DO MOLECULAR CLOUDS DEFORM INTERSTELLAR MAGNETIC FIELDS?

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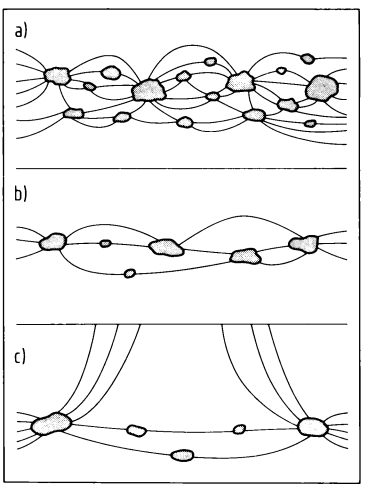
Polarized radio continuum emission and degree of polarization are reduced on dust lanes containing molecular clouds, whereas the total power emission is strong there. Faraday effects can explain only part of this depolarization. The remaining part must be due to tangled field lines within the radio beam.



Distribution of molecular clouds and magnetic field lines in spiral arms with high (a), medium (b) and low star formation (c).

a) Many massive clouds → tangled field structure

b) Moderate number of medium size clouds → tangled field in some places

c) Too few clouds to hold all field lines in the disk

M31 The polarized intensity at λ20 cm radio continuum obtained with the VLA (Beck et al., 1989) is centred on the dark lane outside the most prominent optical arm. ^{12}CO(1-0) emission was observed along 3 scans in an area of high degrees of polarization with the 30-m dish at Pico Veleta (see Bajaja et al., 1990). For the comparison the CO data were smoothed to the resolution of 75" of the radio continuum data. Both along and perpendicular to the arm the total radio continuum emission at λ20 cm and the CO emission are correlated, but the degree of polarization is

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anti-correlated. Tangling of the magnetic field lines in the emission region must cause part of this depolarization in the beam (case a) in the Figure).

M81 Apart from the centre the polarized emission at λ20 cm observed by Krause et al. (1989) with the VLA (D-configuration) is found in the NE and SW quadrants with peaks in the *interarm* regions. It is remarkable that most of the boxes in which ^{12}CO(1-0) has been detected (Brouillet et al., 1988, 1990) coincide with regions of low or zero polarized emission, especially in the NW. This suggests deformation of field lines on scales smaller than the radio beam caused by molecular clouds and their motion (cases a) and b) in the Figure).

NGC 6946 The radio emission of NGC 6946 at λ20 cm was observed with the VLA (D-configuration) by Beck et al. (1990). The total emission is smooth indicating a smooth distribution of the *total* magnetic field, while the polarized emission (and hence the *uniform* field) shows more variations. The polarized emission and percentage polarization at λ20 cm avoid the spiral arms seen in Hα (Bonnarel et al., 1986): maxima are on interarm regions and minima on the Hα arms. Viallefond et al. (priv. comm.) find a correlation between Hα and ^{12}CO(1-0) emission on the main arms. Thus also here the molecular clouds influence the field structure on scales smaller than the λ20 cm beam (case a) in the Figure). A hole in the polarized emission in the SW is due to Faraday depolarization. In this area the high rotation measures indicate that the uniform magnetic field is bending out of the plane of the galaxy (case c) in the Figure).

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