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REDSHIFTS OF SOUTHERN RADIO SOURCES. VII.

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ABSTRACT

Redshifts and low-resolution spectral data are presented for 47 objects, most of which are QSOs identified with flat-spectrum radio sources from the Parkes 2.7 GHz survey. These data were taken with the 3.9 m Anglo-Australian Telescope using both the IPCS and FORS spectrographs. The total spectral coverage is 3200–9500 Å. Three objects are optical counterparts identified with *IRAS* sources.

Subject headings: galaxies: redshifts — quasars — radio sources: general

I. INTRODUCTION

We present low-resolution spectral data over the wavelength range 3200–9500 Å made with the 3.9 m Anglo-Australian Telescope (AAT) of objects identified with southern radio sources from the Parkes 2.7 GHz survey. These observations are part of an ongoing program to determine redshift and space distributions, and the evolution of a complete sample of QSOs with flat radio spectra (see Savage *et al.* 1988). Previous observations in this program have been reported by Peterson *et al.* (1976), Wright *et al.* (1977), Jauncey *et al.* (1978), Wright *et al.* (1979), Peterson *et al.* (1979), and Jauncey *et al.* (1984). These are Papers I–VI in this series. Spectra for many of the individual objects in these papers have been published by Wilkes *et al.* (1983).

Our program concentrates on radio sources with optical identifications based on optical and radio positional coincidence alone. This approach is possible because of accurate ($\sim 2''$) radio positions from the Tidbinbilla interferometer (Batty *et al.* 1982) and from VLA and VLBI positions (see references for Table 1). Optical identifications and position measurements are being made from the SERC J sky survey where possible, which allows reliable identifications to be made to the 22.5 mag plate limit (Jauncey *et al.* 1982). These optical identifications have been made independently of the color and morphology of the objects. This method, unlike techniques based on color selection, does not select against QSOs with redshift higher than 2. This is particularly important in the quest for high redshifts.

II. OBSERVATIONS

The observations reported here were made in four observing sessions: the nights of 1984 August 28/29, 1985 April 16/17 and 17/18, 1986 April 11/12 and 12/13 and August 9/10 and 10/11. All data were collected at the f/15 focus of the AAT using the combination of the IPCS/RGO spectrograph and the faint object red spectrograph (FORS). In this configuration a dichroic reflector divides the spectrum at ~ 5500 Å, with longer wavelengths directed into the FORS and shorter wavelengths into the IPCS. There is an overlap region of ~ 300 Å seen on both spectra. The data are collected and analyzed separately in the two instruments and the usable wavelength covered is from the atmospheric cutoff at ~ 3200 to 9500 Å. The resolution of the instruments is ~ 10 Å for the IPCS and ~ 30 Å for the FORS.

Data for the 47 objects (43 radio sources and four miscellaneous sources selected at other frequencies) are given in Table 1. Column 1 list the source name. Columns (2) and (3) give a position for the object, and columns (4) and (5) indicate radio or optical position and its reference. Most positions have accuracies of $\sim 1''$ or better. Columns (6) and (7) give optical identification and finding chart reference. Finding charts are presented in Figure 1 (Plate 4) for those objects with neither a published finding chart nor a chart readily accessible. Continuum magnitudes at 5500 Å determined from the spectral data and calibrated against standards from Oke (1974) are given in column (8) and are accurate to ~ 0.3 mag. Magnitude estimates in parentheses have considerably larger errors because the observations were made through cloud. The quoted magnitude estimates are the mean determined from the IPCS and FORS observations at 5500 Å. There was generally good agreement between the two determinations of magnitude, with typical differences of ~ 0.3 mag. Flux densities at 2.7 and 5.0 GHz are given in columns (9) and (10), respectively, and are the most recent measurements from Parkes. The mean redshift (from Table 2) is given in column (11) and notes in column (12).

Table 2 gives the spectral data. Column (1) is the source name. Column (2) gives the mean redshift for the object and its standard error based on weighted redshifts for individual lines.

Many objects show absorption lines, and details are given in § III. Columns (3)–(8) give data for the lines identified in the spectrum. These are the centroid wavelength of the line λ_{obs}

