Radio observations of peculiar galaxies

by

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Abstract: With the 1000-foot radiotelescope of the Arecibo Ionospheric Observatory we have observed the positions of 69 peculiar galaxies classified by Arp (1966). Several radio sources were detected, but they could be chance coincidences. Radio maps of the radio sources are given.

I. *Introduction*

Arp (1963) has compiled a catalogue containing 338 peculiar galaxies that he classifies into four groups according to their shape, or to the nature of the peculiarity, taking into account gradual changes in peculiarity from object to object. These four groups are, in turn, divided into a number of subgroups.

Less than ten per cent of the galaxies in Arp's catalogue have been identified with radio sources. The aim of the present work was to see if more of these galaxies could be detected at radio frequencies.

For this purpose we have used the 1000-foot radio telescope of the Arecibo Ionospheric Observatory. Because of the limited motion that can be achieved with this instrument the survey was limited to declinations $3^{\circ} \leqslant \delta \leqslant 35^{\circ}$. A total of 69 galaxies were observed.

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II. *Equipment and observations*

The survey was initiated in February, 1968 at a frequency of 430 Mhz using the 96-foot line feeder whose half-power beamwidth is 10′. These observations continued throughout 1968 and 1969.

Another survey of some selected objects was then carried out at a frequency of 318 Mhz with the line feeder described by Lalonde and Harris (1970) whose HPBW is 16′.

For each galaxy we made sweeps in right ascension about 3^{m} to either side of the position of the object, at two or more declinations. In some cases we also made sweeps in declination at constant right ascension. All galaxies were observed at least twice at each declination on different days. The observations were recorded on magnetic tape and the reductions were done on the A10 computer. A typical observation is shown on Figure 1. On the basis of calibrations using well known sources we arrived at 4.5°K/flux unit at 430 Mhz and 6.8°K/flux unit at 318 Mhz.

III. *Results*

For each galaxy observed at three or more declinations we drew the radio maps shown in Figure 2, where the position of the galaxy is indicated by a cross. Table I summarizes the observations, where the first column indicates the number given to the object in Arp's catalogue, the second column gives the measured fluxes at 318 Mhz and 430 Mhz. In this column a parenthesis indicates a lowed limit, since the maximum of the radiation is beyond the observed region. In the fourth column we indicate the name of radio sources in Dixon's (1970) catalogue which may be indentified with those observed by us. The fifth column contains some comments on the radio sources detected.

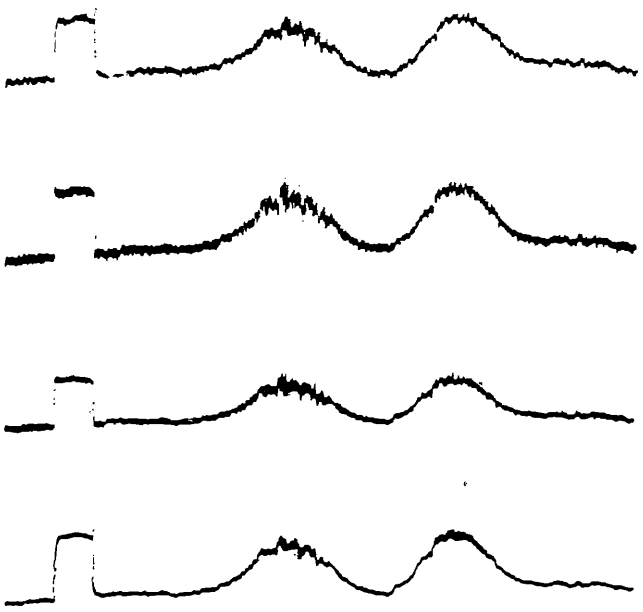

Figura 1

Shapes and sizes of the radio sources are very difficult to ascertain due to the large side lobes of the instrument used.

Etastically we can verify whether the radio sources detected are really associated with the peculiar galaxies.

According to von Horner (1961), the number N (S . λ) of radio sources per square degree, at a given frequency, with flux greater or equal to S, given by:

$$N\,(S\,.\,\lambda) = 4.6 \times 10^{-3} \left[\frac{S}{20\ \left(\frac{189}{\lambda}\right)^{-x}} \right]^{n}$$

where:

x = spectral index of the radio source,

λ = wavelength in centimeters,

n = slope of the log N-log S relation

if we take:

$x = -0.8$; $n = 1.8$

we get:

at 318 Mhz and $S \geqslant 0.15$ f.u. (1°K) ;

N = 10 sources/sq. deg.

at 430 Mhz and $S \geqslant 0.22$ f.u. (1°K) ;

N = 3.7 sources/sq. deg.

From the radio maps we obtain a count of 5 sources/sq, deg. at 318 Mez and 3.7 sources/sq. deg. at 430 Mhz. Therefore, we cannot claim that the radio sources detected can be associated with Arp's peculiar galaxies.

Acknowledgements:

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Dixon, R. S. 1970, Ap. J. Suppl. *20*, 1.

Horner, S. von 1961, Publ. N.R.A.O. *1*, 19.

Lalonde, L. M. and Harris, D. E. 1970. I.E.E.E. Trans. Antennas and Propagation, *AP-18*, 41.

