Faraday rotation constraints on large scale Halo model

Executive Summary

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The global structure of the magnetic field inside the disk of our Galaxy is reasonably well described by dynamo action and constrained by Faraday rotation measurements. The Halo, on the other hand, is much more of an enigma. Other face-on spiral galaxies show spiral magnetic structures in their disk, like the Milky Way, showing that our magnetic field is a fairly typical feature of this class of galaxies. Furthermore, RM-synthesis of CHANGE-ES observations shows an increasing number of edge-on spiral galaxies exhibiting X-shaped structures surrounding the disk and extending orderly to distances of up to tens of kpc. Although the 3-dimensional topology of those magnetized halos and their physical nature is still unclear, they hint to the strong possibility that our galaxy also has a large and well organized magnetized Halo. The possible existence of an extended and topologically well organized magnetic field in the Halo has not been studied for the Milky Way. Specifically, the models in current use only take into account the Disk field, supplemented by a component that extends very little beyond the plane and decays rapidly with height. In this work, conceptually motivated by the possible existence of a Parker-type galactic outflow, we propose a simple Archimedean-like field, for an extended Halo magnetic field. We add this component to a simple disk magnetic field, in order to model the Faraday rotation signal of extragalactic sources as observed on Earth, for two different free electron density profiles, and compare the results with published maps of Faraday rotations measurements. We show that an extended magnetic field in the Halo is not only compatible with the observed Faraday rotations, but is actually favored by them.