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Magnetic Field Configuration in 4C 39.25

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Abstract. We have performed simultaneous multi-frequency polarization VLBA observations of the compact radio sources 3C 395 and 4C 39.25 which show both stationary and superluminal components in their parsec-scale structures. Those of 3C 395 have been reported elsewhere. Here we report on high resolution maps of the total intensity and polarized radio emission of 4C 39.25, trace the magnetic field configuration along the jet, and explore different possibilities for the nature of the components within the framework of the bent shocked relativistic jet model.

VLBI observations performed during the last 15 years (Marcaide et al. 1994 and references therein), revealed the presence of a superluminal component (b) moving between the western (c) and the eastern components (a). Components a and c have steep spectra and remained constant in flux density and stationary relative to each other, while component b brightened and slowed down as it approached component a (Alberdi et al. 1993a). VLBI observations at 22 and 43 GHz showed the presence of a fourth, weak and inverted spectrum component (d), located $\sim$2.7$\pm$0.2 mas west of a (Alberdi et al. 1997a). The distance between a and d has not changed significantly during the last 6 years.

We have performed polarimetric observations at 15 and 22 GHz with the VLBA. Figure 1 shows the polarization maps at 15 GHz (left) and 22 GHz (right) overlaid to the total flux density images. Intercomparison of these maps, and others already published, leads to the following conclusions:

• **Component d**: It shows an inverted spectrum, suggesting that d is the self-absorbed core of the radio source, although the low degree of flux density variability of d casts some doubts. Component d is unpolarized at both frequencies.

• **Component c**: It is usually explained as a bend in the jet trajectory. It is slightly polarized, with the magnetic field mainly aligned to the jet trajectory. The orientation of the B-field suggests that the interaction with the surrounding medium is not significant.

• **Component b**: Over 10 years it brightened and its proper motion progressively decreased. The spectral index of component b is steep, although it flattens with time. *The comparison of the time evolution of the total flux densities of 4C 39.25 and of component b at 22 GHz and lower frequencies yields a strong one-to-one correlation.*

Component b is strongly polarized both at 15 and 22 GHz. The orientation of the field is similar at both frequencies. The B-field forms an angle of 42 degrees with the overall jet ridge line, but it progressively rotates to an orientation perpendicular to the jet axis. If component b consists of a plane perpendicular shock moving down the jet, there will be enhanced flux emission and stronger

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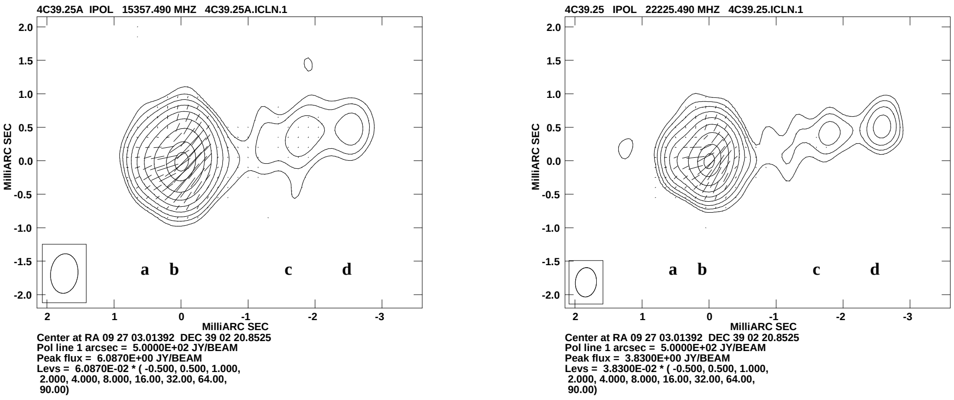

Figure 1. Polarized flux density images of 4C 39.25 at 15 (left) and 22 GHz (epoch 1995.8) overlaid to the total flux density images. E-vectors are shown.

polarized emission (the main orientation of the field should be parallel to the shock front). Since the magnetic field is not strictly perpendicular to the jet trajectory, it could happen that the jet is bending in this region or the shock wave is oblique.

• **Component a**: It exhibits a steep spectrum and is also usually interpreted as associated with a bend in the jet trajectory. This bend may be caused by ram pressure, or intrinsic curved -helical- trajectory of the jet. In both cases, an oblique shock should reside in the bent region, resulting in polarized flux. In fact, component a is polarized at both frequencies: the B-field is perpendicular to the jet trajectory probably due to the interaction of the jet with the medium.

The comparison of the global degrees of polarization and of the angles of 4C 39.25 with those determined in the VLBA-images indicates that the polarization of the source as a whole is mainly due to the compact radio source and, in particular, to component b. *There is a one-to-one correspondence in polarization properties between the compact component b and the source as a whole.*

Similar results have been obtained for 3C 395 and have been reported in the "Blazars, Black Holes and Jets" conference (Alberdi et al. 1997b).

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