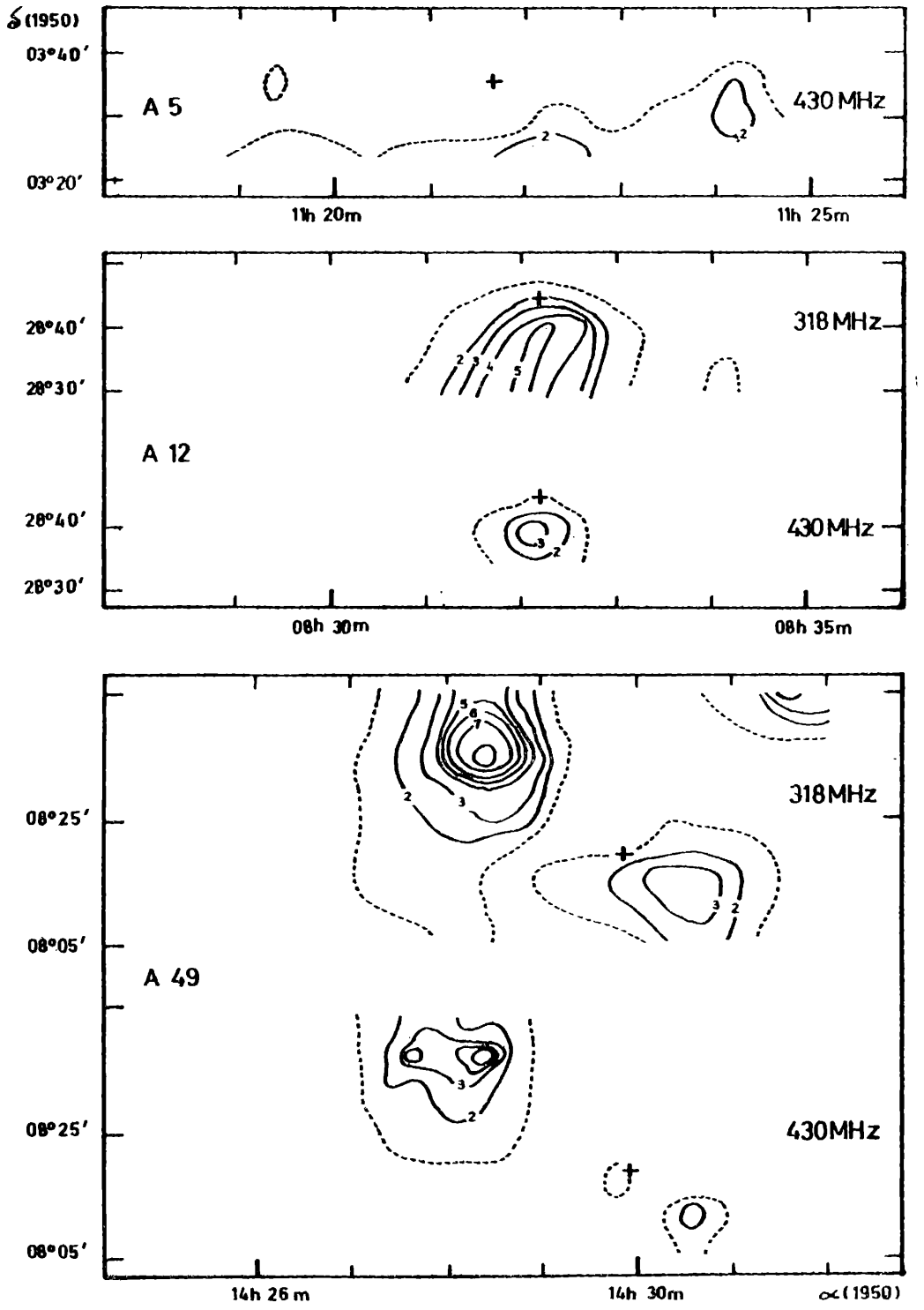
δ(1950)
03°40′
03°20′
A 5
430 MHz
11h 20m
11h 25m
28°40′
28°30′
318 MHz
A 12
28°40′
28°30′
430 MHz
08h 30m
08h 35m
08°25′
08°05′
318 MHz
A 49
08°25′
08°05′
430 MHz
14h 26 m
14h 30m
α(1950)

Figura 2 a

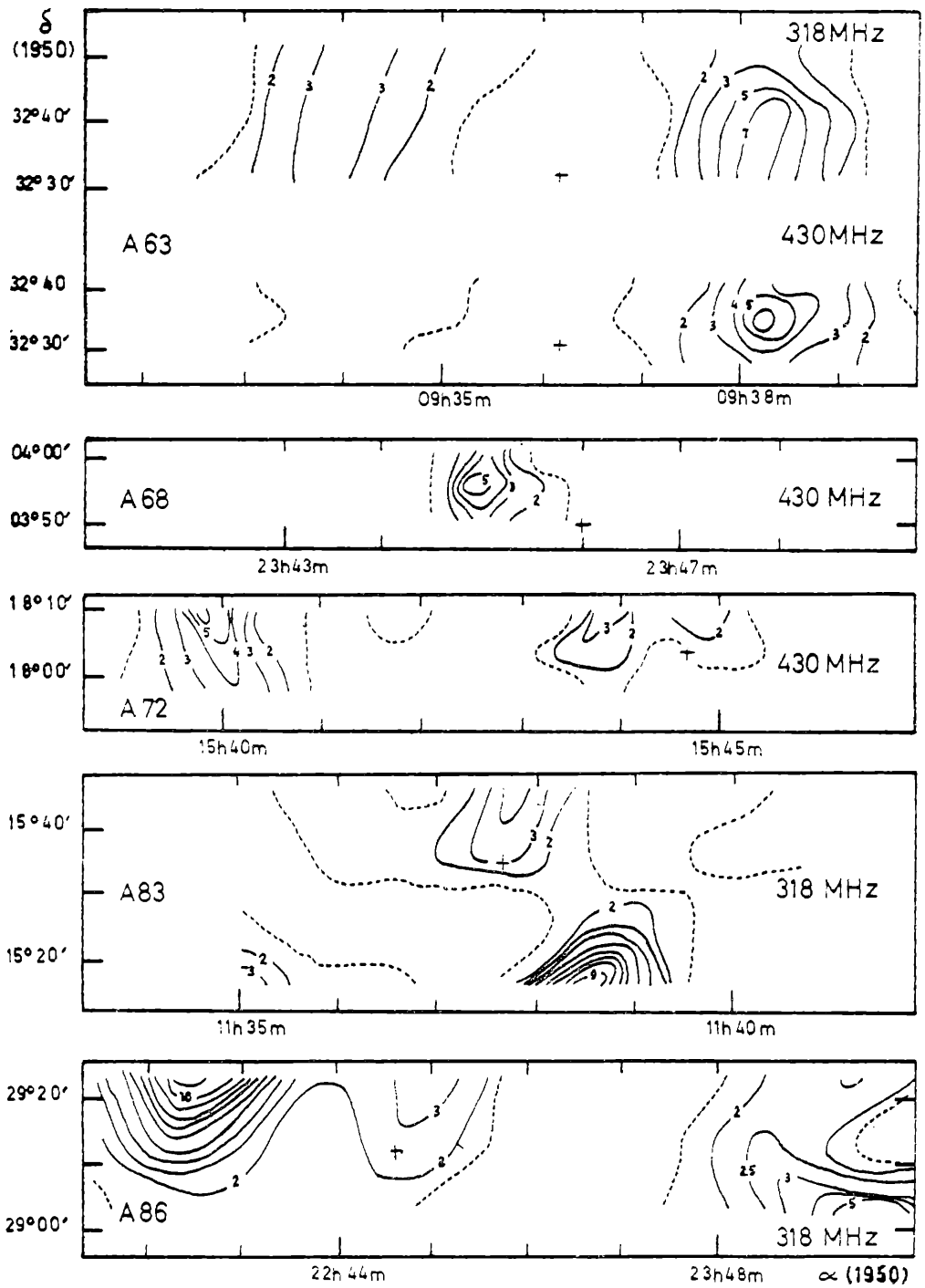
δ (1950)
318MHz
32°40′
32°30′
A 63
430MHz
32°40
32°30′
09h35m
09h38m
04°00′
03°50′
A 68
430 MHz
23h43m
23h47m
18°10′
18°00′
430 MHz
A 72
15h40m
15h45m
15°40′
A83
318 MHz
15°20′
11h35m
11h40m
29°20′
29°00′
A 86
318 MHz
22h44m
23h48m
α (1950)

