HIGHLY POLARIZED EMISSION FROM THE E-HOTSPOT IN DA240

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The hotspot in the eastern lobe of the nearby giant radio galaxy DA240 (z=0.0356) provides a rare opportunity to examine the detailed polarization structure of a hotspot. Maps have been made with the Cambridge 5-km telescope at 2.7 and 5.0 GHz. The 5.0-GHz maps are shown in Figs 1 and 2. The main characteristics are: (a) The hotspot has an overall size in the 2.7-GHz map of 10x18 kpc^2. It blends smoothly at its outer edge into the background of the extended lobe. The 5.0 GHz total intensity map shows a yet more compact region (subcomponent A). It has not been fully resolved in the direction of the minor axis and has a size <1x2.5 kpc^2. There is a second much weaker and diffuse region (subcomponent B). Both subcomponents are superimposed on a broad plateau of emission. The hotspot has spectral index $\alpha(0.61\text{-}5.0)=0.52$, minimum total energy $E_{min}=3\times10^{56}$ ergs and equipartition magnetic field $B_{eq}=2\times10^{-5}$ G, values typical of other hotspots, although its projected distance from the nucleus is very large (0.65 Mpc);

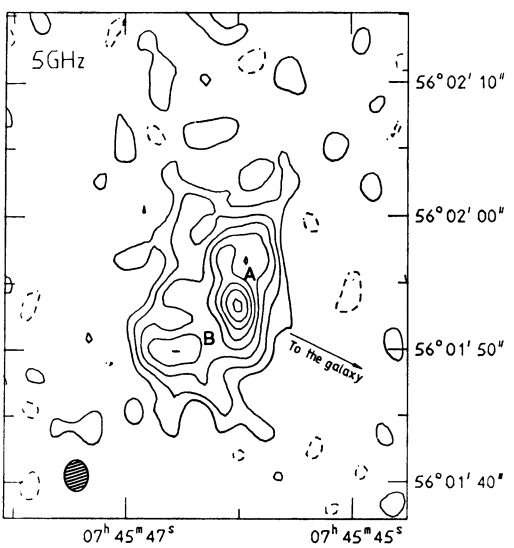

Fig.1. 5.0-GHz map of total intensity. First contour and contour interval are 4 mJy/beam.

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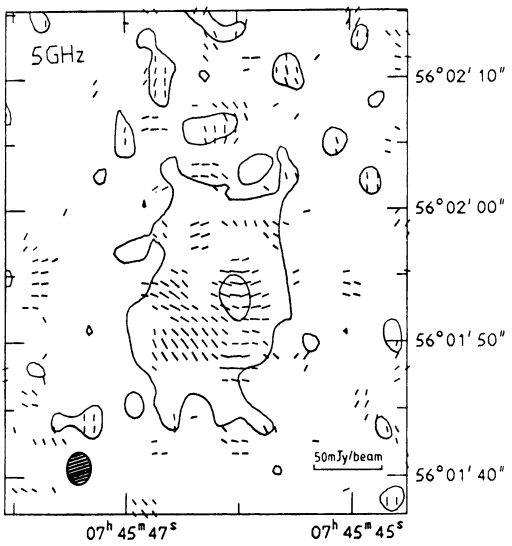

Fig.2. 5.0-GHz map of polarized intensity. The lines indicate the electric vectors.

(b) The hotspot is strongly polarized at both frequencies. At the peak of the compact subcomponent the polarization is about 20% and it increases towards the southeast, reaching 50-60% at the outer edge. The electric vectors in the polarized emission are well aligned over regions large compared with the beamwidth. The integrated polarizations in the hotspot are 24% and 28% at 2.7 and 5.0 GHz. Compared with 22% at 0.61 GHz, these values imply little depolarization at low frequencies; (c) The rotation measure derived from the available data on the integrated polarization for the whole source is very small, about 2.4 rad m^{-2}, and most of it may be galactic in origin. The projected magnetic field may thus be taken as perpendicular to the E-vectors in Fig.2. The magnetic fields in subcomponents A and B are therefore nearly parallel to the major axes of these components, although neither parallel nor perpendicular to the axis of the source as a whole (at PA 63°). The mean direction in the hotspot, however, is almost perpendicular to the source axis.

The very high percentage polarization seen in some parts of the hotspot does not necessarily imply that the magnetic fields in these parts are nearly perfectly aligned. Hotspots are usually regarded as regions of interaction between the advancing energetic beam and the external medium, and the magnetic fields in hotspots are probably initially irregular. The production of high polarization may be due to shearing and compression of these irregular fields into a thin slab or shell-like structure of field.

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