5 GHZ EVN POLARIZATION OF 3C286

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3C286 (1328+307) is a powerful radio source identified with a quasar at z=0.849. There is a foreground galaxy responsible for an H I absorption line system at z=0.6922 (Brown & Roberts 1973), centered approximately 2.″5 to the southeast of 3C286. The radio source has a steep spectrum ($\alpha = -0.61$, $S_\nu \propto \nu^\alpha$ between 1.4 and 15 GHz) which turns over at about 100 MHz. Subarcsecond resolution radio images show a misaligned triple structure, dominated by the central component (Spencer et al. 1989) which accounts for at least 95% of the total flux density at all frequencies. 3C286 is one of the strongest extragalactic sources in polarized emission (0.84 Jy at 5 GHz and 1.41 Jy at 1.4 GHz) and with a rotation measure close to 0 rad m^{-2} (Rudnick and Jones 1983). Hence the observed orientation of the electric field vector is essentially independent of frequency.

Polarization data (3 hours) at 5 GHz were recorded on 17 June 1993, in MKIII mode A at six EVN antennas. Effelsberg, Medicina and WSRT recorded in both hands of polarization. Jodrell Bank, Noto and Onsala recorded LCP only. Stokes U and Q images were obtained using the complex clean in order to use also the data with a single crosshand.

The EVN polarization image reveals strong linear polarization, with the magnetic field dominated by the component perpendicular to the source axis (Fig. 1). The peak in polarized emission is located ~6 mas southwest of the peak in total intensity.

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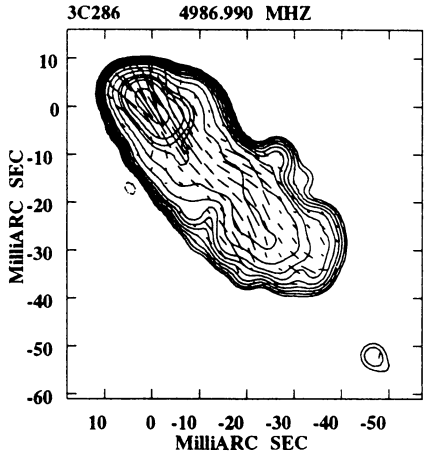

Figure 1. EVN polarization image of 3C286. Contour levels are -3.0,3.0, 4.2,6,8.4,12,16.8,24,45,90,180,240,360 and 750 mJy/beam and the peak is 1.0 Jy/beam. The vectors represent the projected orientation of the electric vector; their length is proportional to the polarized flux density.

The former interpretation of the morphology of 3C286 was that *the brightest region of 3C286 harbours the core*, and the overall arcsecond morphology is that of a misaligned, asymmetric and core-dominated triple. However, on mas scales the cores of quasars are rarely strongly polarized (at most 2%) and the magnetic fields in the jets of quasars are often quite closely parallel to the jet axes (Cawthorne et al. 1993, Dallacasa et al. 1995). Moreover, the lack of reported significant variability in the total flux density of 3C286 and the failed detection at 43 GHz on the Kashima-Nobeyama baseline (Kameno et al. in preparation) imply that the source orientation is near the plane of the sky and that the core has a steep high frequency spectrum. Finally, the counterjet to the east of the brightest region (seen by Phillips and Shaffer, 1983, and by Spencer et al. 1991) has not been detected at 327 MHz above a surface brightness level of 0.02 mJy/mas^2 (Dallacasa et al. in preparation), nor in our 5 GHz combined EVN+MERLIN image nor in Zhang et al. (1994) at 1.67 GHz.

Here we discuss the possibility that *the brightest region of 3C286 is a lobe with hot-spots in an asymmetric, compact FR II radio source.* In fact, the bright knots of emission are immersed in a large cocoon, as can be seen in the high resolution images at 1.7 and 5 GHz (Zhang et al. 1994), and resemble the morphology of the hot-spots at the jet termination where the radio emitting plasma interacts with the ambient medium, as observed with the VLA for many powerful quasars and radio galaxies on larger scales. Moreover, a steep radio spectrum, high fractional polarization and the perpendicular field orientation, in ensemble, are in agreement with the observed properties of the hot-spot regions of FR II sources (Laing 1988), where the high polarization and transverse field are originated by a compression shock (Meisenheimer et al. 1989). The strong asymmetry between the sizes and flux densities of the two lobes may be due to different local environments, and the main lobe would appear brighter and smaller due to a stronger confinement of the radio emitting plasma (Fernini et al. 1993).

However there is a very small contribution of the lobe in terms of both flux density and polarization (contrary to FR II sources). The core has not been detected at a level of 10-20 mJy in any currently available image at any observing frequency. The upper limit to the fractional contribution of the core to the total flux density would be of 0.3%, eventually similar to those found in radio galaxies, rather than in quasars. Finally, the arcsecond component at $0.''8$ to the east should be an unrelated object.

There is also a problem for both interpretations: we would expect ionization of the ambient medium where the interaction with the radio jet takes place. This in turn would trigger significant Faraday rotation also in presence of weak ambient magnetic field. Beyond the local environmental effects in the region where the radio emission is produced, the presence of a gas-rich intervening galaxy (HI column density$\sim 2.6\times 10^{20}$cm^{-2} for $T_{spin} = 100°$K, as from Brown and Roberts 1973) should produce significant effects. Again, an ad hoc geometry, i.e. a face-on spiral galaxy, would minimize such effects and be also consistent with the narrowness of the observed absorption line, corresponding to a velocity dispersion of only 8 km s^{-1}.

It is therefore clear that a straightforward interpretation of the observational evidence is not possible. We have considered the most relevant arguments for and against the two scenarios, and our conclusion to date is that the "hot-spot" interpretation is more likely acceptable. Further higher resolution polarization images, and a more thorough search for the source core will resolve this dilemma.

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