Figura 2 b

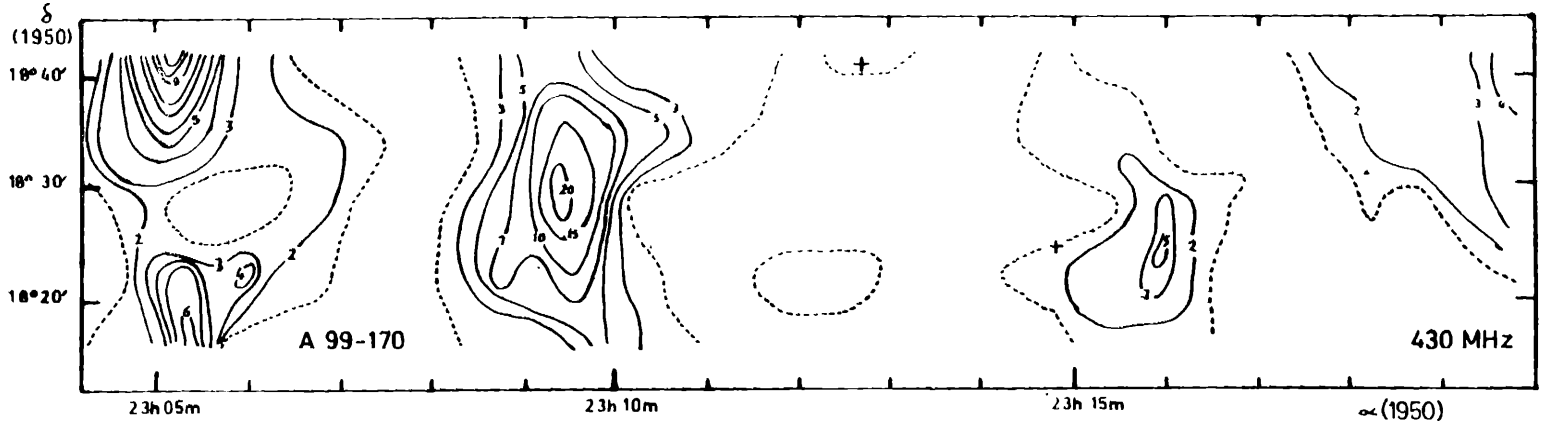
δ
(1950)
18° 40′
18° 30′
18° 20′
A 99-170
430 MHz
23h 05m
23h 10m
23h 15m
α (1950)

Figura 2 c

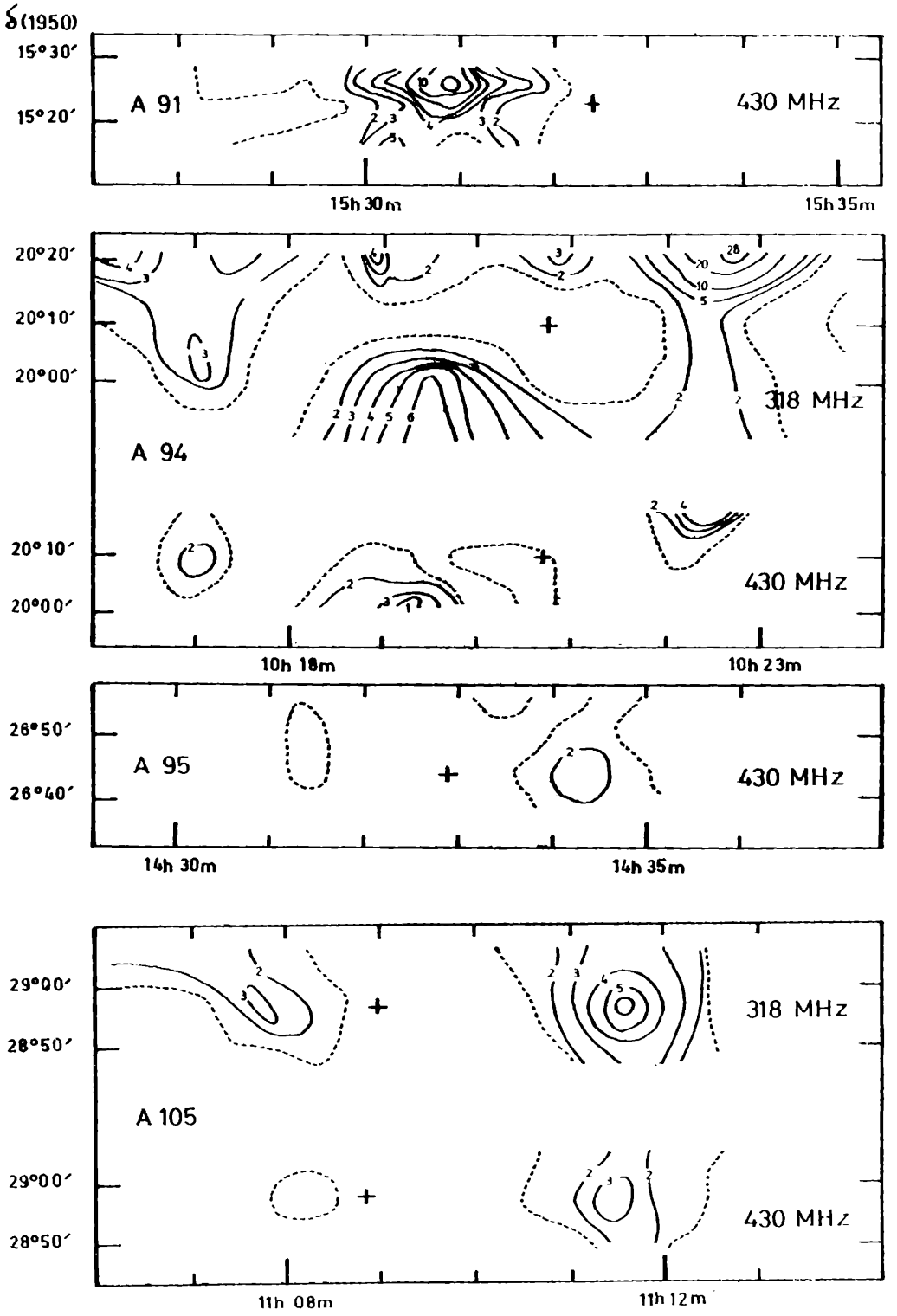
δ(1950)
15°30′
15°20′
A 91
430 MHz
15h 30m
15h 35m
20°20′
20°10′
20°00′
318 MHz
A 94
20° 10′
20°00′
430 MHz
10h 18m
10h 23m
26°50′
26°40′
A 95
430 MHz
14h 30m
14h 35m
29°00′
28°50′
318 MHz
A 105
29°00′
28°50′
430 MHz
11h 08m
11h 12m