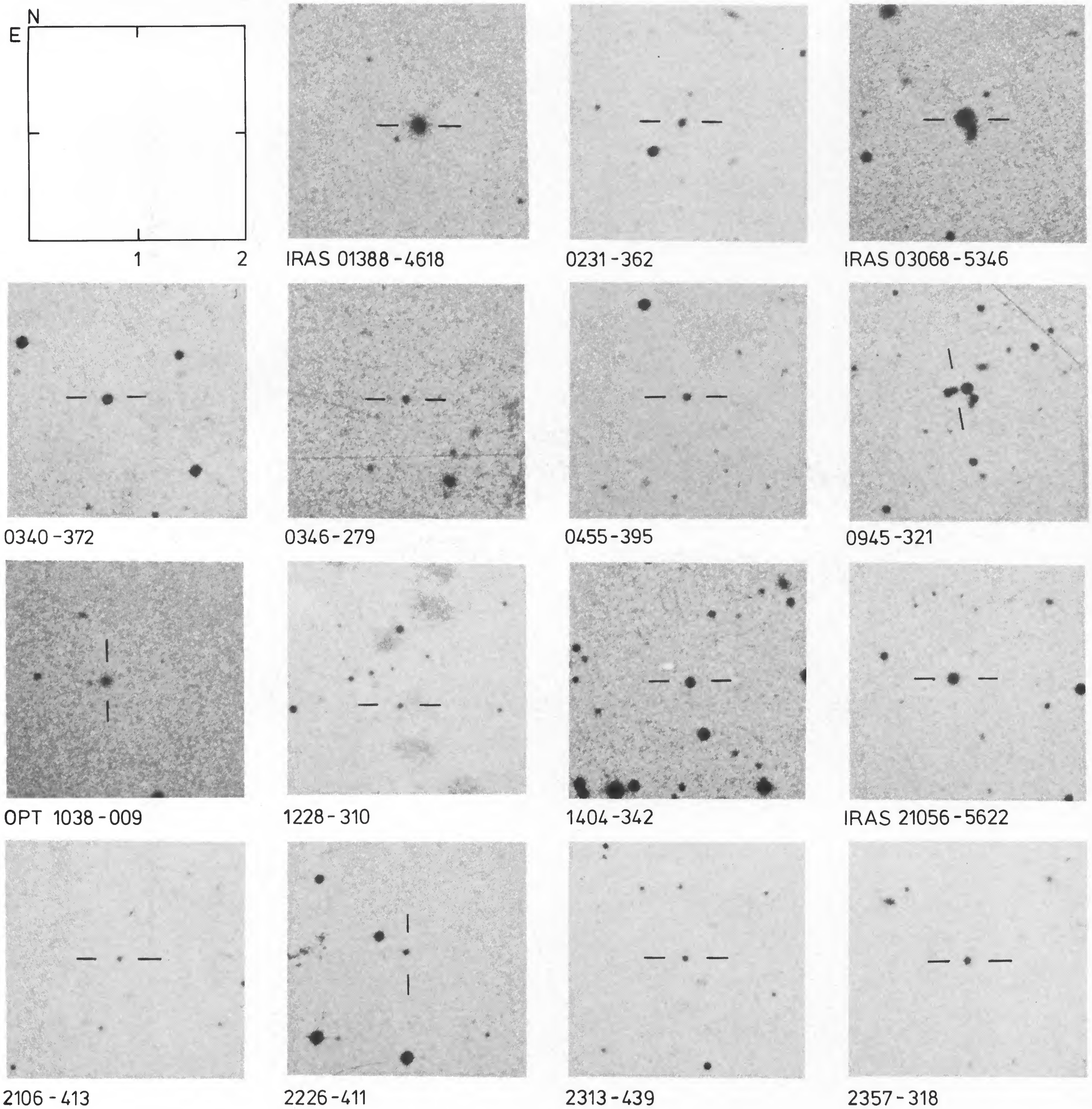

FIG. 1.—Finding charts for those objects which do not have a readily accessible chart in the published literature. Each chart is from the SERC J sky atlas and is 2 arcminutes square with north at the top and east to the left. Additional finding charts have been made for those objects whose optical morphology has been better determined.

WHITE *et al.* (*see* **327**, 561)

