground (Scutum spiral arm at $l < 32°$) causes the observed variation of the polarized emission with galactic coordinates. The distribution of thermal emissivity in our Galaxy [4,5] implies that the region of maximum polarized emission ($50° < l < 60°$) contains components of more than 6 kpc distance. For an average electron density of $n \sim 0.03$ cm^{-3} as inferred by pulsar dispersion measures [6] we calculate a uniform magnetic field component in the line-of-sight direction smaller than 1.6 μG [7].

3. Conclusions

The polarized emission in the Effelsberg 11 cm Survey shows constituents from distant parts of the Galaxy. Combining these data with observations at higher frequencies may allow direct measurements of the magnetic field structure of spiral arms in our Galaxy. At higher frequencies, however, very small intensities are expected (e.g. 1 mK $T_B{}^P$ at 10 GHz).

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