Figura 2 d

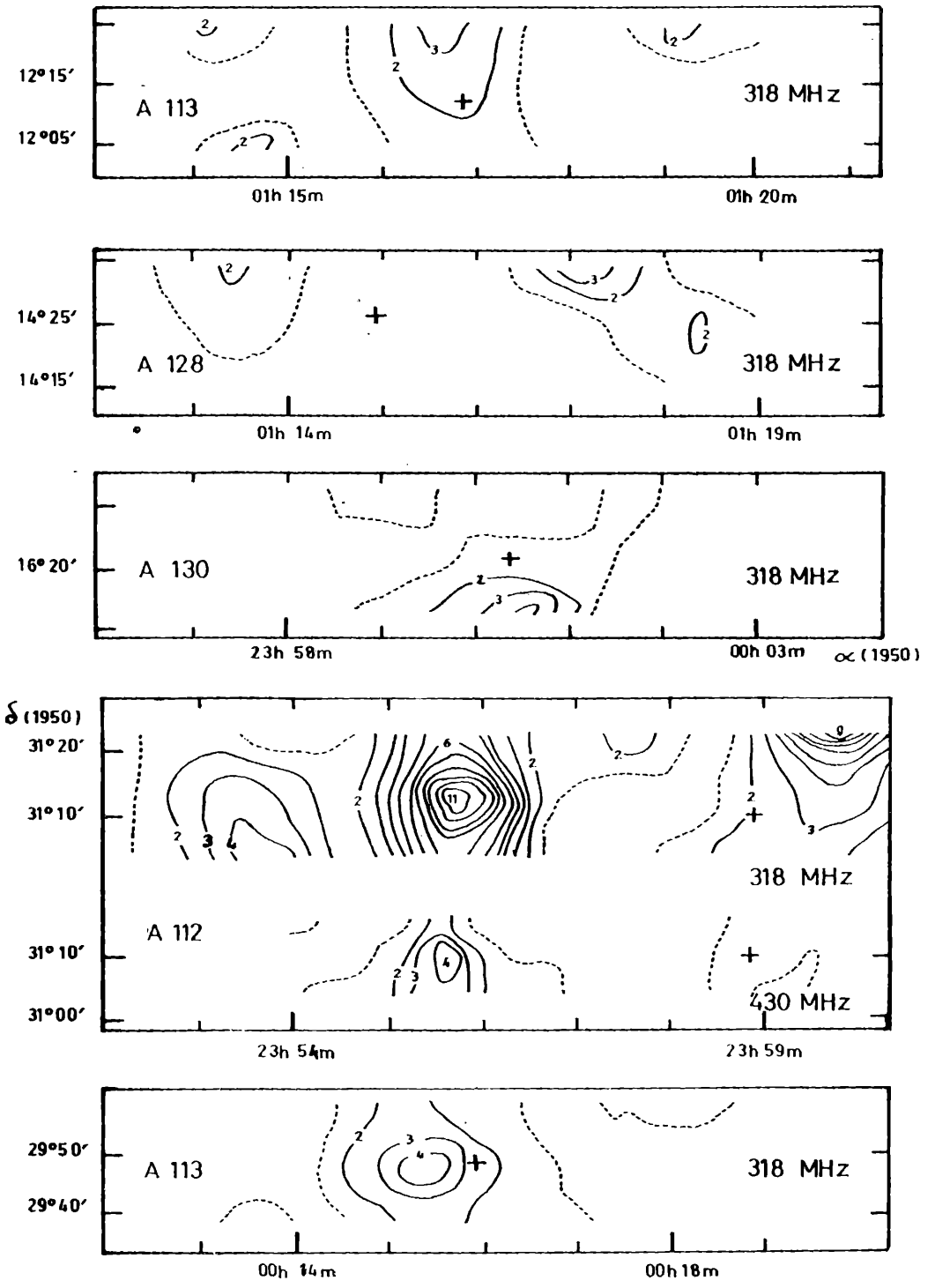
12°15′
12°05′
A 113
318 MHz
01h 15m
01h 20m
14°25′
14°15′
A 128
318 MHz
01h 14m
01h 19m
16°20′
A 130
318 MHz
23h 58m
00h 03m
α (1950)
δ (1950)
31°20′
31°10′
A 112
318 MHz
31°10′
31°00′
430 MHz
23h 54m
23h 59m
29°50′
29°40′
A 113
318 MHz
00h 14m
00h 18m

