MAGNETIC FIELDS IN STAR-FORMING REGIONS OF OUR GALAXY

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Masers provide a direct way of measuring magnetic fields in star-forming regions. OH ground-state masers at 18 cm wavelength exhibit strong circular polarization due to Zeeman splitting. The implied magnetic field strength is typically a few mG, which is sufficient for the field to be dynamically important, e.g. in channelling the observed bipolar outflows. Moreover there are indications that magnetic fields in maser regions are aligned with the large-scale Galactic magnetic field (Reid & Silverstein 1990), and that bipolar molecular outflows are also aligned with the local Galactic magnetic field (Cohen, Rowland & Blair 1984). Some theoretical work in fact suggests that the magnetic field is intimately connected with the origin of the molecular outflow (e.g. Pudritz & Norman 1983; Uchida & Shibata 1985). It is therefore important to investigate the magnetic field configuration in these regions in as much detail as possible.

We report full-polarization spectral-line observations of λ18 cm OH masers in three star-forming regions using MERLIN: G35.2-0.74N, W75N and NGC 7538. These three star-forming regions are clear examples of molecular disk and bipolar outflow structure, with the OH masers embedded at the centre of these regions. The OH masers lie typically within $\sim$1000 AU of the central source. The distributions of the OH masers show the disk-like structure to be orthogonal to the bipolar outflow direction. We found strong linearly polarized masers (with a percentage of linear polarization more than 88%) in W75N and NGC 7538–IRS 11.

In each source, the masers indicate an ordered magnetic field, which in some regions is aligned with the bipolar outflow while in others it is orthogonal to the direction of the outflow. The field strengths measured range from 2 to 8 mG, and are thus apparently relevant for the source evolution and dynamic. In G35.2-0.74N, W75N and NGC 7538–IRS 11, the

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field direction appears to reverse from one side of the disk to the other, suggesting a toroidal component of the magnetic field.

Furthermore, we discovered new 1665 and 1720 MHz OH masers in the region of NGC 7538–IRS 9. We also found new 1667 MHz OH masers in the region of IRS 11, in addition to the 1665 MHz masers previously mapped by Brebner (1988).

We compare our results with magnetic field configurations derived from other polarimetric measurements (e.g. Aitken et al. 1993; Vallee & Bastien 1995). Our results appear to be in good agreement with the magnetic field configurations derived from those measurements, suggesting that the large-scale ($\sim$ 20 arcsec) magnetic field is twisted in the disk region where the masers are embedded. This is the configuration predicted by Uchida & Shibata (1985) and supports their hydromagnetic model against the alternative model proposed by Pudritz and Norman (1983).

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