A STATISTICAL ANALYSIS OF THE RADIO PROPERTIES OF A LARGE SAMPLE OF 374 OPTICALLY SELECTED QUASARS

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ABSTRACT. Using a large, unbiased sample of 374 optically selected QSOs, of which 54 are radio detected, we have computed for different redshift ranges the probability distribution function ψ(R) of R defined as the ratio of monochromatic luminosities at 15 GHz and 2500 Å in the QSO's rest frame. A significant variation of ψ(R) with redshift is noticed. At small redshifts (z < 0.5), the distinctive feature of ψ(R) is a peak near R∼10^2, arising due to the QSOs having steep radio spectrum(α_r<-0.5).

1. THE QSO SAMPLE AND THE PROBABILITY DISTRIBUTION FUNCTION ψ(R)

The sample (374 QSOs) consists of 6 sets, each derived from the radio-surveyed portion of a major QSO list, by excluding all objects with M_B>-23(q_o=0,H_o=50 Km s^{-1} Mpc^{-1}) and also those for which QSO classification or tabulated redshift(z), or app.magnitude(m) has been labelled as doubtful/uncertain in the parent list (Table 1). Radio data available for all 54 detections in the sample permit classification into flat or steep spectrum type, based on α_r defined between∼5 and∼30 GHz and also yield flux density, S_r, at 15 GHz needed for computing 'R' (see Abstract),

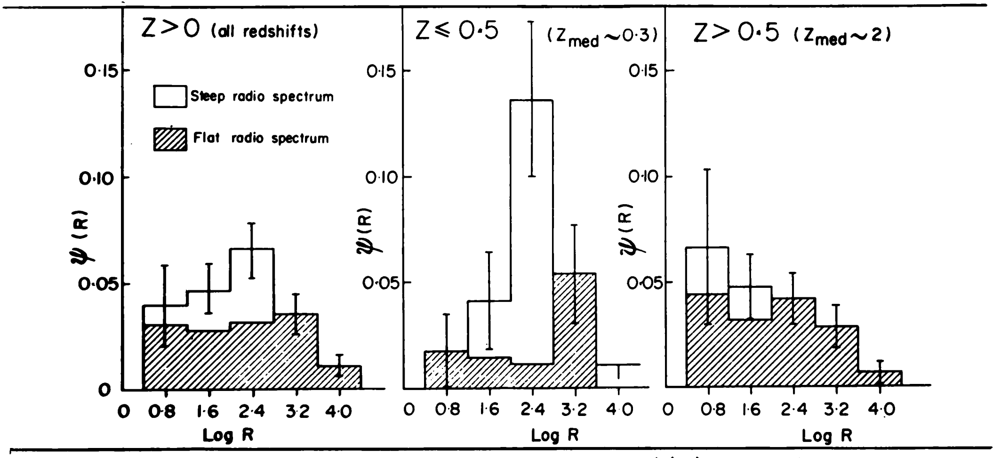

Fig.1:The probability distribution function ψ(R) for different z-ranges.

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Table 1: The 6 sets constituting our sample of 374 optically-selected QSOs

Set, No. of QSOs (radio detections)	Radio telescope used, frequency*, sensitivity limit	Type+ of the adopted mag. (m) and reference to m & z
1. CTIO[1]: 119(12)	VLA[2], 5 GHZ, 10 mJy	m_{con} at λ_e = 1475 Å, (1)
2. BQS[3]: 92(23)	Effelsberg[4], 10.7 GHz, 10 mJy	B-magnitude, (3)
3. AAO§: 53(7)	Parkes[5], 5 GHz, 25 mJy	B-magnitude, (5)
4. MCS[6]: 48(7)	Effelsberg[7], 5 GHz, 10 mJy	m_{con} at λ_o=4500Å, (6), (ϕ)
5. KP[8] : 44(3)	Arecibo[9], 2.4 GHz, ~14 mJy VLA[10], 5 GHz, ~1 mJy	m_{con} at λ_o=4500Å, (8,10)
6. BPS**: 18(2)	Westerbork[10], 1.4GHz, ~4 mJy	B-magnitude, (11)

References: (1) Osmer and Smith (Ap.J.Suppl. 42, 333, 1980); (2) Condon et al. (Ap.J. 244, 5, 1981); (3) Schmidt and Green (Ap.J. 269, 352, 1983); (4) Steppe et al. (preprint, 1985); (5) Savage and Bolton (MNRAS 188, 599, 1979); (6) Lewis et al. (Ap.J. 233, 787, 1979); (7) Strittmatter et al. (Astr.Ap. 88, L12, 1980); (8) Vaucher and Weedman (Ap.J. 240, 10, 1980); (9) Sramek and Weedman (Ap.J. 221, 468, 1978); (10) Sramek and Weedman (Ap.J. 238, 435, 1980); (11) Marshall et al. (Ap.J. 269, 42, 1983); (12) Fanti et al. (Astr.Ap. 61, 487, 1977).

* flux densities at additional frequencies are taken from the references cited here and from the major radio source catalogues.

\+ m_{con}=continuum magnitude, λ_e=emitted wavelength, λ_o=observed wavelength.

§ from the sample given in ref.5. QSOs outside the central 5°x5° are excluded.

ϕ values of m not given in ref.6 are deduced following ref.(10).

**derived from the 'Bologna-Palomar Schmidt' sample defined in ref.(11).

following Schmidt and Green (Ap.J. 269, 352, 1983). For the (320) QSOs undetected in radio, the quoted limits to flux density were adopted for S_r. Note that all the 3 frequencies refer to the QSO's rest frame. Now, using this database we computed ψ(R) for the entire z-range (0 to 3.3), following ref.(10) (Fig.1). It is found to be consistent with the earlier determinations (refs. 10, 12), though much better defined here. We next computed ψ(R) dividing the sample into low ($z\leq0.5$) and high ($z>0.5$) redshift subsamples: a clear variation of ψ(R) with z is noticed (Fig.1). At low-z ψ(R) is marked by a peak arising near $R\sim10^2$ due to steep-spectrum QSOs. For the high-z subsample, ($z_{med}\sim2$), ψ(R) is dominated by flat-spectrum QSOs. This is not likely to be due to an observational bias, since for our major sets of both high-z (CTIO, MCS, AAO) and low-z (BQS) QSOs, the survey frequencies roughly correspond to the same emission frequency of ~15 GHz (see Table 1). The inferred lower probability for steep-spectrum QSOs at high z is also difficult to explain as an artefact of the median optical luminosity of our high-z subsample being higher (by ~3 mag.), compared to our low-z subsample. This is because, as seen from fig.2, optically more luminous QSOs in fact seem to produce steep-spectrum sources, preferrentially. The inferred rarity of steep-spectrum QSOs at high-z may, thus, be real, unless a bias against sources with steep radio spectrum is somehow present already in the parent optical lists of high-z QSOs (Gopal-Krishna et al, in prep.)

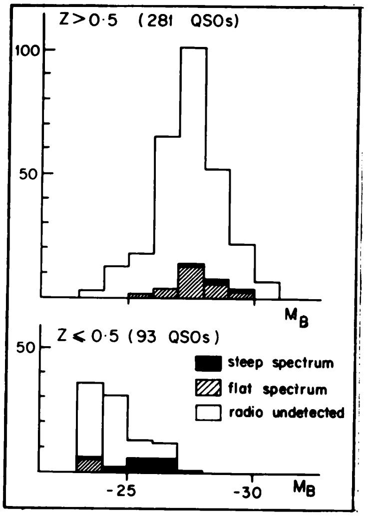

Fig.2: The distribution of M_B for the high-z and low-z QSOs in the sample.