Figura 2 e

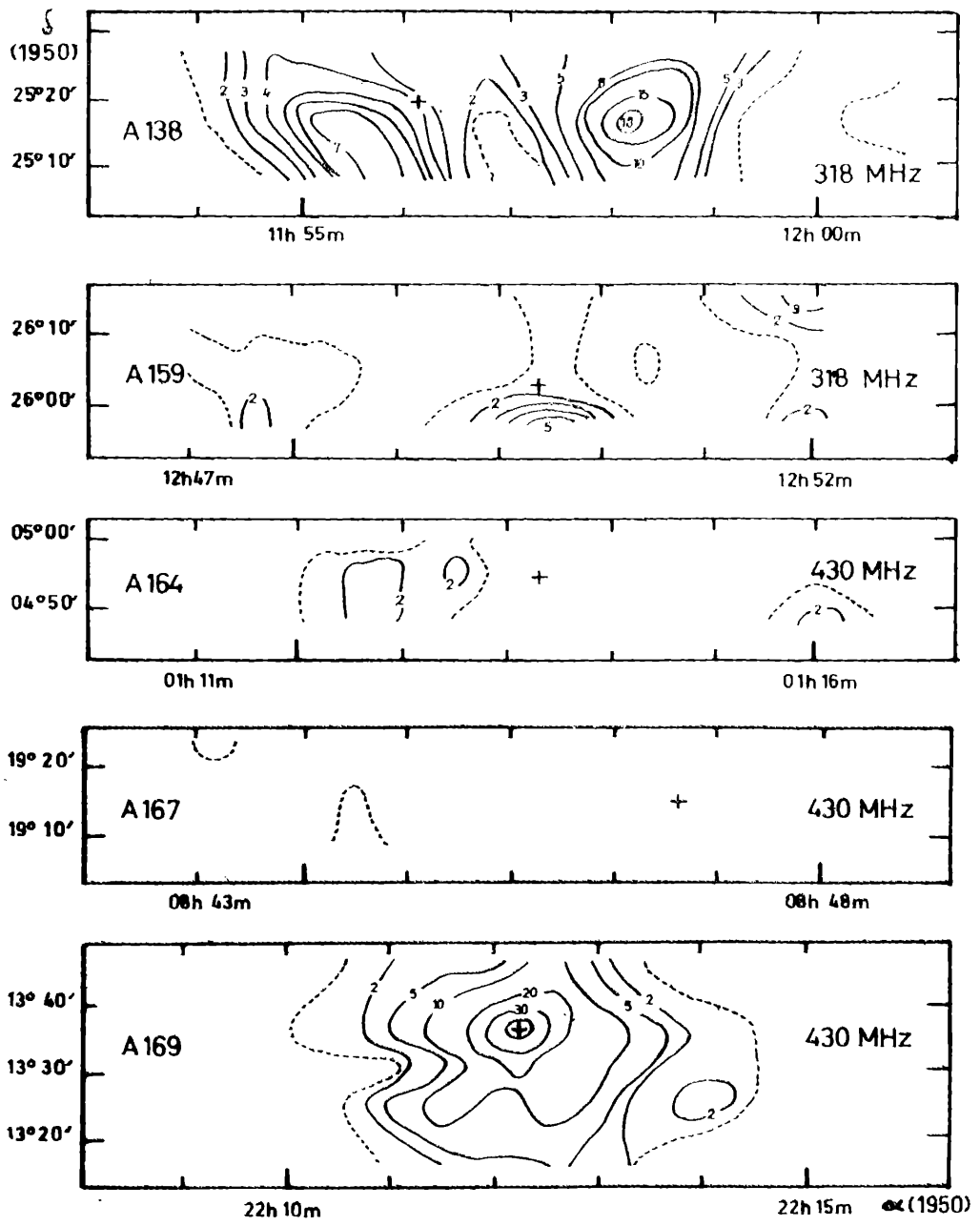
(1950)
25°20′
25°10′
A 138
318 MHz
11h 55m
12h 00m
26°10′
26°00′
A 159
318 MHz
12h47m
12h 52m
05°00′
04°50′
A 164
430 MHz
01h 11m
01h 16m
19° 20′
19° 10′
A 167
430 MHz
08h 43m
08h 48m
13° 40′
13° 30′
13°20′
A 169
430 MHz
22h 10m
22h 15m
α (1950)

Figura 2 f

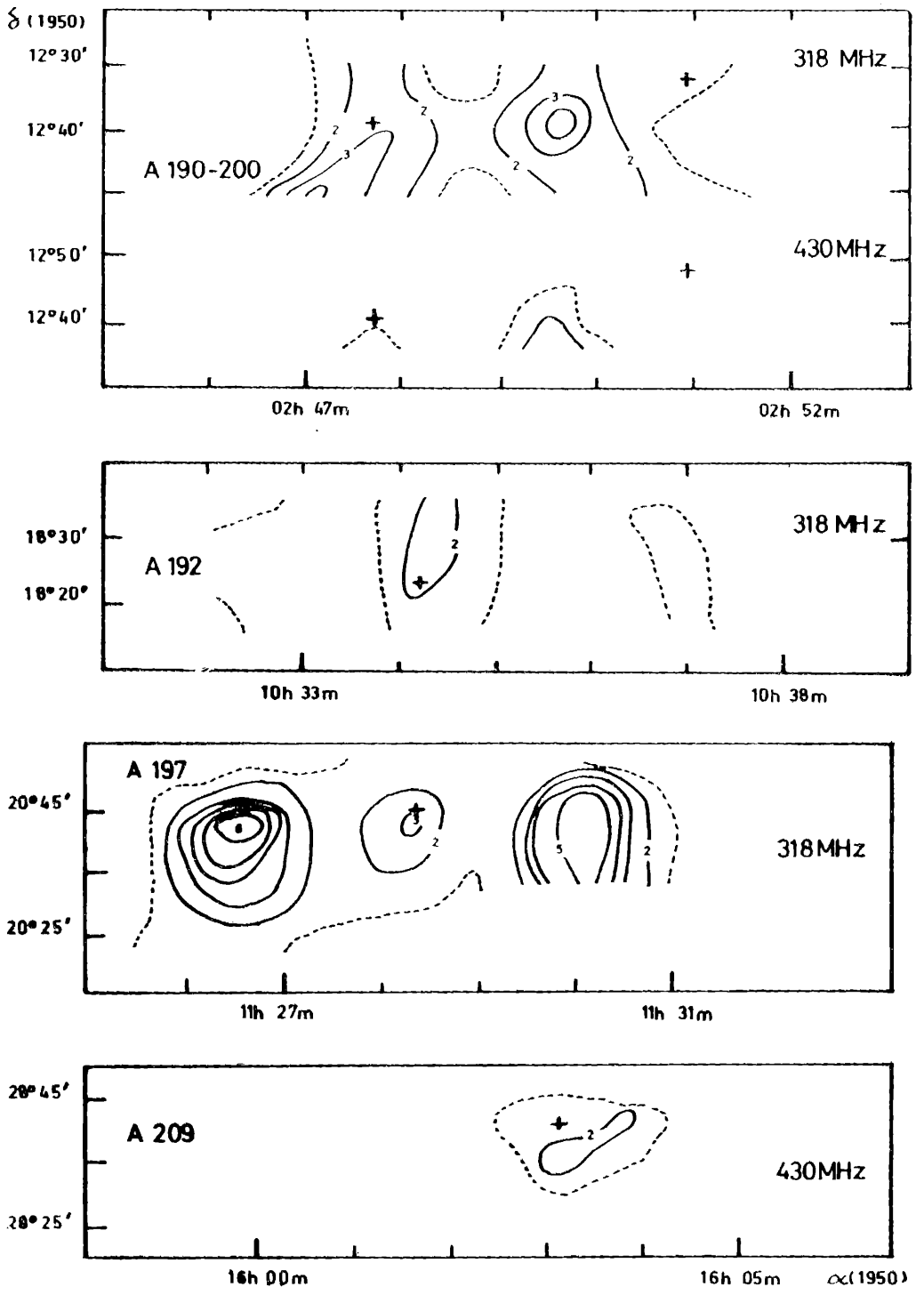
δ (1950)
12°30'
12°40'
12°50'
12°40'
318 MHz
A 190-200
430MHz
02h 47m
02h 52m
18°30'
18°20'
A 192
318 MHz
10h 33m
10h 38m
A 197
20°45'
20°25'
318MHz
11h 27m
11h 31m
28°45'
28°25'
A 209
430MHz
16h 00m
16h 05m
α(1950)

