RADIO EVOLUTION IN HIGH REDSHIFT CLUSTERS

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In this project we try to follow the evolution of the Radio Luminosity Function (RLF) with redshift by observing a set of galaxy clusters with known spectroscopic redshifts. This method has the advantage over previous studies, based on general radio surveys, that most of the redshifts are accurately known, that intrinsically weaker sources are well represented, and that the parent sample of galaxies is well defined. The chief disadvantages are that, because the sample is optically selected, there are few high luminosity radio sources, and that we cannot examine differences between cluster and field populations.

With the VLA we observed 55 clusters with redshifts of 0.25 → 0.90 obtained by J. Gunn, B. Oke and J. Hoessel, R. Kron, and H. Butcher. In 3 of the clusters, the spectra showed only a blue continuum and we classified the redshifts for these clusters as large ($\gtrsim 0.6$). We observed each cluster for ±1 hr at 1460 MHz. We could typically detect radio sources with $S(1460) \gtrsim 4$ mJy. We count as cluster sources those within 0.3 Abell radii of the cluster centers (using q_o=0.0). There were 13 such detections, of which less than 1 is expected by chance. Local, z=0, RLFs (Owen 1975, Auriemma et al. 1977) indicated a differential detection fraction dN/d ln P(1400) which is more or less constant for $P(1400) \lesssim P^*=10^{24.4}$ WHz^{-1}, and which varies as P^{-m}, with m=1.5, for $P > P^*$. In Table I we compare in 3 luminosity decades the number of detections based on the Owen RLF with those actually found, and find the maximum likelihood value of the slope of the RLF, m, in the decade. We calculated our luminosities by summing the fluxes of all detected sources and converting to intrinsic power using H_o=100km s^{-1} Mpc^{-1}, q_o=0, $\alpha = -0.7$. While the detections in the middle decade don't differ much from the z=0 expectation, the slopes have flattened considerably from the local value of -1.5. It is surprising, in view of the supposed rapid evolution at high z (e.g., Windhorst et al. 1982), that there are fewer detectors at $z \simeq 0.6$ than at $z \simeq 0.35$. This suggests that the rate of evolution has considerable structure as a function of P and z, and the RLF may evolve as shown in the sketch below.

Our results differ from Katgert et al., and Windhorst et al. in that, for these low luminosity sources, we see a more rapid evolution at low z, and a slow, or negative evolution at higher z. The difference

D. S. Heeschen and C. M. Wade (eds.), Extragalactic Radio Sources, 425–426.
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https://doi.org/10.1017/S0074180900028333 Published online by Cambridge University Press

could derive either from the inaccuracy of the non-spectroscopic distances used by the Westerbork groups, or from a true/cluster field difference in the RLF evolution.

TABLE I

Redshift bin <z>	0.25 - 0.40 0.35			0.40 - 0.50 0.45			0.50 - 0.90 0.60		
	Ns	Ne	Nd	Ns	Ne	Nd	Ns	Ne	Nd
log P = 23.4 - 24.4	16	5	4	5	1	0	0	0	0
	m = 0.9±0.7			---			---		
log P = 24.4 - 25.4	20	4	5	16	3	3	14	2	1
	m = -0.2±0.7			m = +0.3±0.9			---		
log P = 25.4 - 26.4	20	0.1	0	18	0.1	0	17	0.1	0
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Ns = Number of clusters surveyed in this luminosity-redshift bin
Ne = Number of detections expected from Owen (z=0) RLF
Nd = Number of actual detections in this survey

When more than one source was found, values for the slope m of the RLF in the luminosity-redshift bin are given.

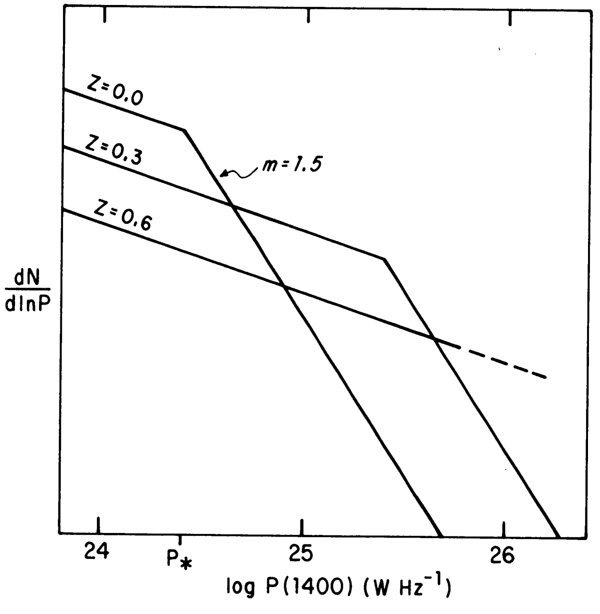

Fig. 1. Suggested form of evolution of the cluster RLF.

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https://doi.org/10.1017/S0074180900028333 Published online by Cambridge University Press