

PHOTOMETRY OF AP LIB AND PKS 0521-36

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SUMMARY

Multicolour (*UBVRIJHKL*) photometry is presented for the two peculiar objects AP Lib (=PKS 1514-22), which is thought to resemble BL Lac, and PKS 0521-36, an N-type galaxy. Both objects have spectra typical of synchrotron emission and are similar in becoming redder as they get fainter, in the manner of BL Lac.

1. OBSERVATIONS

The observations given in Table I were made using the 0.51-m and 1.02-m reflectors at the SAAO, Sutherland (by TGH) and the Radcliffe 1.88-m reflector (by PJA). The *JHKL* data given in Tables II and III were made (by ISG) using

TABLE I
UBVRI photometry of AP Lib

JD	<i>V</i>	<i>B-V</i>	<i>U-B</i>	<i>V-R</i>	<i>R-I</i>	Notes
2439233	15.16	0.92	-0.04			1
2441417	15.4	0.6	-0.2	0.9	0.6	2
2441799.434	14.79	0.67	-0.28			3
2441805.333	14.63	0.71	-0.31			
342	14.65	0.65	-0.32			
349	14.63	0.66	-0.31			
353	14.62	0.69	-0.36			3
373	14.67	0.67	-0.37			
409	14.66	0.68	-0.36			
436	14.62	0.72	-0.37			
503	14.60	0.73	-0.37			
2441839.347	14.91	0.80	-0.25			3
840	14.73	0.73	-0.24	0.90	0.43 ::	4
915.285	14.50	0.69				5
916.244	14.49	0.69				5
918.263	14.41	0.72				5
919.247	14.40	0.67				5
920.288	14.39	0.75				5
921.220	14.52	0.68	-0.35			3
2441921.265	14.46	0.66				5
2442129.524	15.04	0.85	-0.19			3

Notes

1. Observed by Westerlund & Wall (1969).
2. Observed by Strittmatter *et al.* (1972).
3. Observed by P. J. Andrews on Radcliffe 1.88-m reflector using a 12 arcsec diameter diaphragm.
4. Observed by T. G. Hawarden on SAAO 1.02-m reflector, using a 13 arcsec diameter diaphragm.
5. Observed by T. G. Hawarden on SAAO 0.51-m reflector, using a 17 arcsec diameter diaphragm.

TABLE II
Infrared observations of AP Lib

JD	<i>J</i>	<i>H</i>	<i>K</i>	<i>L</i>
2441828	12.8 ± 0.6	12.2 ± 0.5	10.9 ± 0.2	> 8.78
1860	> 11.31	11.6 ± 0.2	10.80 ± 0.15	> 8.74
1925		11.6 ± 0.4	10.61 ± 0.14	

TABLE III
Infrared observations of PKS 0521-36

JD	<i>H</i>	<i>K</i>	<i>L</i>
2441925	12.0 ± 0.5	10.6 ± 0.2	> 8.19
1961	12.1 ± 0.3	10.8 ± 0.2	9.4 ± 0.4

the infrared photometer described by Glass (1973) also at the Cassegrain focus of the Radcliffe reflector.

Circular diaphragms of 12 arcsec (Radcliffe 1.88-m reflector) 13 arcsec (SAAO 1.02-m reflector) and 17 arcsec (SAAO 0.52-m reflector) were used.

2. PKS 0521-36

PKS 0521-36 is an *N*-type galaxy with redshift 0.061, showing pronounced light variations (Westerlund & Stokes 1966). Eggen (1970) has pointed out that the difference between its maximum and minimum fluxes can be accounted for by a model consisting of an ordinary galaxy containing a quasar with the colour of 3C 446 observed during an outburst. Fig. 1(a), based on Eggen's data, shows that as PKS 0521-36 gets fainter so *B-V* becomes redder. This behaviour is also seen in BL Lac, Fig. 1(b) (Racine 1970). Using our infrared observations we derive the overall spectrum of PKS 0521-36 shown in Fig. 2 which appears to imply a typical synchrotron emitter, similar to many quasi-stellar sources (Biraud 1971).

3. AP LIB

The optical appearance of the variable object AP Lib has been described in Hunstead (1971) as being clearly non-stellar with a nebulous envelope. The total diameter is ~ 10 arcsec with the possibility of a small 'jet'. The object had been previously discovered as the variable star AP Lib by Ashbrook (1942) from photographic photometry covering the period 1935 to 1939. A description of the photometric behaviour is given by Biraud (1971). The magnitude usually lay between 15 and 16 with periods of very fast and chaotic variations; variations of up to 0.8 mag in a few days were common, with a few examples of extremely rapid changes of about 0.6 mag in about 5 hr. In 1944 maximum brightness $m_{pg} \simeq 14$ was achieved.

