HOT-SPOTS AND RADIO LOBES OF QUASARS

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A number of investigations have been made of the dependence of largest angular size (LAS) of quasars on their redshifts Z (Miley 1971; Wardle and Miley 1974; Hooley et al. 1978; Wills 1979; Masson 1980). The earlier workers found a relation LAS $\propto Z^{-1}$ indicating a decrease in linear size of quasars as $(1+Z)^{-n}$, where $1 < n < 3$. The latter workers have argued that the apparent decrease is perhaps caused by an inverse correlation between LAS and radio luminosity. It is also interesting to investigate the dependence of size of hot-spots on luminosity and Z.

We report here preliminary results for 28 quasars out of a sample of 35 observed in the full 35-km configuration of the VLA at a wavelength of 6 cm in March 1981. Each source was observed for a few minutes at 2 or 3 hour angles. The sources were selected as those having the largest angular sizes in 6 redshift ranges from the complete 3CR and Schmidt's 4C sample (Hooley et al. 1978), the 4C sample of Wills (1979) and the B2 sample of Fanti et al. (1977).

In Fig.1 are plotted the largest angular size against redshift for the 28 quasars. The sources are divided into 3 ranges of radio luminosity at 178 MHz (H_o=50 kms^{-1} Mpc^{-1}; q_o=1) and are indicated by different symbols as labelled in the figure. The horizontal bar on a symbol indicates that no prominent hot-spots were observed. Even though the radio luminosity of these sources without hot-spots is relatively high, they show a relaxed morphology indicating that they may be 'dying away'. This would be expected for some of the sources of largest linear sizes at a given Z. Such sources comprise about 30% of the sample. No such sources were observed in the highest luminosity range. If we exclude the 3 sources of lowest radio luminosity in Fig.1, the data is consistent with the absence of linear size evolution with Z. This question, however, needs further investigation.

About 40% of the observed quasars have hot-spots of size < 2.5 to ∿ 4 kpc which contain typically 10-30% of the flux-density of the outer lobes. The sizes of hot-spots in the other 30% of the quasars lie in the range ∿ 4-10 kpc. Hot-spots are generally more compact and prominent

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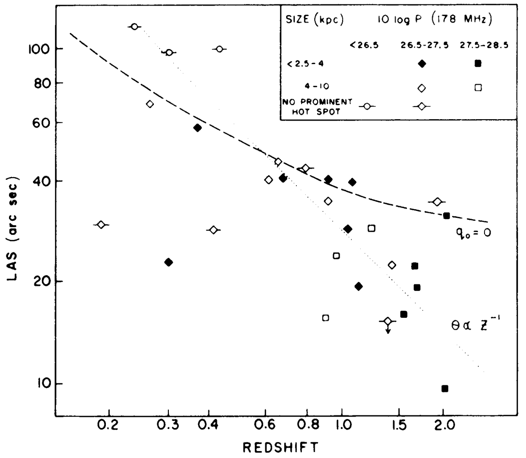

Fig.1. LAS versus redshift for 3 radio luminosity ranges and different hot-spot characteristics (see text)

in one compared to the other outer lobe of the 'double' radio sources. This probably indicates that the relativistic electrons are supplied intermittently to the two outer radio lobes. The apparent increase of the average angular size of hot-spots with redshift and decreasing flux density, as indicated by interplanetary scintillation observations (Readhead & Hewish 1976; Duffett-Smith et al. 1980), is likely to be the result of blending of the hot-spots in the two outer radio lobes.

Another interesting result is that at-least 4 out of these 28 quasars selected for their relatively large angular sizes, and hence likely to have radio axes at large angles to the line of sight, show prominent radio jets (3C9, 0932+02, 1244+32 and 3C280.1). Therefore, these one-sided jets are unlikely to be caused by doppler enhancement for the approaching, and attenuation for the receeding, side of relativistic beams. The radio jets in 3C9 (Z=2.012) and 3C280.1 (Z=1.659) have the highest redshifts and radio luminosities of all jets reported so far. The presence of radio jets in many high luminosity quasars, in contrast to their absence in high luminosity radio galaxies, indicates that the beams supplying energy to the outer lobes are more turbulent in the former than in the latter.

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