Polarization Mapping and Analysis of Loop I

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1 Original Paper

Large-Scale Features of the Radio Sky and a Model for Loop I

2 Abstract

The large-scale radio and microwave continuum sky has been mapped across various frequencies in both intensity and polarization. Away from the Galactic plane, the sky is dominated by large loops and filaments, with Loop I being the most prominent. Given the similarity between Loop I and other radio loops, it is likely they share a common origin, warranting further detailed study. The emission is primarily due to synchrotron radiation from cosmic ray electrons (CREs) spiraling in the Galactic magnetic field, which is highly polarized. This makes polarization surveys crucial for investigating these structures. At low frequencies, Faraday rotation (FR) alters the plane of linear polarization, with the degree of rotation quantified by the rotation measure (RM). At higher frequencies (above a few GHz), the Planck Collaboration combined WMAP and Planck data to produce a high signal-to-noise synchrotron polarized intensity map. The leading explanation for these loops is that they are expanding supernova remnant shells, where CREs are trapped and the magnetic field is compressed. A simple model for Loop I, placing it at a distance of approximately 100–200 pc, successfully reproduces much of the observed large-scale polarization geometry.