TABLE 1

REDSHIFTS OF QSOs AND GALAXIES

(1) Source	(2) Position (B1950) R.A. h m s	(3) Dec. ° ′ ″	(4) O or R*	(5) O,R ref.*	(6) Id.	(7) Finding chart ref.*	(8) Mag. at 5500 Å*	(9) Flux dens. 2.7 GHz (Jy)	(10) Flux dens. 5.0 GHz (Jy)	(11) z	(12) Notes*
0013-005	00 13 37.25	-00 31 53.2	O	38	Q	17,20	20.8	0.80	0.65	1.574	f
0048-427	00 48 48.97	-42 42 52.1	R	21	Q	42,28	18.8	0.68	0.58	1.749	f,o
0104-408	01 04 27.57	-40 50 21.2	R	25	Q	41	19.0	0.57	0.85	0.584	f,o
01388-4618	01 38 51.5	-46 18 03	O	32	G	32,45	17.0			0.0913	f,I,m
0157-418	01 57 46.06	-41 50 32.0	O	28	Q	28	19.8	0.33	0.20	1.150	a,m,o
0221+067	02 21 49.96	+06 45 50	R	25	Q	43	19.0	0.79	0.77	0.5114	f,o
0231-362	02 31 14.49	-36 12 26.7	O	42	G	42,45	(17.6)	0.27	0.18	0.2515	a,k,m,o
03068-5346	03 06 53.9	-53 46 37	O	32	G	32,45	17.2			0.0745	f,I,m
0340-372	03 40 13.27	-37 12 53.4	O	42	Q	42,45	18.6	1.14	0.71	0.2844	a,l,m,o
*0346-279	03 46 33.98	-27 58 19.9	R	10	Q	1,45	(19.4)	1.10	0.96	0.991	f,z,o
0440-285	04 40 38.04	-28 31 06.3	O	36	Q	30	19.2	0.34	0.45	1.952	a,m,o
0455-395	04 55 48.00	-39 32 11.9	O	42	Q	42,45	18.4	0.15	0.14	0.5703	a,m
0743-006	07 43 21.05	-00 36 55.7	R	25	Q	6,7	17.1	1.01	1.31	0.994	b,o
0805-077	08 05 49.63	-07 42 24.0	R	21	Q	3	18.4	1.10	1.01	1.837	d,o
0855-196	08 55 48.73	-19 38 58.1	O	14	Q	2	18.7	1.00	0.78	0.6597	d,o
0920-397	09 20 48.22	-39 46 42.3	R	21	Q	34	18.8	1.60	1.51	0.5912	d,o
0945-321	09 45 58.90	-32 09 48.2	O	45	Q	27,45	18.3	0.58	0.83	2.14	d,n,o
1038-009	10 38 33.79	-00 55 04.0	O	45	G	45	(18.9)			0.1348	c,m,n,o
1042+071	10 42 19.42	+07 11 24.4	R	9	Q	9	20.5	0.50	0.50	0.698	d,o
1142+052	11 42 47.16	+05 12 06.2	R	9	Q	9	19.5	0.60	0.46	1.342	d,o
1218-024	12 18 49.94	-02 25 11.5	R	21	Q	5,6	20.2	0.57	0.44	0.665	c,o
1228-310	12 28 06.00	-31 04 49.7	O	45	Q	45	(20.4)	0.29	0.27	2.276	d,m,n
1236+077	12 36 52.31	+07 46 45.3	R	25	Q	33	(20.1)	0.59	0.67	(0.400)	d,o
1254+006	12 54 29.56	+00 40 48.6	O	45	Q	39	(19.1)	0.13	0.13	1.257	b,m,n
1353-341	13 53 09.82	-34 06 32.0	O	15	G	15	19.4	0.64	0.67	0.2227	g
1404-342	14 04 57.17	-34 17 14.8	R	21	Q	45	(20.1)	0.67	0.60	1.122	b
1411+094	14 11 32.49	+09 29 00.9	O	45	G	8	18.2	0.6	0.45	0.162	f,n,o
1424-418	14 24 46.72	-41 52 54.4	R	21	Q	19	17.7	2.63	2.12	1.522	b
1532+016	15 32 20.17	+01 41 01.6	R	25	Q	23	18.5	0.97	0.79	1.435	f,z
1548+056	15 48 06.93	+05 36 11.2	R	25	Q	33,37	(17.7)	1.83	2.18	1.422	b,h,o
1603+001	16 03 38.91	+00 08 30.1	R	22	G	8	17.9	1.55	1.00	0.055	d,m
1734+063	17 34 47.34	+06 22 48.2	R	9	Q	9	17.9	0.75	0.62	1.207	g,o
1741-038	17 41 20.61	-03 48 48.9	R	25	Q	23,38	(18.6)	2.02	2.30	1.054	b,c
1749+096	17 49 10.39	+09 39 42.8	R	25	Q	11,17	16.6	1.66	1.43	0.322	f,i,o
2012-017	20 12 39.73	-01 46 45.6	O	40	Q	23	17.4	0.78	0.63	*	b,c,f
21056-5622	21 05 37.0	-56 22 40	O	32	Q	32,45	17.7			0.0979	f,I,o
2106-413	21 06 19.39	-41 22 33.3	R	25	Q	35,45	21.0	2.11	2.31	1.0547	f
2126-185	21 26 33.89	-18 34 32.5	R	21	Q	24	20.0	1.32	0.94	0.680	a,m
2144+092	21 44 42.47	+09 15 51.1	R	25	Q	17,33	18.9	0.95	1.01	1.113	f,g,j,o
2155-152	21 55 23.24	-15 15 30.1	R	25	Q	12,23	(19.4)	1.67	1.58	0.672	f
2226-411	22 26 22.12	-41 06 55.3	O	45	Q	45	18.1	1.85	1.05	0.4462	a,m,n,o
2227-445	22 27 57.49	-44 31 55.6	O	42	Q	29,42	18.1	0.26	0.23	1.326	a,m
2239+096	22 39 19.85	+09 38 09.9	R	25	Q	9	19.5	0.65	0.70	1.707	f
2301+060	23 01 56.28	+06 03 56.4	R	9	Q	33	18.8	0.52	0.54	1.268	f
2313-439	23 13 34.86	-43 54 10.2	O	42	Q	42,45	20.1	0.90	0.69	1.847	a,o
2354-117	23 54 57.25	-11 42 22.3	R	10	Q	2,18	(18.9)	1.57	1.39	0.960	f,o
2357-318	23 57 01.45	-31 50 28.8	O	31	Q	31,45	17.6	0.28	0.25	0.991	a,m

(col. [3]), the line identification and its adopted laboratory wavelength (cols. [4] and [5]), the rest wavelength, computed as $\lambda_{obs}/(1 + \bar{z})$ (col. [6]), the line-to-continuum ratio (col. [7]), and the full width of the line determined at half-maximum intensity (col. [8]). Values in parentheses are of relatively low accuracy.

In addition to the objects listed here, three QSOs with redshift >3 were found. Spectral details for these objects will be presented elsewhere (Savage *et al.* 1987*b*).

One feature of the sample worthy of note is the large number of weak-lined QSOs. These are the fainter candidates from our continuing program of objects which on earlier IPCS or IDS data alone were thought to be BL Lac candidates. The determination of redshifts for these difficult targets is possible because of the extended redshift coverage of the IPCS and FORS combination and the excellent sensitivity of the FORS system.

III. NOTES ON INDIVIDUAL OBJECTS

0048−427.—There are strong absorption lines at 3250, 3842, 4001, 4140, 4607, 4700, 4898, 6463, 6953, 7327, and 7592 Å. The 3842 Å line bisects the O IV emission feature. The redshift of the Lyα emission does not agree well with that determined from other emission features. There is some evidence for saturated Lyα absorption affecting the blue edge of the Lyα emission at z(abs) = 1.722.

0104−408.—Weak-lined QSO. Possible BL Lac–type object. There is no feature due to [O II] λ3727.

0157−418.—The C IV emission line is at 3320 Å near the edge of IPCS scan. The C III] λ1909 is very broad. Redshift given by Savage (1984) based on UKST objective prism data is incorrect. We do not confirm the line seen in the prism data at 4970 Å but do confirm the prism line near 4040 Å (AAT data 4082 Å).

0221+067.—Weak-lined QSO. There is an absorption feature at 6872 Å. Hγ may be affected by poor subtraction of Hα in the sky spectrum.

0231−362.—The Hγ emission line falls in the dichroic region between the coverage of the IPCS and FORS. This object has the appearance of a compact galaxy on the SERC J sky survey.

0340−372.—No FORS spectrum.

