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letters to nature

Optical variability of PKS0048-097

HOSKINS *et al.*[1] have identified the Parkes radio source 0048-097 with a neutral stellar object of 17 mag, and Carswell *et al.*[2] have shown that, in common with the BL Lacertae class of quasistellar object (BL Lacertids) it has a featureless optical spectrum, that it is a rapid radio variable at high frequencies[3–6] and that it has a radio spectrum similar to BL Lacertae[3]. (The name 'Lacertid' has been suggested[7] for this class, but this invites confusion with meteor showers.) To complete the identification of PKS0048-097, we have investigated two further characteristics of the BL Lacertids: the rapidity of the optical variability; and the total range of optical variability and its correlation with the decimetric spectral index[8].

Thirty-three blue photographic plates from the Harvard archives, taken between 1921 and 1955 (27 between 1948 and 1955), were measured with a Cuffey Iris Astrophotometer. Relative magnitudes were derived from a reference sequence around the object, which was obtained by a transfer from Mount Wilson Selected Area 117 (see ref. 8). The total amplitude, Δm_{pg} was found to be 2.7 ± 0.3 mag. The available plates cover only a limited time and so this amplitude should be taken as a lower limit. In addition, on two occasions in 1948 the object exhibited rapid increases in brightness of about 1.4 mag in 55 d and about 0.9 mag in 30 d. Moreover, PKS0048-097 fits an empirical relationship, which exists for BL Lacertids[8,9], between Δm_{pg} and the decimetric spectral index α. From the measurements of flux density, S, of Shimmins *et al.*[10] at frequencies, ν, of 408 and 2,650 MHz, the value of α $(= d\log S/d\log\nu)$ was found to be 0.33. This value of α should only be considered as representative because of the known radio variability of the source[3–6].

It is significant that a value of about 1.5 mag seems to be the lower limit on the total amplitude, Δm_{pg} for BL Lacertids with a substantial optical record[9]. This empirical result includes PKS0537-441, for which Δm_{yy} is at least 4.9 mag (ref. 11), as well as B20912+29 (ref. 12 and J. T. Pollock, unpublished). We conclude that radio sources with $\Delta m_{pg} \gtrsim 1.5$ mag should be considered as prime candidates for the BL Lacertae class, and that the use of archival photometric records may be an efficient means of identifying new BL Lacertids.

Concerning the nature of PKS0048-097 and the BL Lacertids in general, Oke and Gunn[13] have shown that the extended object around the quasistellar source BL Lacertae has the spectrophotometric properties of an ordinary giant elliptical galaxy, with a redshift of 0.07. Similar results have been obtained by Wlerick *et al.*[14]. Furthermore, if we make the reasonable assumption that the K correction for this galaxy is about 0.1 mag, then it can be shown with the help of the Oke and Gunn data that the BL Lacertae galaxy fits the Hubble diagram of Sandage[15] for radio and N galaxies within the scatter of the points. BL Lacertae is thus associated with an E galaxy that has an intrinsically high luminosity, but is otherwise a normal redshifted object, and it is reasonable to induce that all BL Lacertids have similar properties. The suggestion that these objects are blueshifted[16] is thus unlikely to be correct, and therefore a major requirement of the local hypothesis for quasars (that they are ejecta from the Milky Way and/or nearby galaxies) apparently cannot be satisfied by the BL Lacertids. It follows that the problem still exists of accounting for the large power radiated by the BL Lacertids and other quasistellar objects at their cosmological distances.

To explain the energy requirements Hjellming[17] has suggested that quasistellar objects are singular 'white holes' which are multiply connected to black holes in our own or some other universe. According to Burbidge[18], the basic concept of white holes originated in the writing of Sir James Jeans in 1929, and has occasionally been revived by Ambartsumian, Hoyle and others. Unfortunately, no theoretical predictions exist for comparisons with observations, and indeed, according to Hjellming (private communication) the hypothesis is highly speculative. Nevertheless, it is well known that most galaxies and many ellipticals have bright semistellar nuclei, and on the basis of morphology it would seem more reasonable to regard the phenomenon of quasistellar objects as an extreme case of bright galactic cores, with which are associated singularities caused by gravitational collapse, rather than white holes.

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