

# RADIOASTRONOMIA

## 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  $3^\circ \leq \delta \leq 35^\circ$ . 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 lower 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 identified with those observed by us. The fifth column contains some comments on the radio sources detected.

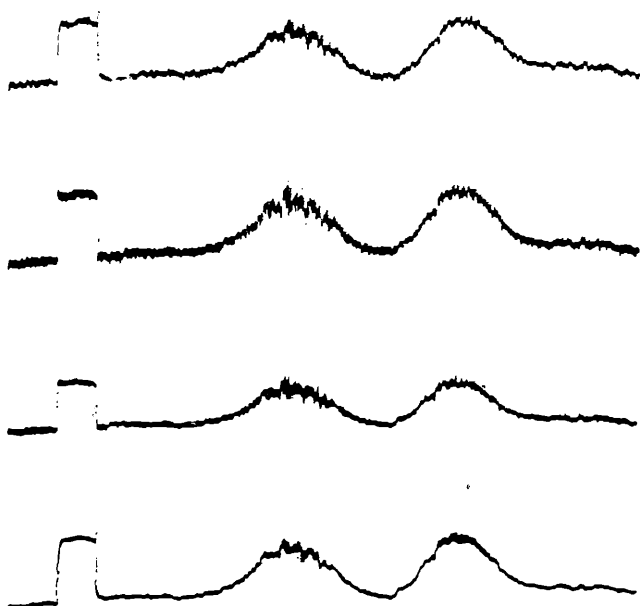


Figura 1

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

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

According to von Horner (1961), the number  $N(S, \lambda)$  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,

$\lambda$  = wavelength in centimeters,

$n$  = slope of the log  $N$ -log  $S$  relation

if we take:

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

we get:

$$\text{at } 318 \text{ Mhz and } S \geq 0.15 \text{ f.u. (1}^\circ\text{K)} ;$$

$$N = 10 \text{ sources/sq. deg.}$$

$$\text{at } 430 \text{ Mhz and } S \geq 0.22 \text{ f.u. (1}^\circ\text{K)} ;$$

$$N = 3.7 \text{ sources/sq. deg.}$$

From the radio maps we obtain a count of 5 sources/sq. deg. at 318 Mhz 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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 Lalonde, L. M. and Harris, D. E. 1970. I.E.E.E. Trans. Antennas and Propagation, AP-18, 41.