0346−279.—Our identification is a 19.4 mag QSO with a redshift of 0.988 and is not the 19 mag E3 suggested by Bolton and Ekers (1966*a*). Wilkes *et al.* (1983) detected a line at 3790 Å, which we confirm. They identified it as Mg II λ2798 (redshift 0.355), but our increased wavelength coverage shows emission lines at 5575, 8615, and 8664 Å, which supports our identification of the 3798 Å line as C III] λ1909.

0440−285.—The Lyα emission feature is blended with N V 1240 Å. Wilkes *et al.* (1983) give a "C," i.e., a poor-quality spectrum for this object, with one line (?) at 4560 Å. Our spectrum confirms the presence of this line, which is now identified with C IV λ1549 as we also see Lyα, C III, and Mg IV.

0743−006.—The C III] λ1909 line is very broad. The [O II] λ3727 line is very weak.

0805−077.—There is some evidence for C II λ1336 at 3763 Å (z = 1.817); Lyα is possibly affected by absorption.

0855−196.—Most permitted emission features show strong absorption on the short-wavelength side. All H I emission features seen on the FORS spectrum are broad.

0920−397.—The Mg II emission feature is affected by absorption. All H I emission features seen on the FORS spectrum are broad.

0945−321.—This object has an unusual spectrum. There is no obvious C III] λ1909 or Mg II λ2798 emission. The original identification by Savage, Bolton, and Wright (1976) is incorrect.

1038−009.—The IPCS data are noisy. An Hβ emission feature is expected at 5517 Å in the region affected by the dichroic response. There is no Hγ emission observed. The spectrum is similar to that of the galaxy NGC 5506 (see Wilson *et al.* 1976).

1042+071.—Very weak-lined QSO and noisy data. Hβ emission is probably present at ~8270 Å.

1142+052.—There are absorption features at 3573 Å in the C IV emission line and 6558 Å in the Mg II emission line which correspond to redshifts of 1.307 and 1.343, respectively.

1218−024.—There is some evidence for a broad Hβ emission at 8210 Å (with line-to-continuum ratio of 0.2) at a redshift of 0.689.

1228−310.—There is some evidence for Lyβ plus O VI λ1030 at 3400 Å and Mg II λ2798 at 9230 Å.

1236+077.—Weak-lined QSO; noisy data.

1411+094.—There are emission features. Redshift determined from absorption lines.

1548+056.—The C IV λ1549 emission line appears to have a P Cygni profile indicating possible strong C IV absorption.

1734+063.—Weak-lined QSO. There are no observed emission features from C III] λ1909 or [0 II] λ3727.

1749+096.—Weak-lined QSO. There are no [O II] λ3727 or Mg II λ2798 emission features.

NOTES TO TABLE 1

Col. (4).—R, arcsec radio position; O, arcsec optical position.

Cols. (5) and (7) REFERENCES.—(1) Bolton and Ekers 1966*a*; (2) Bolton and Ekers 1966*b*; (3) Bolton *et al.* 1968; (4) Bolton *et al.* 1981; (5) Bolton and Wall 1969; (6) Bolton and Wall 1970; (7) Browne *et al.* 1973; (8) Clarke *et al.* 1966; (9) Condon *et al.* 1977; (10) Condon *et al.* 1978; (11) Craine *et al.* 1975; (12) Craine *et al.* 1976; (13) Folsom *et al.* 1971; (14) Hunstead 1971; (15) Jauncey *et al.* 1982; (15) Jauncey and Hazard 1970; (17) Johnson 1974; (18) Kinman *et al.* 1967; (19) Lu 1970; (20) McEwan *et al.* 1975; (21) Morabito *et al.* 1982; (22) Morabito *et al.* 1983; (23) Peterson and Bolton 1973; (24) Peterson *et al.* 1973; (25) Perley 1982; (26) Radivich and Kraus 1971; (27) Savage *et al.* 1976; (28) Savage 1984; (29) Savage *et al.* 1979; (30) Savage and Wall 1976; (31) Savage *et al.* 1987*a*; (32) A. Savage and L. Hunt, unpublished data; (33) Shimmins *et al.* 1975; (34) Spinrad *et al.* 1979; (35) Tzioumis 1987; (36) Vander Haegen 1976; (37) Véron 1971; (38) Véron *et al.* 1976; (39) Wall 1971; (40) Wall 1973; (41) Walter and West 1982; (42) White *et al.* 1987; (43) Wills 1976; (44) Wills and Bolton 1969; (45) This work.

Col. (8).—Magnitudes in parentheses were determined from observations made through cloud.

Col. (11).—Asterisk indicates featureless spectrum.

Col. 12. NOTES.—(a) Observations made night starting 1984 Sep 28; (b) observations made night starting 1985 Apr 16; (c) observations made night starting 1985 Apr 17; (d) observations made night starting 1986 Apr 11; (e) observations made night starting 1986 Apr 12; (f) observations made night starting 1986 Aug 9; (g) observations made night starting 1986 Aug 10; (h) previous finding chart by reference (16); (i) previous finding chart by references (7), (26), and (44); (j) previous finding chart by reference (13); (k) previous finding chart by reference (4); (l) previous finding chart by reference (1); (m) not in complete sample of flat-spectrum sources; (n) optical position uncertainty is ~0\".5; (o) see notes on individual objects in text; (z) previous redshift—see notes on individual objects in text; (I) galaxy identified as an *IRAS* source.

