THE NUCLEAR JETS IN 3C309.1 & 3C380

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ABSTRACT. 8 station VLBI maps of the nuclear jets in 3C309.1 and 3C380 reveal complex, bent, structures which seem hard to reconcile with the concept of ballistic outflow. Together with the observation of "flaring" in the MERLIN/EVN map of the 3C309.1 jet the maps point strongly to the jets being confined fluid flows.

1. THE MAPS

1.1 3C309.1 (z = 0.911)

Fig.1 shows two maps; the top map was made from 8-station European-U.S. VLBI at λ18 cm. The restoring beam is 3 mas and the bottom contour is drawn at 0.2% of the peak brightness of 533 mJy/beam. The scale marks 50 mas (∿$200h^{-1}$ pc for H_o = 100h km s^{-1} Mpc^{-1}). The bottom map was made from MERLIN and EVN data and is also at λ18 cm. The restoring beam is 50 mas and the bottom contour is drawn at 0.1% of the peak brightness of 2.95 Jy/beam. The scale marks 500 mas (∿$2h^{-1}$ kpc).

1.2 3C380 (z = 0.692)

Fig.2 shows an 8 station U.S.-European VLBI map at λ6 cm. The restoring beam is 1 mas and the bottom contour is drawn at 0.2% of the peak brightness of 521 mJy/beam. The scale marks 10 mas (∿40 h^{-1} pc)

2. INTERPRETATION

Both these quasars have overall steep radio spectra but while the overall structure of 3C309.1 (e.g. Cornwell and Wilkinson, M.N.R.A.S., 196, 1067, 1981) resembles that of many, more extended, sources mapped with the VLA that of 3C380 is very distorted (see Wilkinson et al. Nature, 308, p619 (1984)); nevertheless their nuclear jets appear qualitatively similar. Thus whatever causes the distortions in 3C380 must be situated well away ($\gtrsim$ 100 pc) from the nucleus. The most plausible agent for

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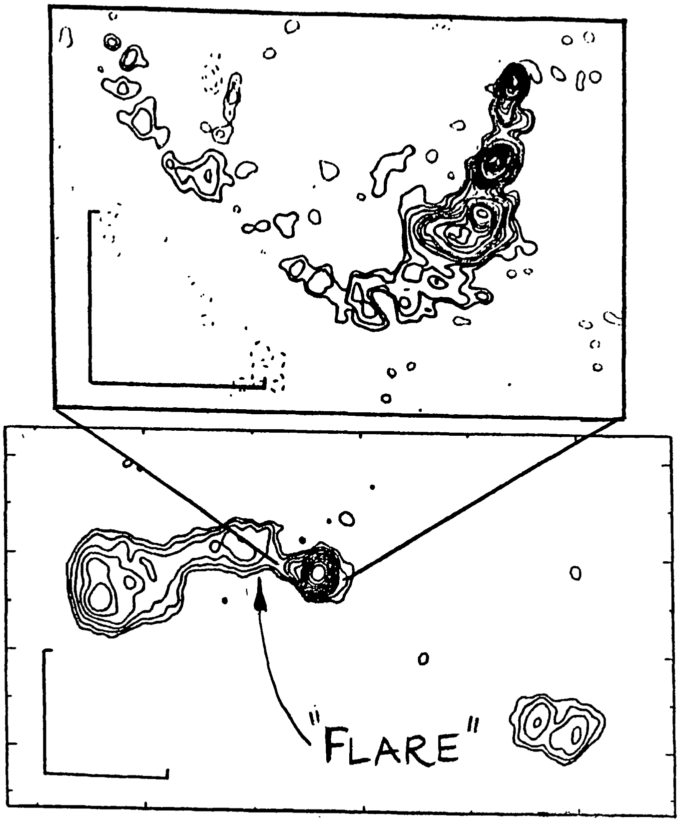

Figure 1 3C309.1

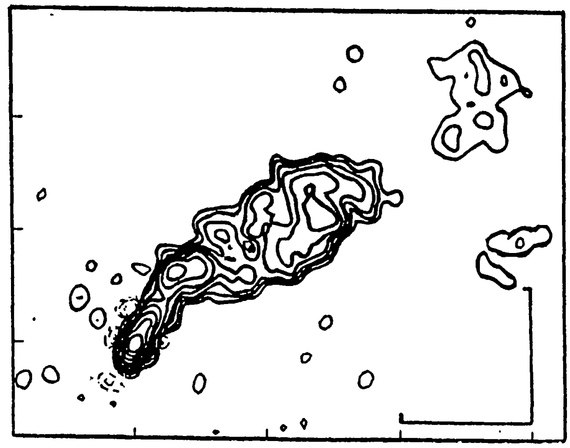

Figure 2
3C380

causing the distortions in 3C380 remains dense gas.

The form of the one-sided nuclear jet in 3C309.1, which is revealed in its entirety in Fig.1, can not be explained as the locus of ballistically moving "plasmons". The wiggles, the sharp changes in brightness seen on the 10s of pc scale and the fact that the jet apparently flares $\sim$1 h^{-1} kpc (projected) away from the nucleus (bottom map in Fig.1) are much more likely to be the result of various Kelvin-Helmholtz instabilities in a confined fluid flow coupled with changes in the pressure exerted by the confining medium.

The nuclear jets in both cases appear to be very one-sided. In the case of 3C309.1 we have maps at other frequencies and can unambiguously locate the, flat-spectrum, core as lying at the northernmost tip. The brightness of any counter-jet more than a few mas away from this nucleus is $\lesssim$0.04 of the brightest knot in the visible jet. So far we have no clear-cut limits on the bulk flow velocity but standard inverse-Compton/X-ray flux calculations indicate that the Doppler factor for the strongest knot must be a relatively modest (compared with that in known superluminals) 3.2. This fits in with motion at γ=2 (favoured by Scheuer and Readhead, Nature, 277, 182, 1979, for the nuclei of classical doubles) at 14° to the line-of-sight. The current evidence, then, points to 3C309.1 as being a double source whose axis is quite close to the line of sight. The question as to whether the jet is intrinsically one-sided or not remains open.