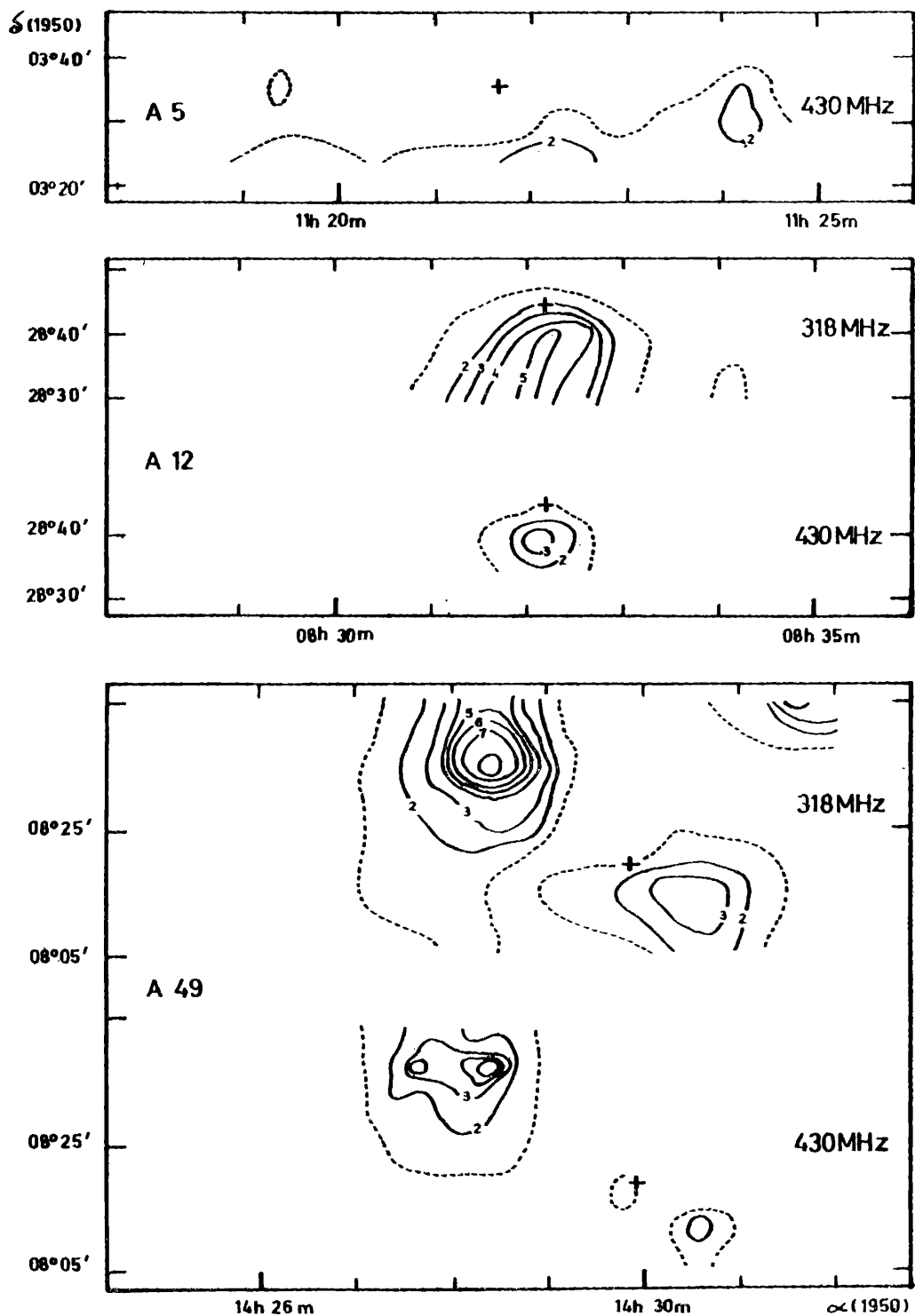


Figura 2 a