TABLE 2

LINE MEASUREMENTS AND IDENTIFICATIONS

(1) Name	(2) Mean redshift	(3) Observed centroid wavelength (Å)	(4) Identification: Line	(5) Identification: Wave-length λ	(6) Computed wave-length (Å)	(7) Line/cont. ratio	(8) Width FWHM (Å)
0013-005	1.574±0.002	3980	CIV	1549	1546	1	60
		4920	CIII]	1909	1911	1	140
		7205	MgII	2798	2799	0.8	94
0048-427	1.749±0.002	(3373)	Lyα	1216	(1227)	1.1	107
		(3425)	NV	1240	(1246)		
		3835	OIV	1402	1395	0.3	77
		4255	CIV	1549	1548	0.7	42
		4504	HeII	1640	1638	0.2	(26)
		(5260)	CIII]	1909	(1913)	0.3	(100)
		7708	MgII	2798	2804	0.6	105
	1.6727±0.0002	3250	Lyα abs	1216	1216		
		4140	CIV abs	1549	1549		
	1.483±0.002	3842	CIV abs	1549	1547		
		6953	MgII abs	2798	2800		
0104-408	0.584±0.002	4439	MgII	2798	2802	0.6	63
		7692	Hβ	4861	4856	0.1	92
		7843	[OIII]	4959	4951	0.1	24
		7920	[OIII]	5007	5000	0.2	24
0138-463	0.0913±0.0002	4066	[OII]	3727	3726	1.1	15
		4291	K abs	3934	3932		
		4334	H abs	3968	3971		
		5305	Hβ	4861	4861	0.3	13
		5412	[OIII]	4959	4959	0.2	10
		5463	[OIII]	5007	5006	0.7	12
		6430	D abs	(5893)	5892		
		7167	Hα	6563	6567	2.3	45
		7336	SII	6717+34	6722	0.4	34
0157-418	1.150±0.005	3320	CIV	1549	1544	2.1	55
		4082	CIII]	1909	1899	0.6	67
		6023	MgII	2798	2801	0.7	130
		7375	[NeV]	3426	3430	0.2	29
		8007	[OII]	3727	3724	0.9	21
		8311	[NeIII]	3869	3866	0.4	16
0221+067	0.5114±0.0003	4231	MgII	2798	2799	0.5	21
		5634	[OII]	3727	3728	0.6	31
		5850	([NEIII])	3869	3871		
		7344	Hβ	4861	4859	0.1	27
		7493	[OIII]	4959	4958	0.3	34
		7565	[OIII]	5007	5005	0.9	23
0231-362	0.2515±0.0001	(3493)	MgII	2798	(2791)	1.2	
		4285	[NeV]	3426	3424	1.7	20
		4683	[OII]	3727	3742	4.2	13
		4843	[NeIII]	3869	3870	1.7	16
		6084	Hβ	4861	4861	0.6	27
		6207	[OIII]	4959	4960	2.8	28
		6267	[OIII]	5007	5008	8.3	24
		8214	Hα	6563	6563	1.8	52
		8411	([SII])	6717+34	6721	0.4	29
0306-537	0.0745±0.0002	4004	[OII]	3727	3726	2.6	12
		4222	K abs	3934	3929		
		4265	H abs	3968	3969		
		6333	D abs	(5893)	5894		
		7056	Hα	6563	6567	1.9	34
		7223	[SII]	6717+34	6722	0.5	31

TABLE 2—*Continued*

(1) Name	(2) Mean redshift	(3) Observed centroid wavelength (Å)	(4) Identification: Line	(5) Identification: Wave-length λ	(6) Computed wave-length (Å)	(7) Line/cont. ratio	(8) Width FWHM (Å)
0340-372	0.2844±0.0004	3593	MgII	2798	2797	0.6	108
		4788	[OII]	3727	3728	2.2	16
		4971	[NeIII]	3869	3870	0.8	13
0346-279	0.991±0.002	3798	CIII]	1909	1908	1.2	51
		5575	MgII	2798	2800	0.7	101
		(8650)	Hγ	4340	(4345)		
0440-285	1.952±0.003	3610	Lyα	1216	(1223)	1.1	153
		4568	CIV	1549	1547	0.5	98
		5639	CIII]	1909	1910	0.5	107
		(8280)	MgII	2798	(2805)	1.0	
	1.9541±0.0002	3592	Lyα abs	1216	1216		
		8260	MgII abs	2798	2798		
0455-395	0.5703±0.0001	7787	[OIII]	4959	4959	0.3	21
		7863	[OIII]	5007	5007	0.9	28
0743-006	0.994±0.004	3796	CIII]	1909	1904	0.3	145
		5582	MgII	2798	2799	0.3	54
		8674	Hγ	4340	4350	0.1	
0805-077	1.837±0.003	3448	Lyα	1216	1215	4.5	22
		3965	OIV	1402	1398	0.2	
		4400	CIV	1549	1551	0.8	78
		4658	HeII	1640	1642	0.4	9
		(5412)	CIII]	1909	(1908)	0.2	
		7946	MgII	2798	2801	0.1	72
0855-196	0.6597±0.0009	4655	MgII	2798	2805	1.6	43
		5689	[NeV]	3426	3428	0.3	27
		6183	[OII]	3727	3725	0.2	26
		6432	Hζ	3889	3875	0.4	33
		6583	Hε	3970	3966	0.2	38
		6819	Hδ	4102	4109	0.2	77
		7234	Hγ+[OIII]	4340+63	4359	0.8	68
		8088	Hβ	4861	4873	1.3	114
		8227	[OIII]	4959	4957	0.7	31
		8305	[OIII]	5007	5004	2.9	31
	0.6463±0.0002	4607	MgII abs	2798	2798		
		8002	Hβ abs	4861	4861		
0920-397	0.5912±0.0007	4460	MgII	2798	2803	0.8	51
		6175	Hζ	3889	3881	0.1	74
		6308	Hε	3970	3964	0.2	41
		6536	Hδ	4102	4108	0.3	75
		6913	Hγ	4340	4345	0.6	76
		7742	Hβ	4861	4866	1.3	91
		7888	[OIII]	4959	4957	0.1	24
		7963	[OIII]	5007	5004	0.9	31
0945-321	2.14±0.01	3835	Lyα	1216	1221	0.9	117
		3908	NV	1240	1245	0.4	
		(4347)	SiIV	1397	(1384)	0.2	54
		4835	CIV	1549	1540	0.4	102
1038-009	0.1348±0.0004	4229	[OII]	3727	3727	0.9	7
		5625	[OIII]	4959	4957	0.5	28
		5679	[OIII]	5007	5004	0.9	20
		7456	Hα	6563	6570	0.7	57
		7630	[SII]	6717+34	6724	0.3	30

