The Primordial Origin Model of Magnetic Fields in Spiral Galaxies

SOFUE, Yoshiaki (Meisei University / University of Tokyo)
MACHIDA, Mami (Kyushu University)
KUDOH, Takahiro (NAOJ)

We propose a primordial-origin model for composite configurations of global magnetic fields in spiral galaxies (Figure 1)[1].

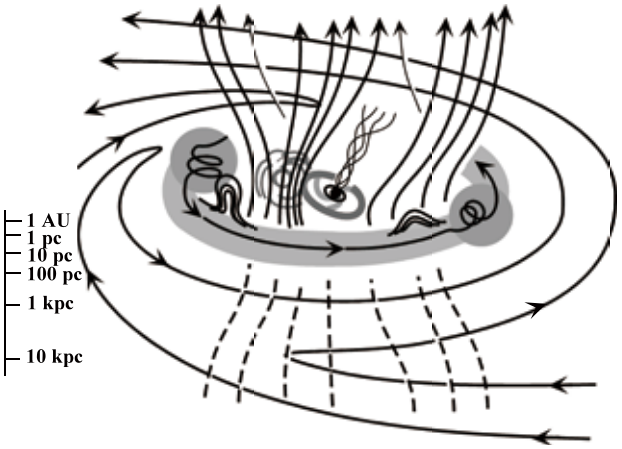

Figure 1: Schematic illustration of magnetic fields in spiral galaxies, including our Galaxy.

We show that a uniform tilted magnetic field wound up into a rotating disk galaxy can evolve into composite magnetic configurations comprising bisymmetric spiral (S=BSS), axisymmetric spiral (A=ASS), plane-reversed spiral (PR), and/or ring (R) fields in the disk, and vertical (V) fields in the center (Figure 2). By MHD simulations we show that these composite galactic fields are indeed created from a weak primordial uniform field, and that the different configurations can co-exist in the same galaxy (Figure 3). We show that spiral fields trigger the growth of two-armed gaseous arms. The centrally accumulated vertical fields are twisted and produce jets toward the halo. We find that the more vertical was the initial uniform field, the stronger is the formed magnetic field in the galactic disk.

Reference

[1] Sofue, Y., Machida, M., Kudoh, T.: 2010, *PASJ*, **62**, 1191.

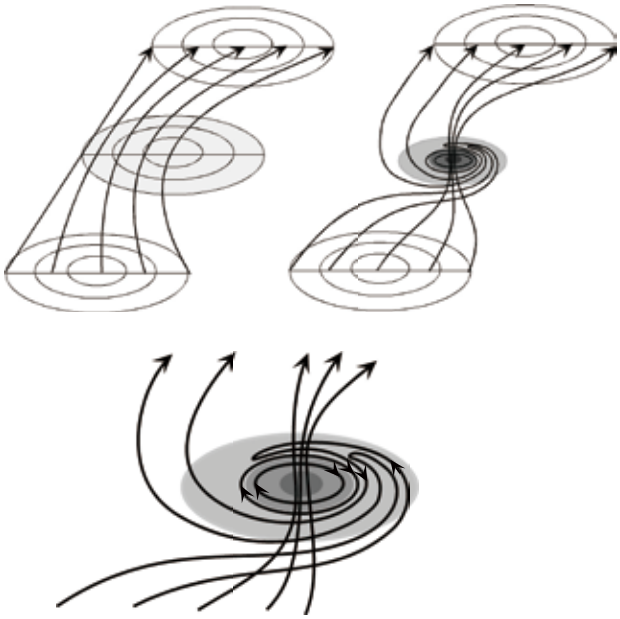

Figure 2: Origin of S, R and V fields from a tilted lopsided magnetic field in a rotating gaseous disk.

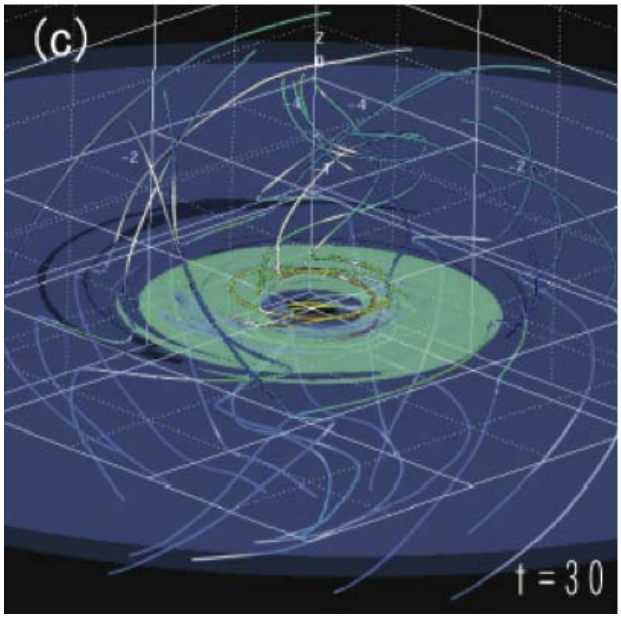

Figure 3: MHD simulation of the primordial origin model of magnetic field in a disk galaxy. The snap shot is taken at ~ 140 My. Curves show the magnetic lines of force. Blue and green surface show the iso-surface of the density. The initial magnetic field is uniform and its inclination to the rotation axis is 45º. The tilted field lines are wound up to create S configuration near the disk plane and V configuration in the central region.