

# LARGE-SCALE CONFIGURATION OF THE MAGNETIC FIELD IN SPIRAL GALAXIES\*

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**Abstract.** Global configuration of magnetic field in several spiral galaxies were determined by analysing characteristic variation of Faraday rotation within the galaxy disks. The majority has an open spiral, bisymmetric field configuration, while some (10–20%) have a ring field.

We propose a simple method to discriminate one of the two major proposed configurations of magnetic field in spiral galaxies, from a characteristic variation of rotation measure and position angle of linear polarization along the major and minor axes. If the variation is antisymmetric with respect to the galaxy center, the field is in a ring-like configuration; while, if it is symmetric, the field is in a bisymmetric, open spiral configuration (Figure 1).

TABLE I  
Field configurations in spiral galaxies

Galaxy	Field configuration
Milky Way <sup>a</sup>	BSS (= bisymmetric, open spiral)
M31 <sup>a</sup>	Ring
M33 <sup>a</sup>	BSS
M51 <sup>a</sup>	BSS
M81 <sup>a</sup>	BSS
NGC 253	BSS?
NGC 2903	BSS
NGC 6946 <sup>a</sup>	BSS?
IC 342	Ring

<sup>a</sup> See the literature cited in Sofue *et al.* (1985).

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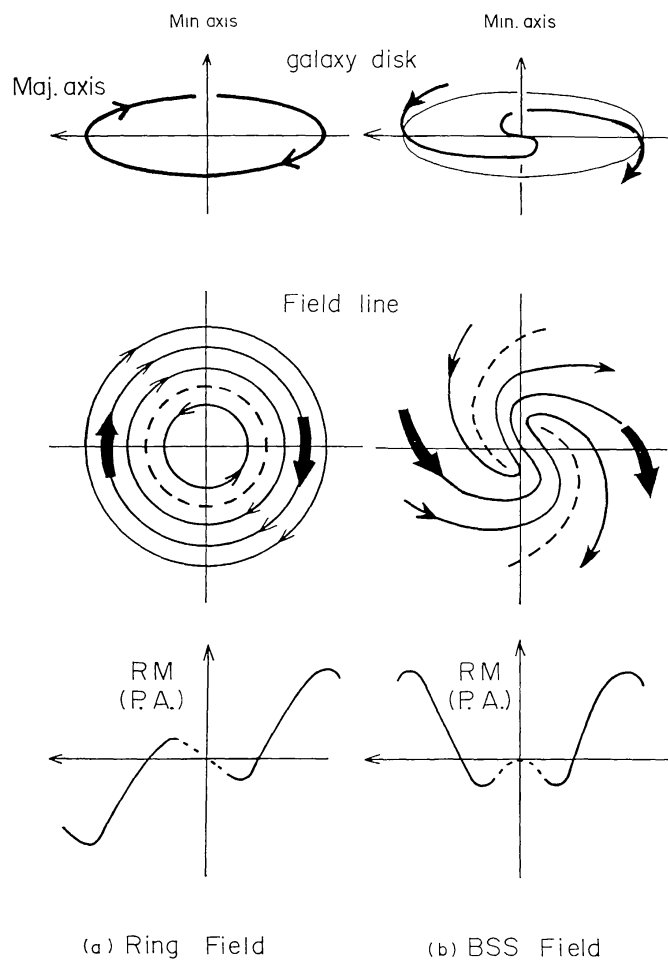


Fig. 1. Two major configurations of magnetic field distribution in spiral galaxies. If the field configuration is ring-like (left), the variation of rotation measure and position angle of linear polarization along the major axis of the galaxy is antisymmetric with respect to the galaxy center. On the other hand, if the field lines run in an open spiral, bisymmetric configuration, the variation is symmetric with respect to the center (right).

In order to apply the method for the determination of field configurations, we performed intensive measurements of linear polarization at 5 GHz along major and minor axes for ten spiral galaxies using the 100 m telescope in Bonn. Distributions of the polarization intensity and polarization angle along the axes were obtained for the three galaxies, NGC 253, NGC 2903, and IC 342 (Figure 2).

By applying the method proposed in Figure 1, we have derived the field configuration in NGC 2903 to be that of a bisymmetric open spiral, while IC 342 has a more ring-like field configuration. Adding this to the literature data, we conclude that spiral galaxies seem to have either a ring or a bisymmetric spiral magnetic field configuration. Table I shows the field configurations for several nearby spiral galaxies obtained so far.