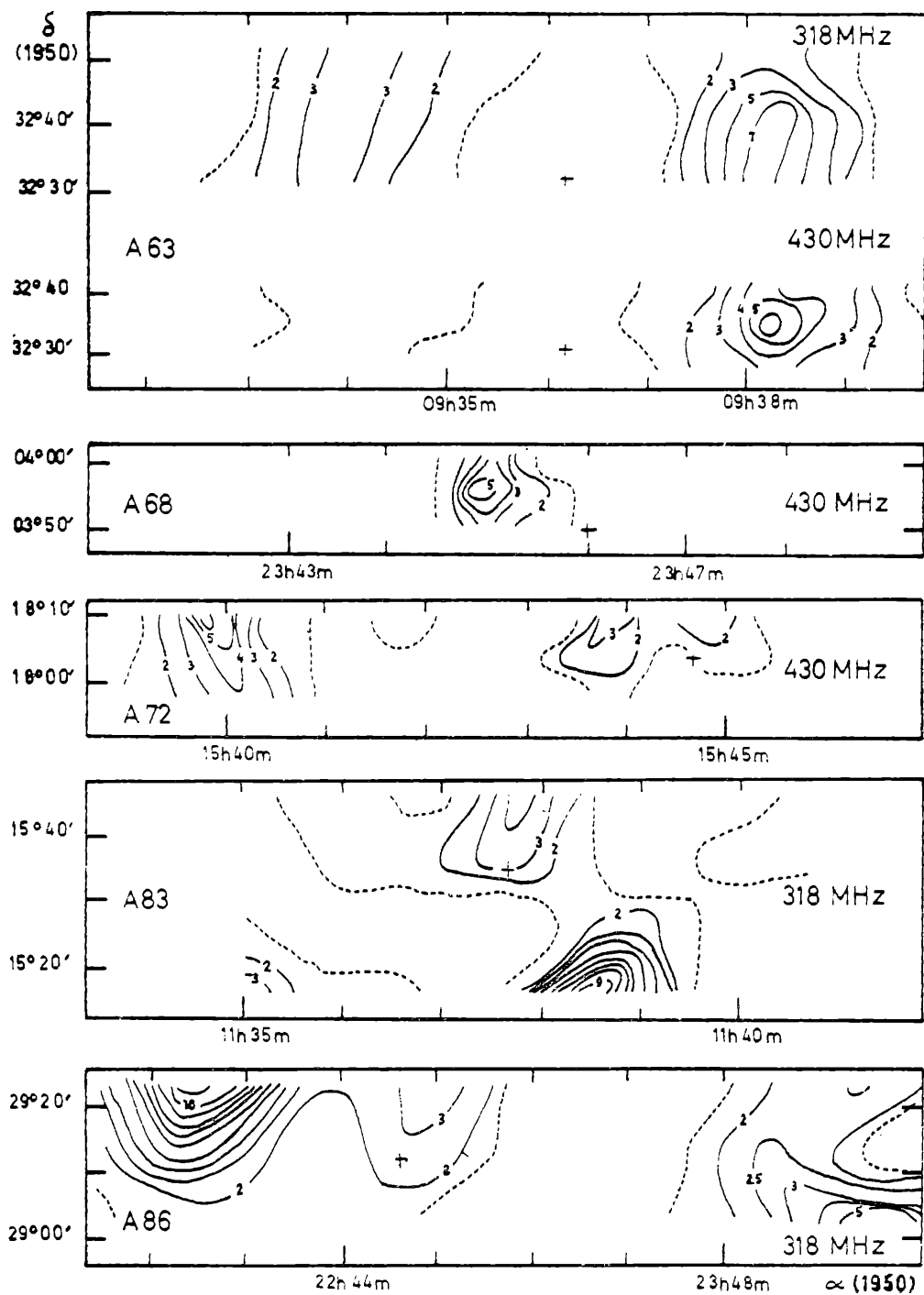


Figura 2 b

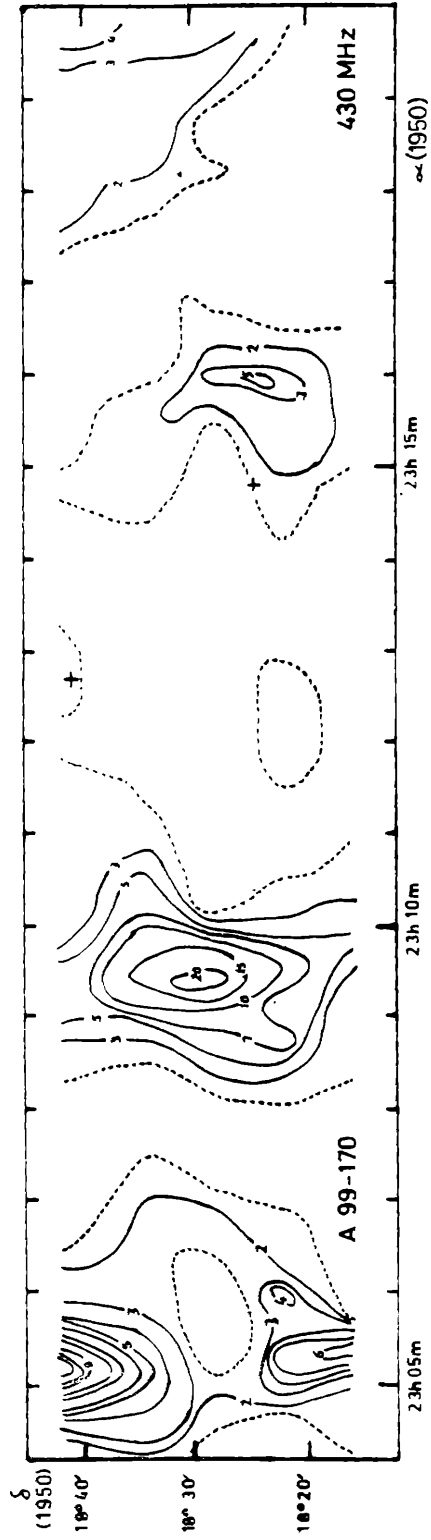


