RADIO FLUX FLICKER OF EXTRAGALACTIC SOURCES

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Compact sources (compactness evidenced by flat/complex spectra) display a "flicker" in their intrinsic centimeter wavelength radiation, with an amplitude of about 2% and a characteristic time scale of a few days.

Two hundred thirty sources were observed daily for 10-25 days, on three occasions at 9 cm and on one occasion at 6 cm wavelength. The 9 cm observations were made with the 92 m telescope at Green Bank; the 6 cm observations with the 43 m telescope. Sources were selected principally from the 5 GHz surveys (Pauliny-Toth et al. 1972a,b, 1978). They were selected only on the basis of flux density and position. Most are stronger than 1 Jy at 6 cm, and lie between 35° and 60° declination; all are stronger than 0.4 Jy. Observations consisted of transits nominally through the midpoint of a dual-feed configuration. The ratio of response in the two feeds is then a measure of pointing error in declination, which was in turn used to correct the observed antenna temperature. For each source and each observing period, a mean temperature T and its standard deviation σ_T were calculated from the daily observations. Finally, a fluctuation index $\mu = \sigma_T/T$ was obtained for each source in each observing period.

Only nighttime observations will be considered in the analysis. It was found that daytime observations have significantly larger scatter, probably due primarily to thermal effects in the telescope structure. The sources were separated into two classes: (s) = steep, well defined radio spectra; (f) = flat, complex, or poorly defined spectra.

The distributions of fluctuation indices, $\psi(\mu_s)$ and $\psi(\mu_f)$, are shown in Table 1 and Figure 1. In all observing periods, at both wavelengths, the mean value of μ for (f) sources is significantly greater than that for (s) sources. The distribution $\psi(\mu_s)$ can be taken as representing the system performance; flux density of a strong source can be measured with an accuracy of about 1-1/2% in one transit with the 92 m telescope. The distribution $\psi(\mu_f)$ then indicates that flat spectra sources have an additional scatter in their measured fluxes. The indices, μ, are not

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correlated with pointing errors, elevation, flux density, solar elongation, or galactic latitude. For these and other reasons, instrumental or atmospheric effects can be ruled out as the cause of the difference between $\psi(\mu_s)$ and $\psi(\mu_f)$, as can interplanetary and interstellar scintillation. Thus the difference is intrinsic to the sources themselves.

Table 1
Mean Values of Fluctuation Indices, μ

period	wavelength	μ (No.) (s)	(f)
May-June 79	9 cm	0.016 (52)	0.027 (49)
May-June 80	9	0.014 (52)	0.024 (51)
Nov-Dec 80	9	0.016 (27)	0.024 (36)
June 80	6	0.014 (18)	0.024 (17)

An autocorrelation analysis was done on the data of the May-June 1979 observing period. The flux density fluctuations of (s) sources had a characteristic time of about one day, consistent with the sampling rate. The characteristic time scale for fluctuations of the (f) sources, however, was 3-4 days.

I conclude that compact extragalactic sources exhibit a "flicker" in their intrinsic centimeter wavelength radiation, with an average amplitude of about 2% and a characteristic time scale of 3-4 days.

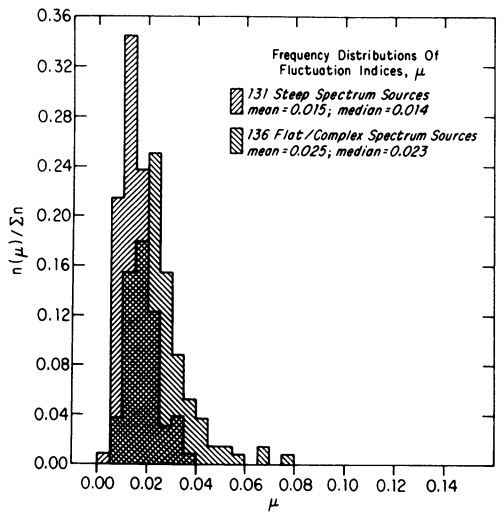

Fig. 1. Frequency distributions of fluctuation indices, μ. Nighttime data from the three observing periods at 9 cm wavelength are combined. The two distributions are significantly different. The 131 values of μ for steep spectrum sources have a mean of 0.015 and a median of 0.014. The 136 values of μ for flat/complex spectrum sources have a mean of 0.025 and a median of 0.023

REFERENCES

Pauliny-Toth et al. 1972a. A.J. 77, 265.
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