Figura 2 g

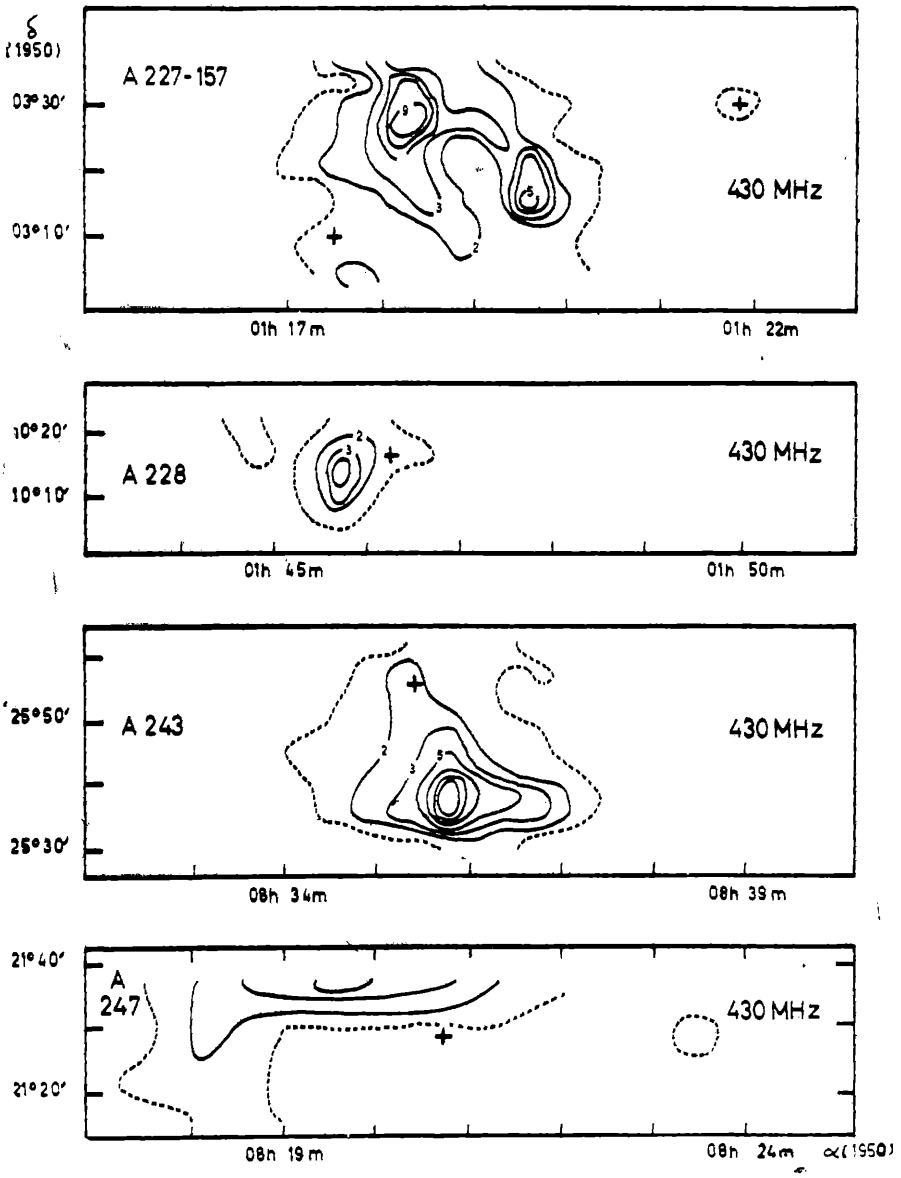
δ (1950)
A 227-157
03°30'
03°10'
430 MHz
01h 17m
01h 22m
10°20'
A 228
10°10'
430 MHz
01h 45m
01h 50m
25°50'
A 243
25°30'
430 MHz
08h 34m
08h 39m
21°40'
A 247
21°20'
430 MHz
08h 19m
08h 24m
α (1950)