Figura 2 c

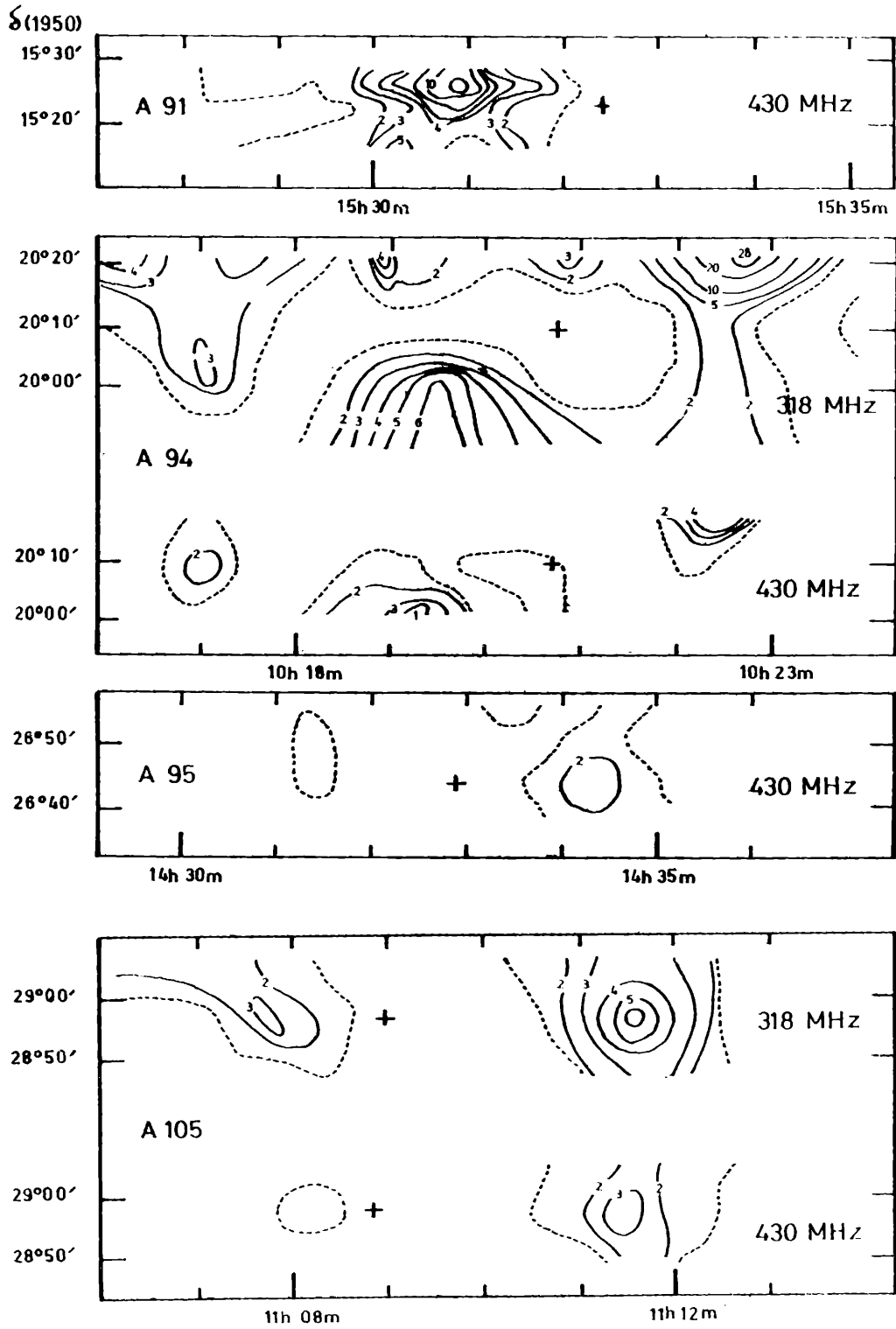