TABLE 2—*Continued*

(1) Name	(2) Mean redshift	(3) Observed centroid wavelength (Å)	(4) Identification: Line	(5) Identification: Wave-length λ	(6) Computed wave-length (Å)	(7) Line/cont. ratio	(8) Width FWHM (Å)
1042+071	0.698±0.004	4773	MgII	2798	2811	(0.4)	
		6294	[OII]	3727	3707	0.4	22
		8425	[OIII]	4959	4962	(0.3)	
		8499	[OIII]	5007	5006	(0.4)	
1142+052	1.342±0.003	3629	CIV	1549	1550	1.5	61
		4459	CIII]	1909	1904	0.5	98
		6571	MgII	2798	2806	0.5	161
1218-024	0.665±0.002	4682	MgII	2798	2812	0.2	86
		5691	[NeV]	3426	3423	0.7	27
		6197	[OII]	3727	3722	0.9	27
		6436	[NeIII]	3869	3865	0.5	39
		(7250)	Hγ	4340	(4347)	0.3)	74
		(7256)	[OIII]	4363	(4350)	0.3)	
		8098	Hβ	4861	4864	0.2	64
		8247	[OIII]	4959	4953	0.6	32
		8329	[OIII]	5007	5002	1.9	29
1228-310	2.276±0.008	3999	Lyα	1216	1221	3.4	112
		(4584)	OIV	1402	(1400)	2.0	
		5059	CIV	1549	1544	1.0	102
		6251	CIII]	1909	1908	0.3	170
1236+077	(0.400±0.005)	(3946)	MgII	2798	(2819)		
		(6978)	[OIII]	5007	(4984)		
		(9161)	Hα	6563	(6544)		
1254+006	1.257±0.003	(3500)	CIV	1549	(1551)	0.7	
		4296	CIII]	1909	1903	0.3	84
		6326	MgII	2798	2803	0.3	165
		7747	[NeV]	3426	3432	0.1	52
		8941	HeI	3965	3961	0.4	29
1256-229	Featureless spectrum						
1349-439	Featureless spectrum						
1353-341	0.2227±0.0003	4557	[OII]	3727	3727	7.9	15
		5940	Hβ	4861	4858	0.3	24
		6062	[OIII]	4959	4958	0.6	29
		6120	[OIII]	5007	5005	1.5	29
		7703	[OI]+[SIII]	6300	6300	0.6	29
		8037	Hα	6563	6573	3.1	50
		8221	SII	6717+34	6724	1.0	45
1404-342	1.122±0.001	4050	CIII]	1909	1906	0.3	87
		5941	MgII	2798	2796	0.4	57
1411+094	0.162±0.002	4562	K abs	3934	3926		
		4606	H abs	3968	3964		
		5084	G abs	(4340)	(4375)		
		6001	b abs	(5175)	(5164)		
		6847	D abs	(5893)	(5892)		
		7607	Hα abs	6563	6546		
1424-418	1.522±0.002	3533	OIV	1402	1401	0.3	
		3909	CIV	1549	1550	0.3	45
		4812	CIII]	1909	1908	0.3	36
		7071	MgII	2798	2804	0.2	74
1519-273	Featureless spectrum						
1532+016	1.435±0.005	3786	CIV	1549	1555	0.7	98
		4634	CIII]	1909	1903	0.3	93
		6806	MgII	2798	2795	0.3	114

TABLE 2—*Continued*

(1) Name	(2) Mean redshift	(3) Observed centroid wavelength (Å)	(4) Identification: Line	(5) Identification: Wave-length λ	(6) Computed wave-length (Å)	(7) Line/cont. ratio	(8) Width FWHM (Å)
1548+056	1.422±0.001	3753	CIV	1549	1550	1.6	
		(4620)	CIII]	1909	(1908)	0.2	
		6778	MgII	2798	2799	0.4	100
1603+001	0.055±0.002	4149	K abs	3934	3933		
		4197	H abs	3968	3978		
		4550	G abs	(4340)	4313		
		5462	b abs	(5175)	5177		
		6240	D abs	(5893)	5915		
		6870	Hα abs	6563	6512		
1734+063	1.207±0.001	3417	CIV	1549	1548	1.1	41
		6179	MgII	2798	2800	0.1	92
1741−038	1.054±0.002	(3890)	CIII]	1909	(1894)	0.4	
		5747	MgII	2798	2798	0.5	90
		7005	[NeV]	3426	3410	0.1	
		7659	[OII]	3727	3729	0.2	25
		7949	[NeIII]	3869	3870	0.1	
		8166	Hε	3970	3976	0.05	
		8430	Hδ	4102	4104	0.1	
		8919	Hγ	4340	4342	0.1	147
1749+096	0.322±0.001	6423	Hβ	4861	4859	0.05	67
		6559	[OIII]	4959	4961		
		6605	[OIII]	5007	4996	0.1	34
		8677	Hα	6563	6564	0.3	84
		8873	SII	6717+34	6712	0.06	46
2105−563	0.0979±0.0002	4091	[OII]	3727	3726	1.4	11
		(4320)	K abs	3934	(3935)		
		4360	H abs	3968	3971		
		5337	Hβ	4861	4861	0.9	12
		6464	D abs	(5893)	5888		
		6915	[OI]+[SIII]	6300	6298	0.1	25
		7211	Hα	6563	6568	3.4	45
		7381	[SII]	6717+34	6723	0.5	35
2106−413	1.0547±0.0003	(3920)	CIII]	1909	(1908)	(2.0)	
		5750	MgII	2798	2798	0.5	55
		7039	[NeV]	3426	3426	0.3	43
		7655	[OII]	3727	3726	0.7	29
		7951	[NeIII]	3869	3870	0.5	27
2126−185	0.680±0.001	6269	[OII]	3727	3732	0.6	27
		8169	Hβ	4861	4863	0.1	80
		8327	[OIII]	4959	4957	0.2	31
		8410	[OIII]	5007	5006	1.0	42
2144+092	1.113±0.001	3274	CIV	1549	1549	2.0	32
		4031	CIII]	1909	1908	0.7	47
2155−152	0.672±0.001	4685	MgII	2798	2802	0.8	72
		6233	[OII]	3727	3728	0.2	28
		6517	Hζ	3889	3898	0.1	120
		6820	Hδ	4102	4079	0.1	100
		7300	Hγ	4340	4366	0.1	110
		8126	Hβ	4861	4860	0.1	59
		8286	[OIII]	4959	4956	0.2	23
		8372	[OIII]	5007	5007	0.6	33