Figura 2 h

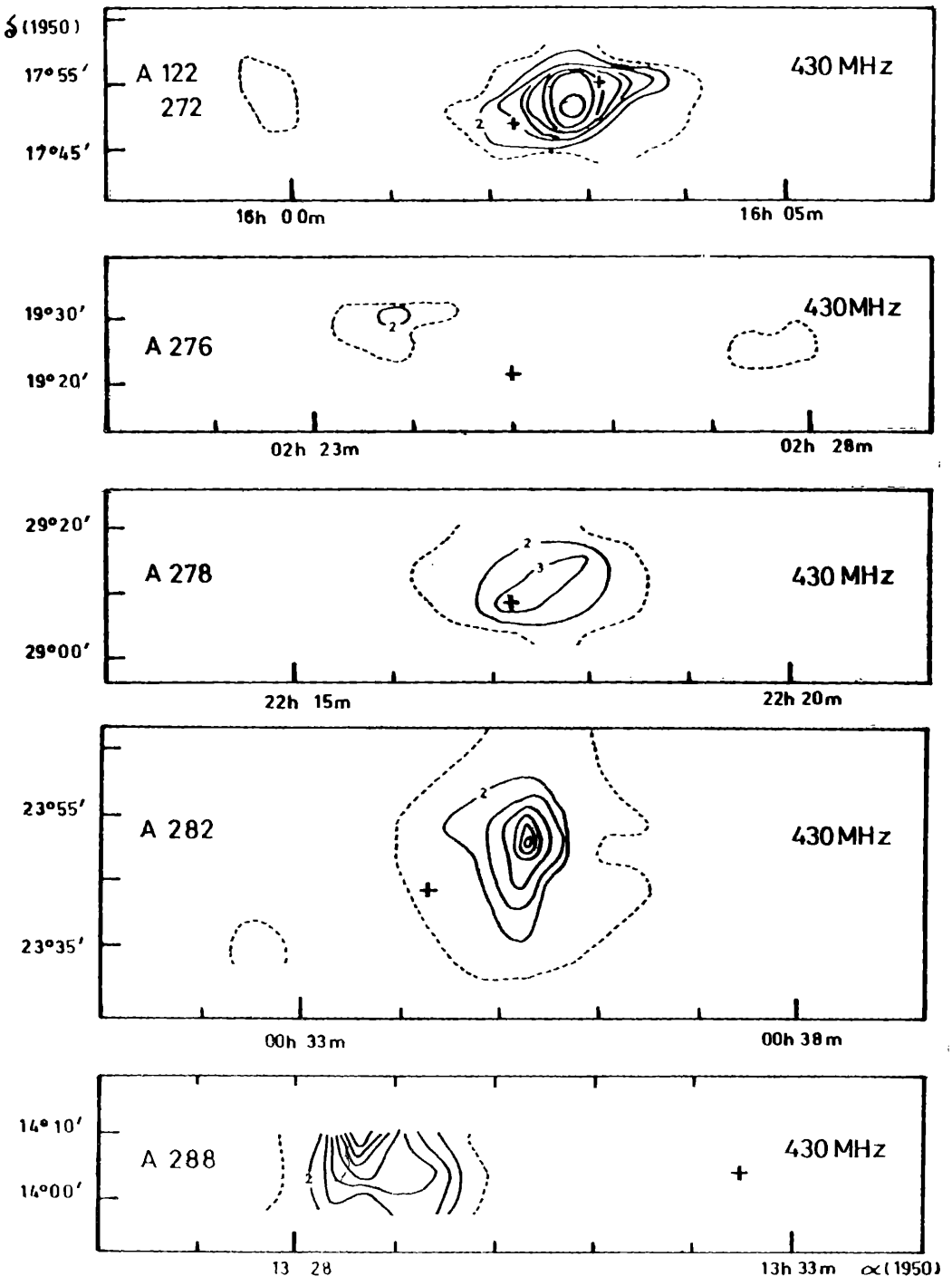
δ (1950)
17°55′
17°45′
A 122
272
430 MHz
16h 00m
16h 05m
19°30′
19°20′
A 276
430MHz
02h 23m
02h 28m
29°20′
29°00′
A 278
430 MHz
22h 15m
22h 20m
23°55′
23°35′
A 282
430MHz
00h 33m
00h 38m
14° 10′
14°00′
A 288
430 MHz
13 28
13h 33m
α (1950)

Figura 2 i

TABLE I

Arp Number	Radiosource R.A (1950.0) h	m	s	Position Dec. o	′	Flux 318	430	Other identifications	Notes
A 5	11	22	24	03	24.0		(.60)		
	11	24	10	03	29.6		.56		
A 12	08	32	16	28	38.0	.76	.82		
A 13									3C-454.3 very near
A 28									no source in region observed
A 42									id. A 28
A 49	14	28	30	08	36.8	1.28	1.16	OQ+048,4C+08.42	
	14	29	54	08	16.8	.51	.24		overlapping at
	14	30	42	08	10.8	.51	.44		318 Mhz
	14	31	36	08	35.0	(.62)			Not observed at 430 Mhz
A 56									id. A 28
A 63	09	34	00	32	40.0	(.5)	(.4)	B2 0934+32B(?)	Extended source
	09	38	19	32	34.9	1.1		4C+32.31,OK+363	
							1.4	B2 0938+32A,	
A 68	23	45	04	03	56.0		1.2	4C+04.82	
A 72	15	40	00	18	09.4		1.4	4C+18.43,H 1540+18 OR+167	
	15	44	00	18	10			4C+18.44	
A 82									Extended source 4^m W of A 82
A 83	11	37	40	15	41	(.56)	.67		
	11	38	22	15	16.7	1.35		4C+15.37	
A 86	23	42	30	29	23	1.7		B2 2342+29 4C+29.20	Observations at 430 Mhz
	23	45		29	23	(.5)		B2 2344+29 B	at 2 declinat.
	23	49	40	29	03.3	(.85)		B2 2349+29	confirm results of 318 Mhz
A 87									3C-263.1 29′ North of A 87
A 89									id. A 28
A 91	15	30	52	15	25		2.76	4CP 15.49,OR+151 4C+15.49	
A 94	10	17	06	20	09	.43	.64		
	10	19	21	20	01	.90	.89	4C+19.33,OL 233 H 1019+19	
	10	22	40	20	20	4.1		3C 242,NRAO 354	
A 95	14	34	21	26	45	.59	.60	OQ+256 (?)	
	14	31	17	26	53	.49	.29		
A 99,170	23	09	30	18	31		5.4	3C 457,4C+18.70	
	23	16	00	18	25		1.1	VRO 18.23.04, OZ+127, H 2316+18	
A 105	11	08	00	28	57	.45	.29		
	11	11	28	28	57	.88	.76		
A 112	23	53	38	31	03.3	.7		B2 2353+31A, 4C+31.67	
	23	55	44	31	12.0	1.7	1.0		
	23	59	51	31	23.3	1.3			
A 113	00	15	18	29	48	.6	.4		
A 117	14	07	50	17	47.1		5.0	PKS 1407+17.OQ+112 4C+17.57, VRO 17.14.01	

