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Radio Sources similar to BL Lac

BL LAC (VRO 42.22.01) is the most rapid radio variable known¹ and is also an optically violent variable². It had long been thought to be a variable star³ and its low galactic latitude ($l = 10^\circ$) suggests a possible galactic origin. These two facts have prompted two recent searches for similar objects. MacDonell and Bridle⁴ have investigated the spectra of known radio sources between $l = \pm 10^\circ$, and although they found three which had opaque microwave spectra (DW 0224+67, DA 93 and DW 0727-11), none of these was found to vary. They concluded that the sources were probably compact extragalactic objects. Recently, Biraud⁵ has compared the positions of variable stars with those of known radio sources and found two new coincidences. One of these, PKS 1514-24, was identified with AP Lib, which showed rapid optical variability between 1936 and 1939.

We have monitored PKS 0727-11 and PKS 1514-24 since 1967 as part of an extensive variable source patrol programme at 2,295 MHz. These two sources were selected from the Parkes Transit Catalogue⁶, on the basis of having flat low frequency spectra which are characteristic of radio variables⁷. The measurements were made with a 26 m telescope equipped with a maser radiometer⁸ at the NASA Deep Space Station 51, near Johannesburg. Subject to operational constraints, measurements were made at monthly intervals. The observations were in the form of drift curves, which were analysed digitally using least squares curve fitting techniques. Only the right circular component of the flux was measured, and an accuracy of ± 0.08 flux units (1 flux unit = 10^{-26} W m⁻² Hz⁻¹) or $\pm 2\%$, whichever was greater, was achieved.

The results are shown in Fig. 1. Only PKS 0727-11 was found to vary, and recent variations were so rapid as to require measurements at weekly intervals. The present activity seems to have begun with a weak outburst of about 0.4 flux units in early 1969. Three subsequent outbursts reached maxima in February 1970, October 1970 and January 1971. MacDonell and Bridle's data extend only to January 1970 and their failure to detect variability can probably be attributed to the low level of activity before 1970, and the wide spacing of their measurements. Brandie and Stull⁹ also failed to detect variability at 8,000 MHz. Their data only covered two months during 1970 at a time when the source intensity was changing slowly.

Our patrol programme is limited to sources south of $+20^\circ$ declination, and does not therefore include BL Lac. Con-

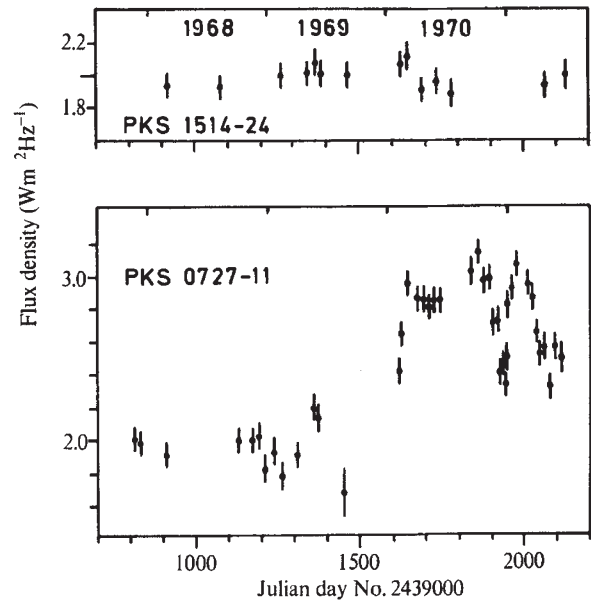


Fig. 1 Variation in radio emission of PKS 1514-24 and PKS 0727-11.

sequently we have no data at 2,295 MHz for a direct comparison with PKS 0727-11. None of the thirty variables so far found at this frequency, however, has shown such rapid variations, and only 3C 120 has variations of greater relative amplitude. PKS 0727-11 is therefore an unusual variable; whether in fact it does fall in the same class as BL Lac must await further measurements at higher frequencies.

PKS 0727-11 has also been observed with intercontinental interferometers using Deep Space Stations in Australia, California and South Africa. Kellerman *et al.*¹⁰ detected a compact component < 0.001 arc s in June 1969 between Australia and California. Subsequent measurements over the same base-line and also between Australia and South Africa have confirmed the presence of the compact component (unpublished results of J. Gubbay, A. J. Legg, D. S. Robertson, A. T. Moffet, D. B. Schaeffer and myself); the component intensity does not, however, follow the total flux variations and probably reflects complex structure in the source.

The object has not yet been identified optically^{4,6} but Bolton and Wall¹¹ have shown that, as a result of brightness changes, some quasars not visible on the Palomar Survey prints can be identified from second epoch plates. If the present activity is accompanied by violent optical variations, then a new search may well reveal the optical object.

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