TABLE 2—*Continued*

(1) Name	(2) Mean redshift	(3) Observed centroid wavelength (Å)	(4) Identification Line	(5) Wave-length λ	(6) Computed wave-length (Å)	(7) Line/cont. ratio	(8) Width FWHM (Å)
2226-411	0.4462±0.0001	4047	MgII	2798	2798	1.8	26
		4955	[NeV]	3426	3426	0.8	
		5398	[OII]	3727	3726	13.6	19
		(5598)	[NeIII]	3869	(3871)	2.6	
		5738	Hε	3970	3968	1.0	
		5932	Hδ	4102	4102	0.6	
		(6291)	Hγ+[OIII]	4340+ 4363	(4350)		
		7030	Hβ	4861	4861	2.0	32
		7171	[OIII]	4959	4959	6.3	31
		7240	[OIII]	5007	5006	20.1	24
		9108	[OI]+[SIII]	6300	6298	1.1	39
		9202	[OI]	6364	6363	0.5	52
		9496	Hα	6563	6566	6.1	
2227-445	1.326±0.002	3605	CIV	1549	1550	1.6	
		6505	MgII	2798	2797	0.4	95
2239+096	1.707±0.006	(3283)	Lyα	1216	(1213)	2.6	
		(3800)	OIV	1402	(1404)	0.4	(84)
		4185	CIV	1549	1546	0.5	(39)
		(5130)	CIII]	1909	(1895)	0.4	(84)
		7590	MgII	2798	2804	0.5	143
2301+060	1.268±0.004	3517	CIV	1549	1551	2.3	51
		3706	HeII	1640	1634	0.6	10
		4330	CIII]	1909	1909	0.6	37
		6358	MgII	2798	2803	0.6	59
2313-439	1.847±0.005	3453	Lyα	1216	1213	6.4	27
		3993	OIV	1402	1403	0.4	
		4438	CIV	1549	1559	0.6	114
		(5420)	[CIII]	1909	(1904)	0.5	
		7957	MgII	2798	2795	0.3	103
2354-117	0.960±0.002	3745	CIII]	1909	1911	0.5	180
		(5518)	MgII	2798	(2815)	(0.8)	
		6705	[NeV]	3426	3421	0.2	
		7311	[OII]	3727	3730	0.3	
2357-318	0.991±0.001	3800	CIII]	1909	1909	0.5	53
		5575	MgII	2798	2800	1.2	77

21056−5622.—This object appears to be stellar on SERC J plates although selected from the *IRAS* catalog as a possible active galactic nucleus candidate. The spectrum supports its identification as a galaxy with Ca II H and K and Na I D in absorption.

2144+092.—IPCS spectrum only.

2226−411.—The [Ne III] line observed at 5598 Å is blended with some residual of the λ5577 night sky emission.

2313−439.—The C III] λ1909 line is near the edge of the IPCS scan.

2354−117.—Present redshift in agreement with preliminary value quoted by Wright, Ables, and Allen (1983).