Figura 2 d

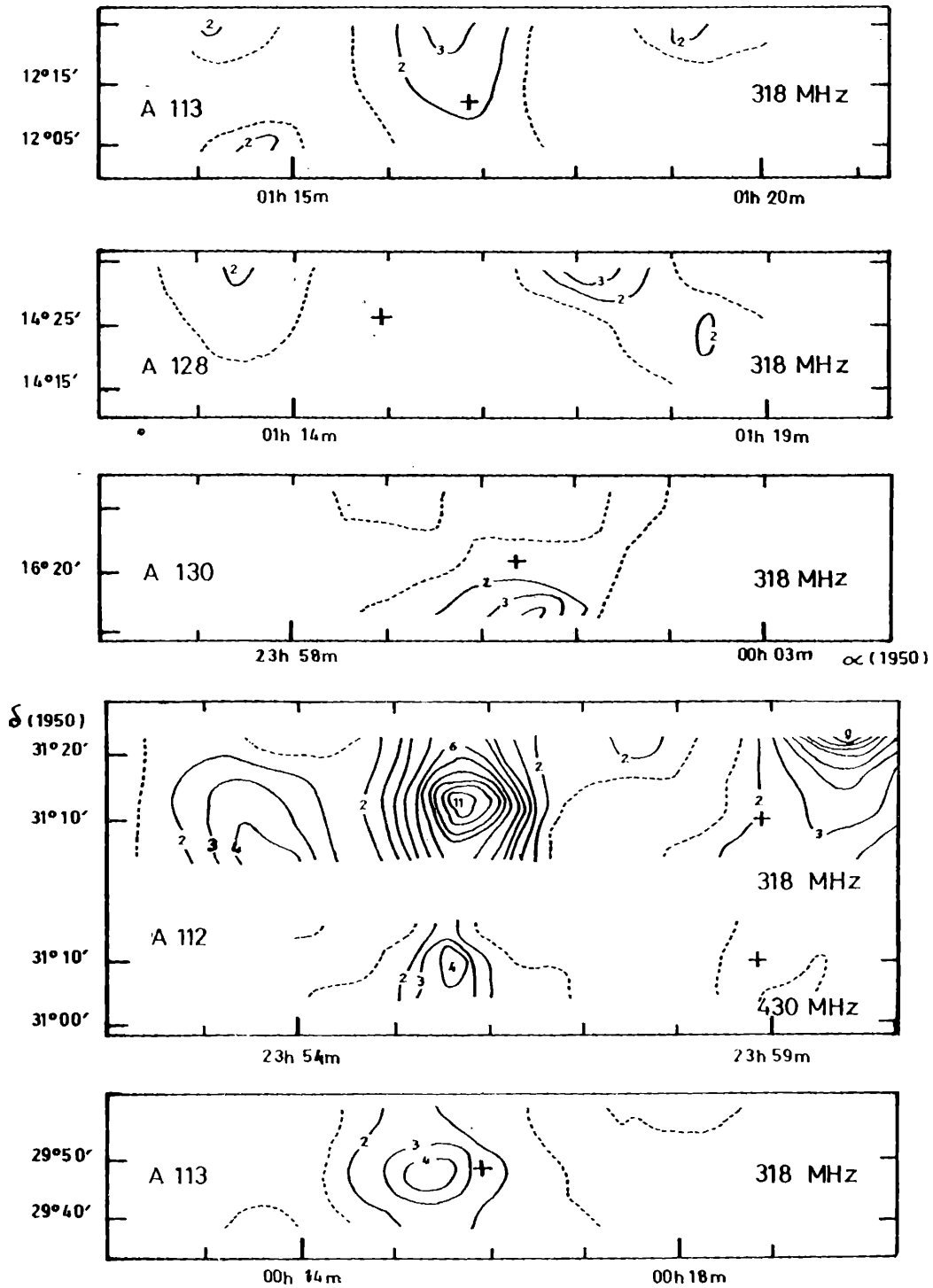