AP Lib has been identified with the radio source PKS 1514-24 (Biraud 1971; Bond 1971). The radio spectrum is extremely flat with the possibility of variability at 408 MHz (Hunstead 1971). There is also the possibility that AP Lib is a γ -ray source (Frye *et al.* 1971).

The optical spectrum shows neither emission nor absorption lines and so no definite evidence for it being galactic or extragalactic is available. AP Lib has been associated with the similar objects BL Lac, W Com, OJ287, etc., to form a new

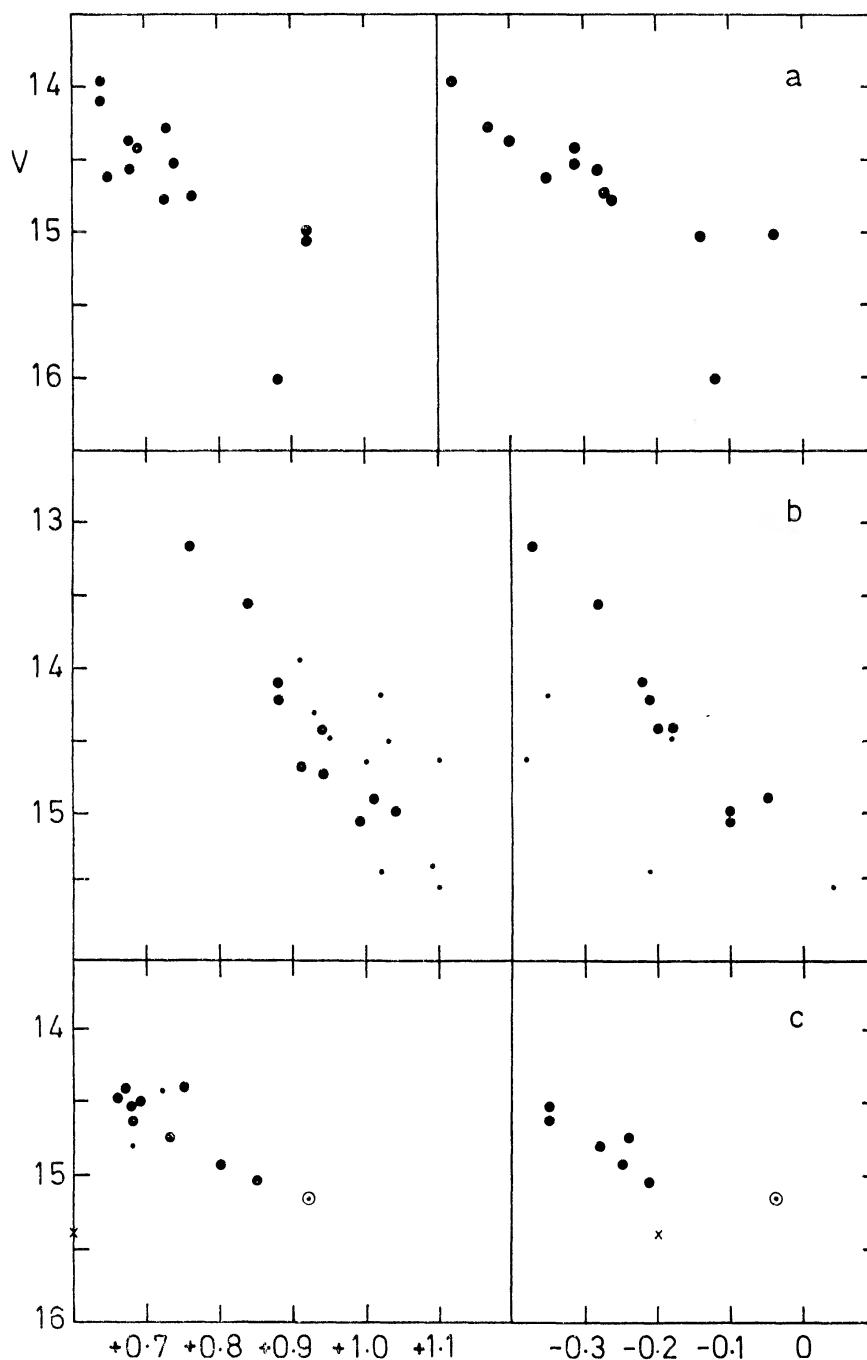


FIG. 1. Relations between the colours and magnitudes of (a) *PKS 0521-36*, from Eggen (1970); (b) *BL Lac* from Racine (1970); (c) *AP Lib*; filled circles are data from Table I, small symbols indicate lower weight. Open circles are from Westerlund & Wall (1969). Crosses from Strittmatter et al. (1972).

class of objects which are generally assumed to be extragalactic and related to the N -galaxies.

