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Rotation-Measure Mapping of 3C 119

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Abstract. The compact steep-spectrum source 3C 119 has been mapped using the VLBA at four frequencies spread over the 5 GHz observing band. The high rotation-measure reported at short wavelengths is found to continue unbroken beyond the depolarization wavelength indicating that 3C 119 is depolarized by an external medium.

1. Introduction

3C 119 is a compact steep-spectrum source that has been identified with a quasar at $z = 1.023$ (Eracleous & Halpern 1994) and is known to have an unusually high rotation measure of 1728 rad m^{-2} and a depolarization wavelength between 3 and 6 cm (Kato et al. 1987). Previous VLBI observations (Fanti et al. 1986; Ren-dong et al. 1991) show that the radio structure of 3C 119 is extremely distorted. Ren-dong et al. suggest that this structure may result from a precessing jet viewed from inside the cone of precession or from the deflection of the jet by a dense, external medium.

2. Observations

3C 119 was observed with the VLBA on March 27 1995 using four IFs spread across the 5 GHz VLBA observing band in order to see if there is any detectable rotation-measure structure. A rotation measure of 1728 rad m^{-2} would correspond to a total rotation of almost 50°between the two most-widely separated IFs.

Each IF was mapped separately in polarization and the polarization position angles were calibrated with reference to observations of OJ 287 which was assumed to have a polarized position angle of 75°(taken from the nearest observation of OJ 287 in the UMRAO database).

3. Results

The total intensity maps show three bright components and some indications of a jet joining them (Fig. 1, left). Fanti et al. (1986) show that Component D (using their nomenclature) has a flat spectrum and can be identified as the core while A and B are both steep spectrum components.

The polarized emission is dominated by Component A, which is 2% polarized. The polarized structure is resolved (Fig. 1, right) with a brighter, extended region (A0) and a dimmer, compact component (A1). The segment of the jet between Components A and B appears to be more closely aligned with A1 than A0.

Component A0 has a rotation measure of 1499 ± 157 rad m^{-2} while A1 has a rotation measure of 1605 ± 250 rad m^{-2}, both of which are consistent with the Kato et al. value.

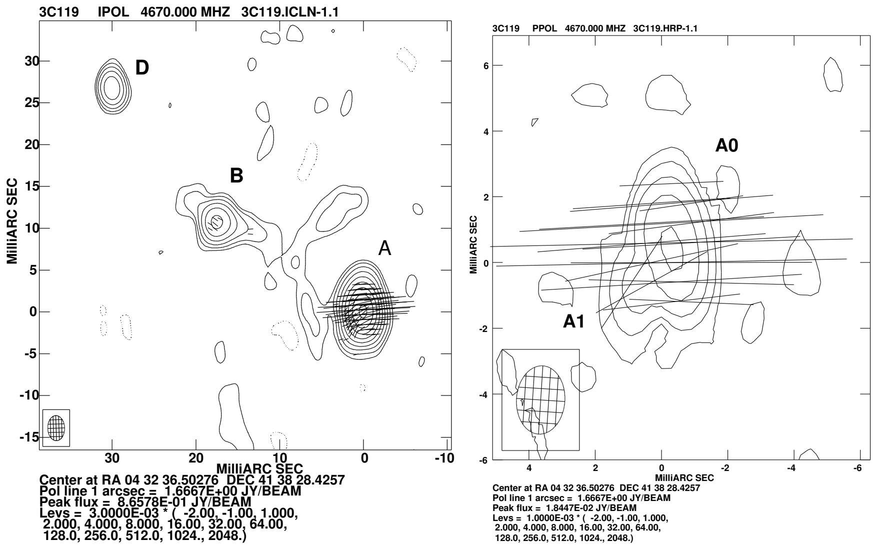

Figure 1. Electric polarization vectors overlayed on contours of total intensity using natural weights (left) and an expanded view of Component A with contours of polarized intensity using uniform weighting (right).

Polarization is also detected in Component B at the 1.2% level with a rotation measure of $779 \pm 597\,\mathrm{rad\,m^{-2}}$.

4. Conclusions

There is no sign of a departure from the λ^2 Faraday rotation law at the depolarization wavelength which is not consistent with models where the depolarization is due to thermal matter mixed with the emitting plasma (Burn 1966). This indicates that the depolarization must be caused by variations in the Faraday depth of material between the emitter and the Earth. The angular scale of these variations must be smaller than the beam (2 mas by 1 mas for uniform weighting). Such a small angular size suggests that the screen is more likely to be associated with the source than with our galaxy. This lends support to the hypothesis that 3C 119 is interacting with a dense external medium.

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References

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