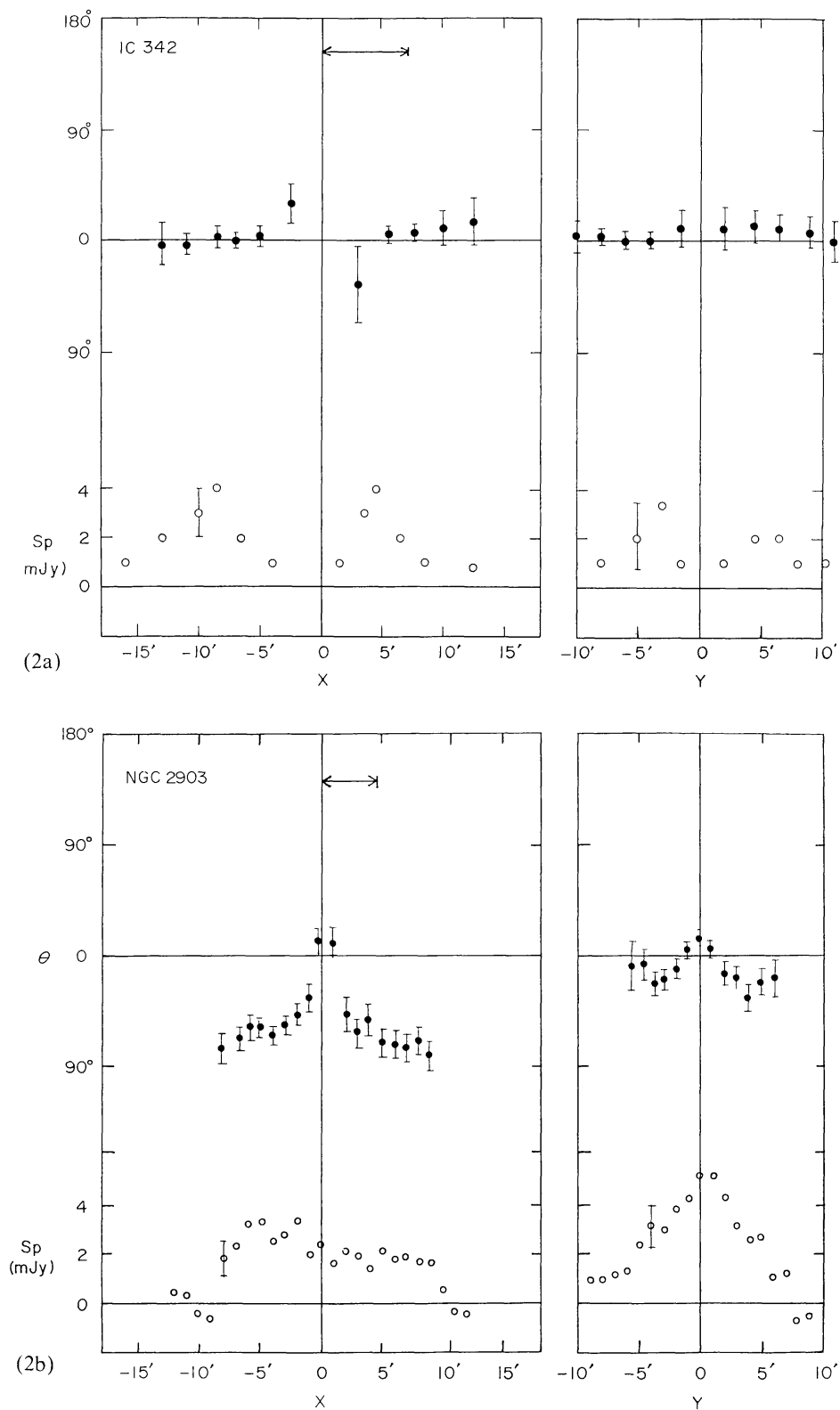


Fig. 2a-b. Variations of the position angle of linear polarization at 5 GHz for spiral galaxies IC 342, NGC 2903, and NGC 253 (filled circles), and the distributions of polarization intensity along the major ( $X$ ) and minor ( $Y$ ) axes.

**Reference**

Sofue, Y., Klein, U., Beck, R., and Wielebinski, R.: 1985, *Astron. Astrophys.* (in press).