3.6 CM VLBI TOTAL INTENSITY AND POLARIZATION IMAGES OF BL LACERTAE OBJECTS

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1. Introduction

The major distinguishing features of BL Lacertae Objects are weak or absent line emission and strong and variable optical, infrared, and radio polarization (Angel and Stockman 1980; Kollgaard 1994). The radio emission and much of the optical emission is believed to be synchrotron radiation. There are now some 20 BL Lacertae objects for which VLBI polarization (VLBP) images have been made at $\lambda = 6\,\mathrm{cm}$ (Gabuzda *et al.* 1994 and references therein). In nearly every BL Lacertae object in which polarization structure has been detected, the polarization position angles in knots in the jets are nearly parallel to the VLBI structural axis. Assuming the jet components to be optically thin, the magnetic fields inferred by this orientation are nearly perpendicular to the direction of the jet; perhaps the most natural interpretation of this is that the knots are associated with shocks that compress an initially tangled magnetic field as they propagate down the VLBI jet, enhancing the magnetic field transverse to the compression (Laing 1980; Hughes, Aller, & Aller 1989).

At $\lambda = 6\,\mathrm{cm}$, the degrees of polarization of the cores of BL Lacertae objects ($\sim 2 - 5\%$) are typically higher than that of quasars ($\leq 2\%$); one possible origin for this is that the total observed polarizations for most of the cores in BL Lacertae objects include a substantial contribution from newly emerging knots (Gabuzda *et al.* 1994).

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2. Results of 3.6 cm VLBI Polarization Observations of BL Lacertae Objects

3.6 cm polarization images of BL Lacertae objects clearly show the tendency for χ to be aligned with the local jet direction, although there is evidence that the dominant magnetic field in components can *occasionally* be longitudinal. A striking example of this is offered by a knot in 1219+285, which is polarized with χ clearly perpendicular to the jet direction. The considerable degree of polarization of this component (10%) argues that it is optically thin, so that the inferred dominant magnetic field is longitudinal. This clearly suggests that at least occasionally, the discrete components observed in the jets of BL Lacertae objects are either not transverse shocks, or are weak shocks in which the compression is insufficient to dominate an underlying longitudinal magnetic field.

In 0735+178 and OJ 287 (Gabuzda & Cawthorne, in preparation) there is evidence for the detection of jet polarization in places where there is no clear evidence for an I component. In both cases, this polarization is close to transverse to the jet direction, implying an associated longitudinal magnetic field, if the emission is optically thin. If this is indeed the case, this may be interknot polarization, indicating the presence of a dominant longitudinal magnetic field in the underlying (unshocked) flow.

The 3.6 cm cores are on average somewhat more weakly polarized than at 6 cm. Only 2 of 22 measurements of 6 cm core polarizations (or limits to core polarization) indicated the cores to be polarized less than 2%, whereas the 3.6 cm measurements indicate 5 of 9 cores to be polarized less than 2%. Both of the sources for which polarization was detected in jet components but not in the cores (1219+285 and BL Lac) have comparatively low redshifts, so that the linear scales which are observed are somewhat smaller than those for the other sources. These tendencies are all consistent with a picture in which the observed "core" polarizations are typically a superposition of a quite weakly polarized core and newly emerging jet components (shocks).

These results are discussed more completely in a paper by Gabuzda & Cawthorne, to be submitted to *MNRAS* in November, 1995.

References

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