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REFERENCES

Batty, M. J., Jauncey, D. L., Rayner, P. T., and Gulkis, S. 1982, *A.J.*, **87**, 938.
Bolton, J. G., and Ekers, J. 1966*a*, *Australian J. Phys.*, **19**, 275.
———. 1966*b*, *Australian J. Phys.*, **19**, 559.
Bolton, J. G., Shimmins, A. J., and Merkelijn, J. 1968, *Australian J. Phys.*, **21**, 81.
Bolton, J. G., Trett, J. Carignan, C., and Binette, L. 1981, *Australian J. Phys.*, **34**, 445.
Bolton, J. G., and Wall, J. V. 1969, *Ap. Letters*, **3**, 117.
———. 1970, *Australian J. Phys.*, **23**, 789.
Browne, I. W. A., Crowther, J. H., and Adgie, R. L. 1973, *Nature*, **244**, 146.
Clarke, M. E., Bolton, J. G., and Shimmins, A. J. 1966, *Australian J. Phys.*, **19**, 375.
Condon, J. J., Hicks, P. D., and Jauncey, D. L. 1977, *A.J.*, **82**, 692.
Condon, J. J., Jauncey, D. L., and Wright, A. E. 1978, *A.J.*, **83**, 1036.
Craine, E. R., Johnson, K., and Tapia, S. 1975, *Pub. A.S.P.*, **87**, 123.
Craine, E. R., Strittmatter, P. A., Tapia, S., Andrew, B. H., Harvey, G. A., Learheart, M. R., and Kraus, J. D. 1976, *Ap. Letters*, **17**, 123.
Folsom, G. H., Smith, A. G., Hackney, R. L., Hackney, K. R., and Leacock, R. J. 1971, *Ap. J. (Letters)*, **169**, L131.
Hunstead, R. W. 1971, *M.N.R.A.S.*, **152**, 277.
Jauncey, D. L., Batty, M. J., Gulkis, S., and Savage, A. 1982, *A.J.*, **87**, 763.
Jauncey, D. L., Batty, M. J., Wright, A. E., Peterson, B. A., and Savage, A. 1984, *Ap. J.*, **286**, 498.
Jauncey, D. L., and Hazard, C. 1970, *Ap. Letters*, **7**, 1.
Jauncey, D. L., Wright, A. E., Peterson, B. A., and Condon, J. J. 1978, *Ap. J. (Letters)*, **219**, L1.

Johnson, K. H. 1974, *A.J.*, **79**, 1006.
Kinman, T. D., Bolton, J. G., Clarke, R. W., and Sandage, A. 1967, *Ap. J.* (*Letters*), **147**, L848.
Lu, P. K. 1970, *A.J.*, **75**, 1161.
McEwan, N. J., Browne, I. W. A., and Crowther, J. H. 1975, *Mem. R.A.S.*, **80**, 1.
Morabito, D. D., Preston, R. A., Slade, M. A., and Jauncey, D. L. 1982, *A.J.*, **87**, 735.
Morabito, D. D., Preston, R. A., Slade, M. A., Jauncey, D. L., and Nicolson, G. D. 1983, *A.J.*, **88**, 1138.
Oke, J. B. 1974, *Ap. J. Suppl.*, **27**, 21.
Perley, R. A. 1982, *A.J.*, **87**, 859.
Peterson, B. A., and Bolton, J. G. 1973, *Ap. Letters*, **13**, 187.
Peterson, B. A., Bolton, J. G., and Shimmins, A. J. 1973, *Ap. Letters*, **15**, 109.
Peterson, B. A., Jauncey, D. L., Wright, A. E., and Condon, J. J. 1976, *Ap. J.* (*Letters*), **207**, L5.
Peterson, B. A., Wright, A. E., Jauncey, D. L., and Condon, J. J. 1979, *Ap. J.*, **232**, 400.
Radivich, M. R., and Kraus, J. D. 1971, *A.J.*, **76**, 683.
Savage, A. 1984, *M.N.R.A.S.*, **206**, 745.
Savage, A., Bolton, J. G., and Wright, A. E. 1976, *M.N.R.A.S.*, **175**, 517.
———. 1979, *M.N.R.A.S.*, **179**, 135.
Savage, A., *et al.* 1986, in *IAU Symposium 124, Observational Cosmology*, ed. A. Hewitt, G. Burbidge, and Li-Zhi Fang (Dordrecht: Reidel), p. 673.
Savage, A., Gulkis, S., Batty, M. J., Jauncey, D. L., White, G. L., Peters, W. B., and Kalafi, M. 1987*a*, in preparation.
Savage, A., and Wall, J. V. 1976, *Australian J. Phys. Ap. Suppl.*, No. 39, p. 39.
Savage, A., White, G. L., Jauncey, D. L., Peterson, B. A., Wright, A. E., Batty, M. J., and Gulkis, S. 1987*b*, in preparation.
Shimmins, A. J., Bolton, J. G., and Wall, J. V. 1975, *Australian J. Phys. Ap. Suppl.*, No. 34, p. 63.
Spinrad, H., Kron, R., and Hunstead, R. W. 1979, *Ap. J. Suppl.*, **41**, 701.
Tzioumis, A. K. 1987, Ph.D. thesis, University of Sydney.
Vander Haegen, J. 1976, *Australian J. Phys. Ap. Suppl.*, No. 39, p. 69.
Véron, M. P. 1971, *Astr. Ap.*, **11**, 1.
Véron, M. P., Véron, P., Adgie, R. L., and Gent, H. 1976, *Astr. Ap.*, **47**, 401.
Wall, J. V. 1971, *Australian J. Phys. Ap. Suppl.*, No. 20, p. 1.
———. 1973, *Ap. Letters*, **15**, 101.
Walter, H. G., and West, R. M. 1982, *Astr. Ap.*, **111**, 357.
White, G. L., Batty, M. J., Jauncey, D. L., Savage, A., and Gulkis, S. 1987, in preparation.
Wilkes, B. J., Wright, A. E., Jauncey, D. L., and Peterson, B. A. 1983, *Proc. Astr. Soc. Australia*, **5**, 2.
Wills, B. J. 1976, *A.J.*, **81**, 1031.
Wills, D., and Bolton, J. G. 1969, *Australian J. Phys.*, **22**, 775.
Wilson, A. S., Penston, M. V., Fosbury, R. A. E., and Boksenberg, A. 1976, *M.N.R.A.S.*, **177**, 673.
Wright, A. E., Ables, J. G., and Allen, D. A. 1983, *M.N.R.A.S.*, **205**, 793.
Wright, A. E., Jauncey, D. L., Peterson, B. A., and Condon, J. J. 1977, *Ap. J.* (*Letters*), **211**, L115.
Wright, A. E., Peterson, B. A., Jauncey, D. L., and Condon, J. J. 1979, *Ap. J.*, **229**, 73.

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