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Polarimetric Observations of 15 AGNs at High Frequencies

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Abstract. We have obtained total and polarized intensity images of 15 AGNs with the VLBA at 7 mm at 17 epochs from 25/26 March 1998 to 14 April 2001. The VLBA observations are accompanied at many epochs by simultaneous measurements of polarization at 1.35/0.85 mm as well as less frequent simultaneous optical polarization measurements. We discuss the similarities and complexities of polarization behavior at different frequencies along with the VLBI properties.

1. Introduction

We have completed a 3-year program of bimonthly polarimetric observations of 8 quasars (0420-014, 0528+134, 3C 279, 3C 273, 1510-089, 3C 345, CTA 102, and 3C 454.3), 5 BL Lac objects (3C 66A, OJ 287, 1803+784, 1823+568, and BL

Lac), and 2 radio galaxies (3C 111 and 3C 120) at high frequencies. Sequences of the images for all sources can be found on our web-site: **www.bu.edu/blazars**.

2. Observations

The VLBA observations were at 43 GHz in both right and left circular polarization, with 15-20 scans of 3-5 minute duration each. The data reduction is described in Jorstad et al.(2004 in prep.), Stirling et al.(2003). At 1.35 and 0.85 mm we observed with the James Clerk Maxwell Telescope (JCMT) using SCUBA polarimeter (Greaves et al. 2002). We measured optical polarization at several epochs with the Steward Observatory 1.5 m telescope. Data reduction follows the procedure described in Smith et al. (1992).

3. Discussion

Fig. 1 presents examples of almost simultaneous observations of the polarized emission in the inner radio jets and in the optical and sub-mm regions. Analysis of the data shows an obvious connection between the polarized emission at sub-mm wavelengths and the strongest polarized emission in parsec-scale jets of quasars. This implies co-spatiality of the emission regions or roughly the same magnetic field direction in the emission regions at both frequencies. The EVPAs in the optical region appear to be related to 7 mm. However, the fractional polarization is higher in the optical region, which indicates that the higher frequency emission originates in a magnetically-ordered localized section of the 43 GHz emission region. In general, for quasars the magnetic field is oblique to the parsec-scale jet direction (assuming a negligible Faraday rotation at 43 GHz) and no correlation is detected between the position angle of the inner jet and EVPAs at mm and sub-mm wavelengths, except for 3C 279 and 3C 345, for which there is a significant relation among the parameters. The cores of 3C 120 and 3C 111 are unpolarized, as is also observed for the quasar 3C 273. This may be due to Faraday depolarization. However, in the case of 3C 273, the fractional polarization and EVPA are very similar at mm (bright knots) and sub-mm waves, at which Faraday effects are unlikely to be important. Three BL Lac objects out of 5 show a significant connection between the EVPA in the VLBI core (the peak of the polarized intensity coincides with the core), EVPAs at higher frequencies, and direction of the jet. The EVPAs align with the innermost jet direction. For BL Lac itself this relation has been explained as regulation of the magnetic field by swinging of the jet nozzle (Stirling et al. 2003).

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References

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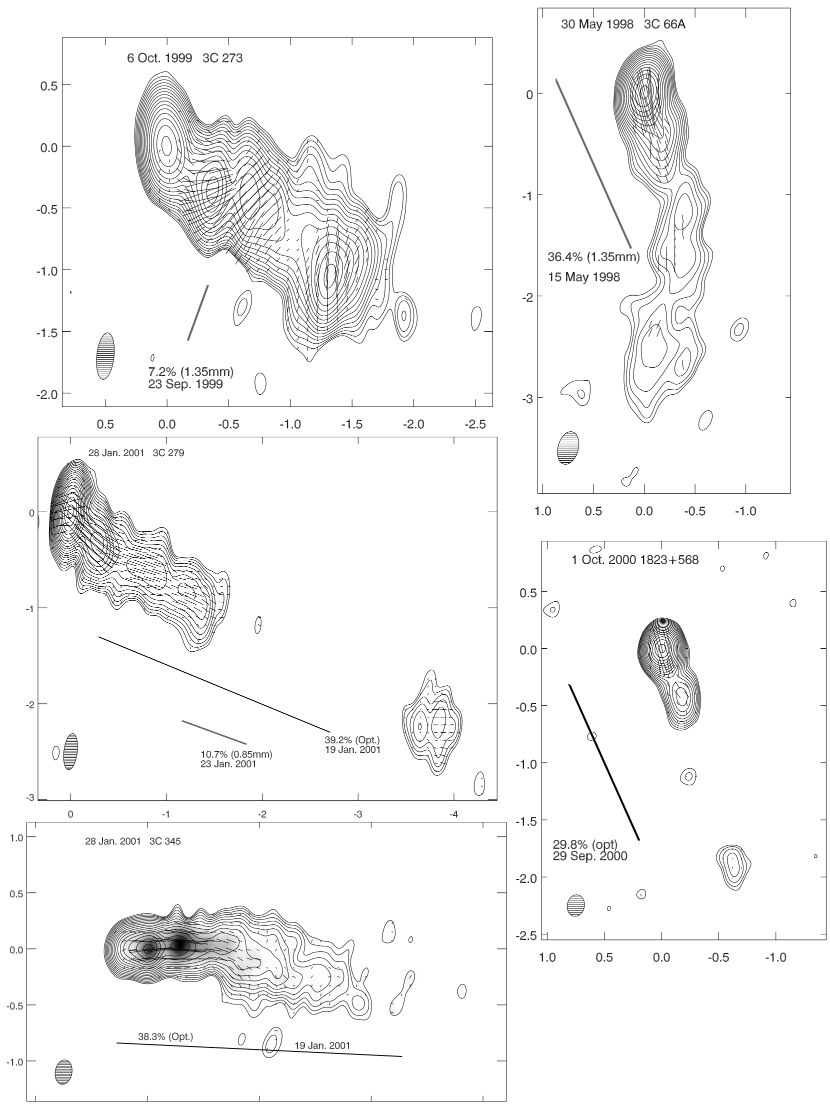

Figure 1. The VLBA images at 43 GHz for 3C 66A (S_{max}=0.448 Jy beam^{-1}, S^{p}_{max}=0.019 Jy beam^{-1}), 3C 273 (S_{max}=2.27 Jy beam^{-1}, S^{p}_{max}=0.176 Jy beam^{-1}), 3C 279 (S_{max}=8.28 Jy beam^{-1}, S^{p}_{max}=0.278 Jy beam^{-1}), 3C 345 (S_{max}=2.57 Jy beam^{-1}, S^{p}_{max}=0.200 Jy beam^{-1}), 1823+56 (S_{max}=1.01 Jy beam^{-1}, S^{p}_{max}=0.09 Jy beam^{-1}). The sticks indicate the direction of the EVPA.