RADIO PROPERTIES OF A 'QUARTER JANSKY SAMPLE' OF EXTRAGALACTIC SOURCES,DEFINED AT 408 MHz

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ABSTRACT. For a complete sample of 42 sources, defined over a narrow flux density range around 0.25 Jy at 408 MHz, properties related to size and nuclear radio emission are discussed and compared with the 3CR sample.

1.1 THE QUARTER JANSKY SAMPLE (QJS)

The QJS consists of all 42 sources found in 5C6 and 5C7 surveys,within the range 0.2-0.35Jy at 408 MHz(Pearson and Kus,MNRAS 182,273,1978).The sample was observed with VLA at 1.5 and 5 GHz in A-configuration (and, additionally in C-configuration in case of more diffuse sources) and integrated flux densities were measured at 5GHz with the Effelsberg telescope (D.J.Saikia et al., in preparation).Three of the 42 sources are found to have flat spectra ($\alpha > -0.5$) between 0.4 and 5 GHz.We have established optical counterparts for 13 sources in the QJS, the brightest of them being three 19-mag galaxies.The QJS galaxies are,thus,expected to lie beyond $z \sim 0.3$ but probably not beyond $z \sim 2$(R.Windhorst, thesis,1984).Thus,the expected luminosity range for the QJS galaxies is $P \sim 10^{26}$ -10^{28}W/Hz at 408 MHz.Since 20-25% of sources in both the 10 Jy sample (LRL) (Laing et al.MNRAS 204,151,1983) and the 1 Jy sample (Lilly et al,MNRAS 215, 37,1985) are quasars,we expect~10 quasars in the QJS. A majority of these quasars must have steep radio spectra, since the QJS contains only 3 flat spectrum sources.

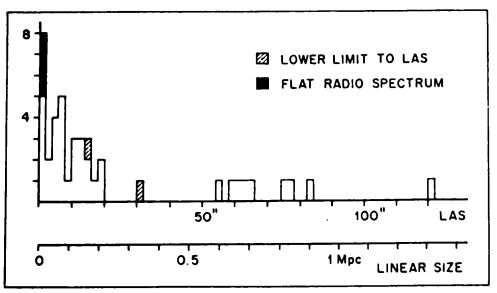

Fig.1: LAS-distribution for the QJS (42 sources). The linear-size scale is computed for $z=1, q_o=0, H_o=50$ Kms^{-1} Mpc^{-1}.

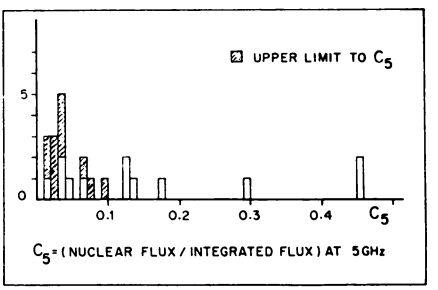

Fig.2: The distribution of core-fraction (C_5) for the QJS-FR II subsample of 23 sources (LAS>6").

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1.2 THE POPULATION OF COMPACT STEEP SPECTRUM SOURCES (CSS)

From Fig.1,only 5 of the 39 steep spectrum sources in the QJS are compact (LAS $\leq$3").This fraction(f=13%) is much smaller than f=14/41=34% reported by Fielden et al.(MNRAS 204,289,1983) for a similar sample defined over 0.1-1 Jy range at 408 MHz.We note that the value of 'f' for the QJS would have been greatly overestimated if LAS had to be derived solely from the 5 GHz(A-array) maps; even moderately extended components seen at 1.4 GHz are often found missing from the 5 GHz maps.We,thus,find no evidence for a substantially higher f for the quarter-Jansky sources as compared to 3CR sources(which are~30 times stronger).Further,spectra of all the 5 CSS sources in the QJS,defined at 0.4,1.4 and 5 GHz,fall with frequency.Down to m_v~22,all 5 of them remain undetected(Perryman,MNRAS,187,223&683,1979).

1.3 EVIDENCE FOR COSMOLOGICAL EVOLUTION OF THE LINEAR SIZE

The expected luminosity range (~10^{26}- 10^{28} W/Hz at 408 MHz) corresponds to the Fanaroff-Riley class II(FR-II) morphology for the QJS galaxies whose number and median z are estimated to be about 32 and 1,respectively (Sect.1.1). For them,a median size of 50 to 180Kpc is estimated (Fig.1.).From literature, a median size of 350$\pm$50 Kpc is estimated for the nearby(z <0.4)FR-II galaxies in the 10-Jy LRL sample,which belong to the same luminosity range as the QJS galaxies(z_{med}~1).A decrease of linear size with z is,thus,indicated(see, also,Kapahi,MNRAS 214,19p,1985).Note that the quoted uncertainty in the median size for the QJS galaxies incorporates plausible deviations of individual galaxies from the assumed z=1(Fig.1,Sect.1.1)and also allows for the choice of up to any 9 steep spectrum QJS sources that have to be dropped from the consideration on account of being potential quasars(additional quasars in the QJS may be present among the 3 flat spectrum sources; Sect.1.1).

1.4 PROMINENCE OF THE RADIO NUCLEI (CORES)

For a subsample containing all 23 confirmed FR-II type sources among the most extended two-third QJS sources(i.e.LAS >6"),values of core-fraction,C_5 (=core flux/integrated flux) could be determined at 5 GHz, (see Fig.2).Further, applying identical selection criteria to the 10 Jy LRL sample, we have derived an equivalent subsample of 89 FR-II sources(with LAS>13")and have,further,estimated their core-fractions from literature.Whereas only 8%(7/89)sources in this LRL subsample have C_5> 0.1,30%(7/23)sources in the equivalent QJS subsample have such prominent cores(Fig.2).Thus,FR-II type sources with prominent cores are more common in metre-wavelength samples selected at an order-of-magnitude lower flux level,compared to the 10 Jy sample.

Within the QJS subsample of 23 sources, we now confine to the galaxy population which is estimated to be ~ 18, including 4 or 5 sources with C_5 > 0.1(Gopal-Krishna et.al.,in prep.).Now,since the cores usually have flatter radio spectra than the lobes,the measured value of C_5 for a distant source would normally be substantially higher than the intrinsic value(radio'K-correction').It can then be inferred that in terms of both radio luminosity and core-fraction statistics,the FR-II galaxies in the QJS should be intrinsically similar to the nearby FR-II galaxies(z <0.4)in the LRL sample,provided typical redshift for the QJS galaxies were close to 1(Gopal-Krishna et al.,in prep.).