We have obtained the photometric data given in Tables I and II. Observations covering a period of more than 4 hr were made on JD 2441805 to look for very rapid variations. The range in B over this interval is only 0.05 mag, most at least of which must represent errors in the photometry. The series of observations from

JD 2441915 to 2441921 shows only small random changes with total range 0.13 over 6 days including a change of 0.08 mag in 1 hr which may be marginally significant. The biggest rapid change was from $B = 15.71$ on JD 2441839 to $B = 15.46$ on JD 2441840. Bearing in mind the small number of observations, our photometry confirms the behaviour described by Ashbrook.

Fig. 1(c) shows the relations between the colours and magnitude for AP Lib. If we eliminate the point due to Strittmatter *et al.* (1972) there is a reddening of $B-V$ and $U-B$ as AP Lib gets fainter. There is at present no indication of whether the variations are due to a part or the whole of the optical object.

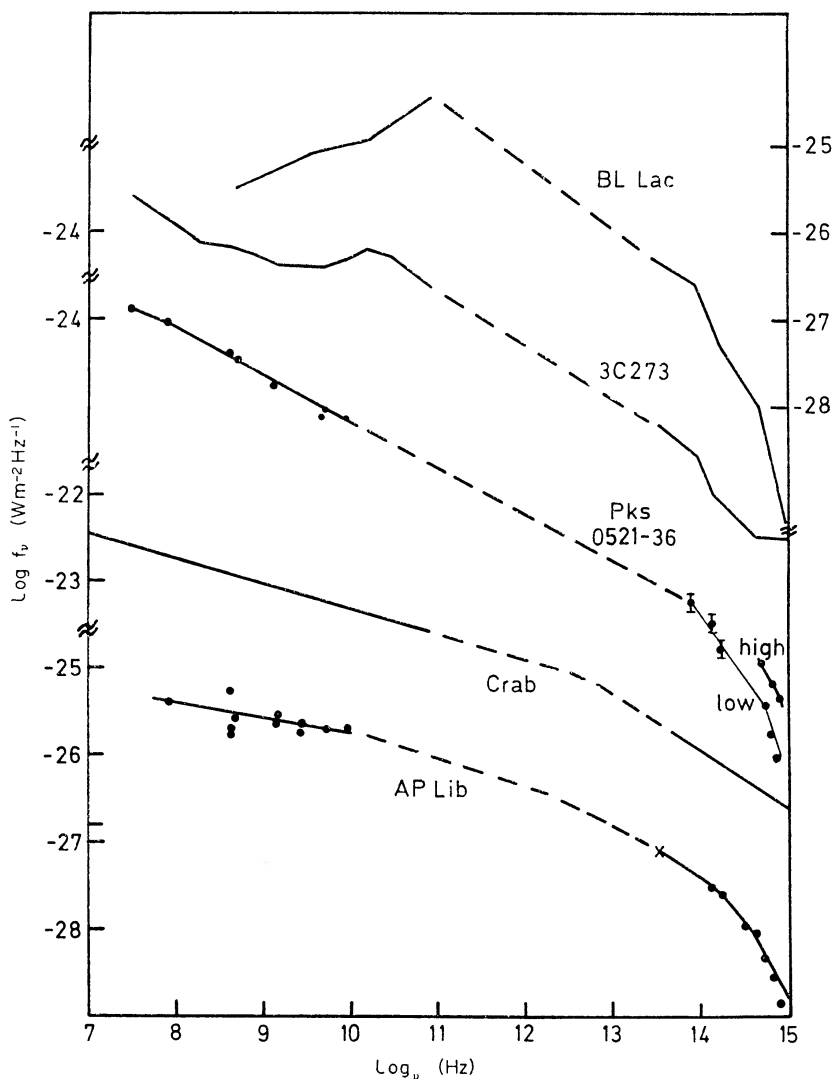


FIG. 2. Flux density distributions of AP Lib and PKS 0521-36 together with those of other objects which may be similar to them.

From Fig. 2 it appears that AP Lib possesses a synchrotron spectrum which does not closely resemble either BL Lac or OJ 287 (Strittmatter *et al.* 1972) and which in the radio region appears to be 'harder' than those of most quasars; instead it seems similar to that of the Crab nebula (Becklin & Kleinmann 1968). Other points of similarity are (i) total fluxes of the same order if similar linear size is assumed and (ii) visual polarization of 5 per cent compared to 9 per cent for the

Crab nebula (Oort & Walraven 1956). The possibility that AP Lib is a galactic object cannot be entirely rejected. The optical appearance, the variation of colour with magnitude and the position in the ($U-B$, $B-V$) two-colour diagram are similar to those of BL Lac and PKS 0521-36. The energy distribution over the infrared-ultraviolet region of the spectrum is very similar to PKS 0521-36 which strengthens the similarity to an N -type galaxy.

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