DEPOLARIZATION OF EXTRAGALACTIC RADIO SOURCES

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In the last decade correlations of the depolarization parameter λ_d with several parameters, i.e., the radio luminosity L, redshift z, and source size D have been investigated by several authors, where λ_d is the wavelength at which the percentage polarization drops to its half maximum. Kronberg et al. (1972) first pointed out that λ_d decreases with increasing z, while Morris and Tabara (1973) showed that λ_d increases with L and suggested that the depolarization is due to the internal Faraday rotation within radio sources. Conway et al. (1974), on the other hand, suggested that the λ_d-(1+z) relation is primary. Recently, Cohen (1979) showed that the λ_d-z relation may be the remnant of the physically meaningful relation λ_d-L, though the former is statistically real.

In fact, the diagrams of λ_d-L, λ_d-z, and λ_d-(1+z) shown in Figures 1, 2, and 3 all indicate some correlations. This is mainly due to the (implicit) variable z. (λ_d is corrected by a facter $(1+z)^{-1}$ from the observed frame to the emmited frame.) In this paper, we have analysed correlations between these parameters which are all the function of z.

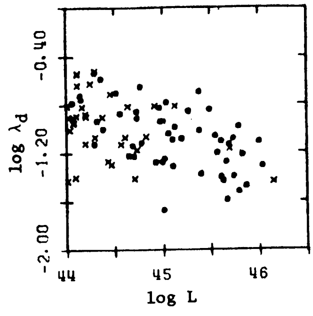

Figure 1. The depolarization λ_d vs. the radio luminosity L for radio galaxies (×) and quasars (•).

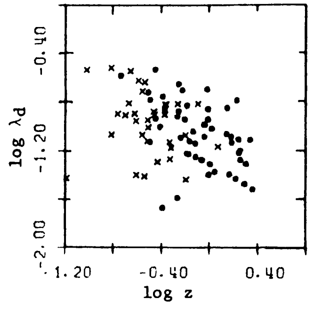

Figure 2. The same as Figure 1 but for λ_d vs. redshift z.

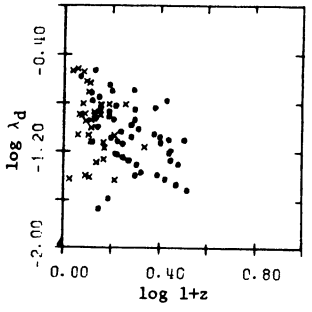

Figure 3. The same as Figure 1 but for λ_d vs. (1+z).

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The reality of the correlation is tested as follows: λ_d's in the set of parameters (λ_d, L, z) for sample sources are randomly rearranged. From each set of the rearranged parameters, the slope of the straight line derived by linear regression, the standard deviation (SD), and the correlation coefficient were obtained and then compared with those for the original sample sources.

The sample sources are (1) spectral types of S and C_- with the spectral index $\alpha > 0.5$ ($S \propto \nu^{-\alpha}$), (2) regular depolarization type (see Conway et al. 1974), and (3) the radio luminosity $L > 10^{44}$ erg/s, assuming $q_o = 0.5$ and $H = 50$ km/s/Mpc. Condition (3) is based on the fact that low luminous sources show different polarization properties from higher luminous sources (Morris and Tabara 1973).

Figures 4 and 5 show the slope vs. SD plots for 100 sets of rearranged parameters together with those of the original one. In figure 4, SD of the original sample sources is significantly smaller than those of rearranged sets. However, SD's of the original set for log λ_d -log z (Figure 5) and log λ_d-log (1+z) relations are not so significant. In case of the distribution of the correlation coefficients, the situation is almost the same, and hence we conclude that the log λ_d-log L relation is physically meaningful, and indicates $L \propto \lambda_d^{-4.6}$. This is consistent with the ram pressure model of radio sources.

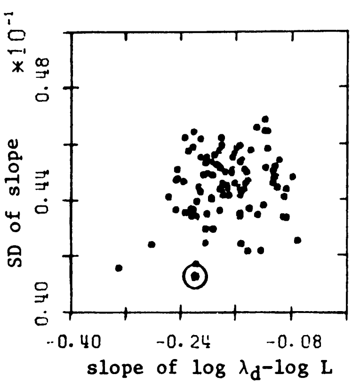

Figure 4. The slopes of linear regression for the rearranged sets of log λ_d-log L and those standard deviation. The original set is shown by the dotted circle.

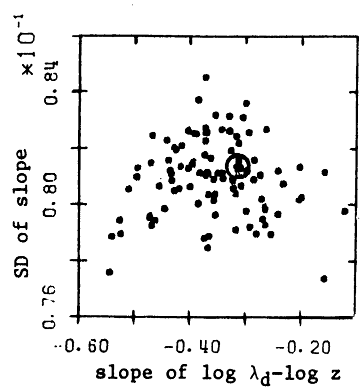

Figure 5. The same as Figure 4 but for log λ_d-log z.

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