Arp Number	Radiosource R.A (1950.0) h	m	s	Position Dec. o	′	Flux 318	430	Other identifications	Notes
A 119									Several sources with maxima outside observed región
A 128									id. A 119
A 130	00	00	35	16	13.3	(.6)			
A 134									Virgo A 5° to the N.
A 138	11	55	40	25	11.7	1.1			Scintillate (see
	11	58	10	25	16.7	2.8		OM+297,4C+25.37 PKS 1158+25.2	Fig. 1)
A 159	12	49	36	25	58.3	(.7)	(.3)	ON+282	
A 162	10	47	06	28	07.4		(.5)	OL+278	
A 163									id. A 28
A 164	01	11	45	04	55.6		.6	OC+020	
	01	12	33	04	55.6		.4		
	01	15	57	04	44.7		(.4)		
A 167									See map
A 169	22	12	13	13	36		8.1	3C 442,PKS2212+13 NRA0681 OA+576.....	
A 171	14	34	18	03	40.6		6.7	PKS 1434+03; 4C+03.30	
A 190 y	02	47	06	13	30.1	(.6)	(.2)	CD+178	
200	02	49	36	12	40.1	.6	.3		
A 192	10	34	25	18	36.2	.4		OL+157	
	10	37	01	18	21.2	.2			
A 197	11	26	33	20	41.6	.96	.48		
	11	28	21	20	41.6	.47	.26		
	11	30	09	20	41.6	.85	.48	VR+020.11.02	
A 203	11	27	40	28	45.9		(.5)	OM+248 (?)	
A 209	16	03	12	20	39.9		.58	H 1603+20	
A 212									id. A 28
A 216	23	26	11	03	15.4		.17	OZ+043 (?)	
A 220	15	32	44	23	39		.34	OR+253 (?)	
A 227 y	01	17	42	03	04		(.8)		
157	01	18	21	03	28		3.5	4C+03.02, PKS 1118+03 NRAO 68, OC+031	
	01	19	36	03	15		1.8	3C 039, PKS 1109+03 NRAO 69, OC+032.9	
	01	21	48	03	30		.4		
A 228	01	45	50	10	12.6		1.0	OC+176	
A 235									id. A 28
A 242									id. A 28
A 243	08	35	31	25	56		.6		
	08	35	55	25	38.1		2.4	OJ+260, PKS 0835+15 4C 25.22	
A 247	08	19	36	21	36		1.4		In map appears as
	08	23	24	21	28		.3		extended
	08	14	28	21	50	(.7)		OJ+224 (?)	
	08	18	12	21	16	(.8)		VR 021.08.02,OJ+230	
	08	18	50	21	44	(.6)			
	08	20	57	21	16	(.3)		OJ+237 (?)	
A 263									id. A 28
A 272	15	59	47	17	52		.27		

Arp Number		Radiosource R.A h	m	s	Position (1950.0) o	′	Flux Dec. 318	430	Other identifications	Notes
		16	02	53	17	50.3		1.8	OJ+106,4C 17.66 VRO 17.16.01	
A	276	02	23	48	19	31.1		.42		
		02	27	30	19	25.1		.13		
A	278	22	17	22	29	08.6		.87	B2 2217+19	
A	282	00	32	39	23	34		(.2)		
		00	35	21	23	52.6		1.7	CTD 5	
A	286	14	19	14	04	11		.51		
A	288	13	28	48	14	09.5		1.9	4C+14.48,OP+148	
A	290	02	01	38	14	45.8		1.4		
		02	02	38	14	54.4		1.6	PKS 0202+14,DAO67, NRAO 91	seen only in declination scan
		02	02	38	15	07.6		.9	4C+15.05	
A	294									id. A 28
A	303									id. A 28
A	305									id. A 28
A	307	09	26	00	11	46.2		2.0	4C 11.32	
A	316	10	19	09	22	14.0		6.3	OL+226,NRAO 352,DAO286 PKS 1019+22,3C 241	
		10	08	09	22	48.6		.91	4C 22.27, OL+214	
A	327	05	15	04	06	44		.60		
		05	15	20	06	25		.62	4C+06.22,OG+025	
A	331	01	04	44	32	09		9.2	NRAO 53, B2 010+32 3C 31, 4C+32.35,DAO35	
A	333	02	35	32	10	45.3		.8	4C+10.07	
		02	39	42	10	45.3		(1.0)	OD+166,4CP 10.08	
		02	42	25	10	32.4		.8	4C+10.08	
A	335	10	57	25	05	02		2.3	4C+0 5.47	

Observaciones en la línea de 21 cm. del hidrógeno neutro en la región del polo sur celeste ($\delta \leqslant -85°$)

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Abstract: Data from the observation of the 21-cm neutral hydrogen line are presented for the region $297° \leqslant l \leqslant 309$, $-22° \leqslant b \leqslant -32°$, and $-90 \leqslant v \leqslant 90$ Km/s. Shown are 143 profiles of the zone and isophotes at constant l, constant b, and constant velocity from —36 to + 12 Km/s, every 4 Km/s.

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** Becarios de la Comisión de Investigaciones Científicas de la Provincia de Buenos Aires.

En este trabajo se presentan los resultados observacionales en la línea de 21 cm del hidrógeno neutro, de la región comprendida entre $297° \leqslant l \leqslant 309°$, $-22° \leqslant b \leqslant -32°$, y en el rango de velocidades $-90 \leqslant v \leqslant 90$ Km/s.

Esta región galáctica corresponde a la zona del polo sur celeste, aproximadamente al sur de $-85°$. Estudios anteriores de Bajaja, Colomb (1973), con una más baja resolución angular indicaron la presencia de hidrógeno neutro a velocidades intermedias. En algunas regiones cercanas a las del presente estudio, las concentraciones de hidrógeno se presentan alineadas al campo magnético galáctico (Bajaja et al, 1973). Dado este peculiar comportamiento del gas se decidió realizar un estudio más detallado de la región.