Figura 2 e

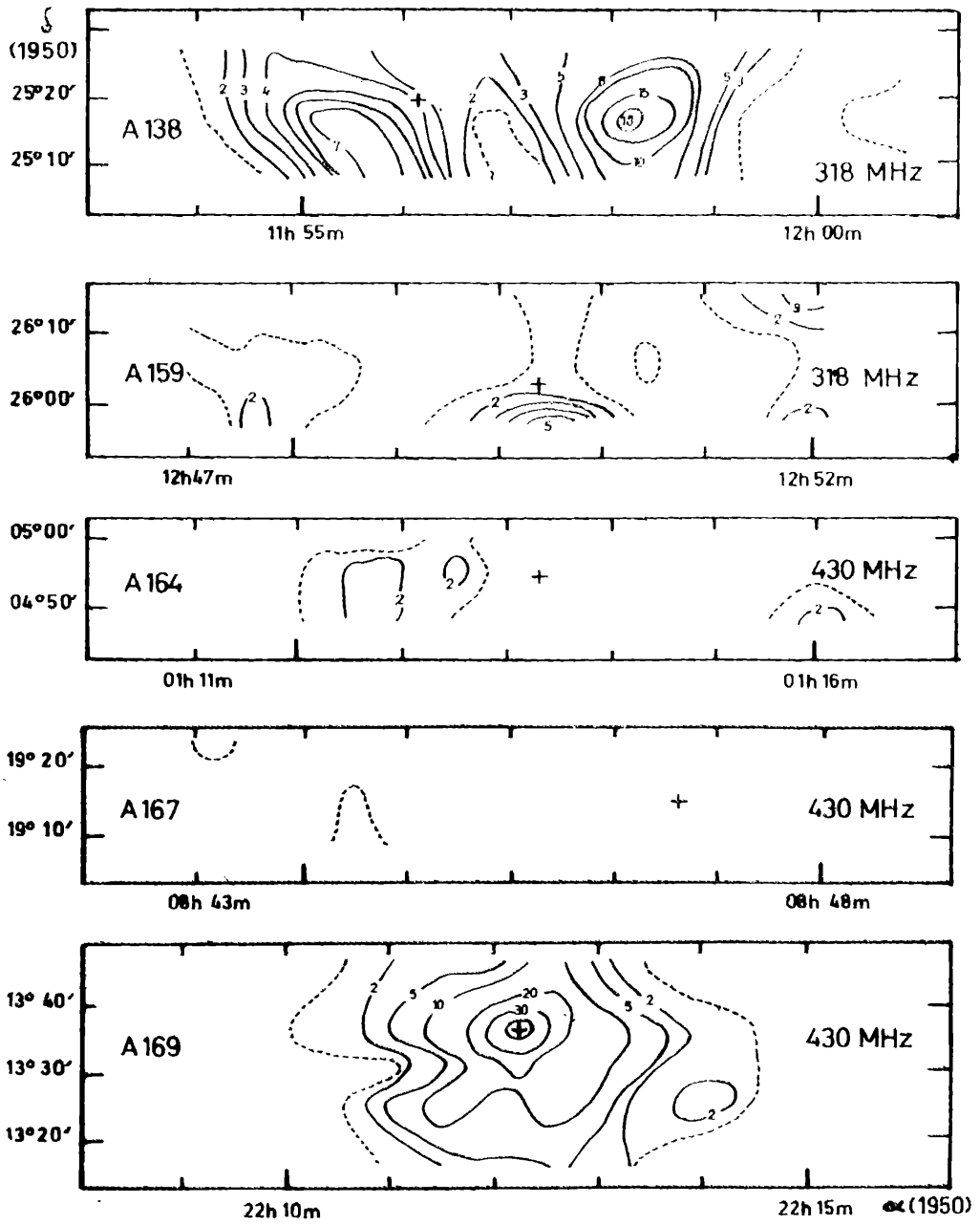


Figura 2 f



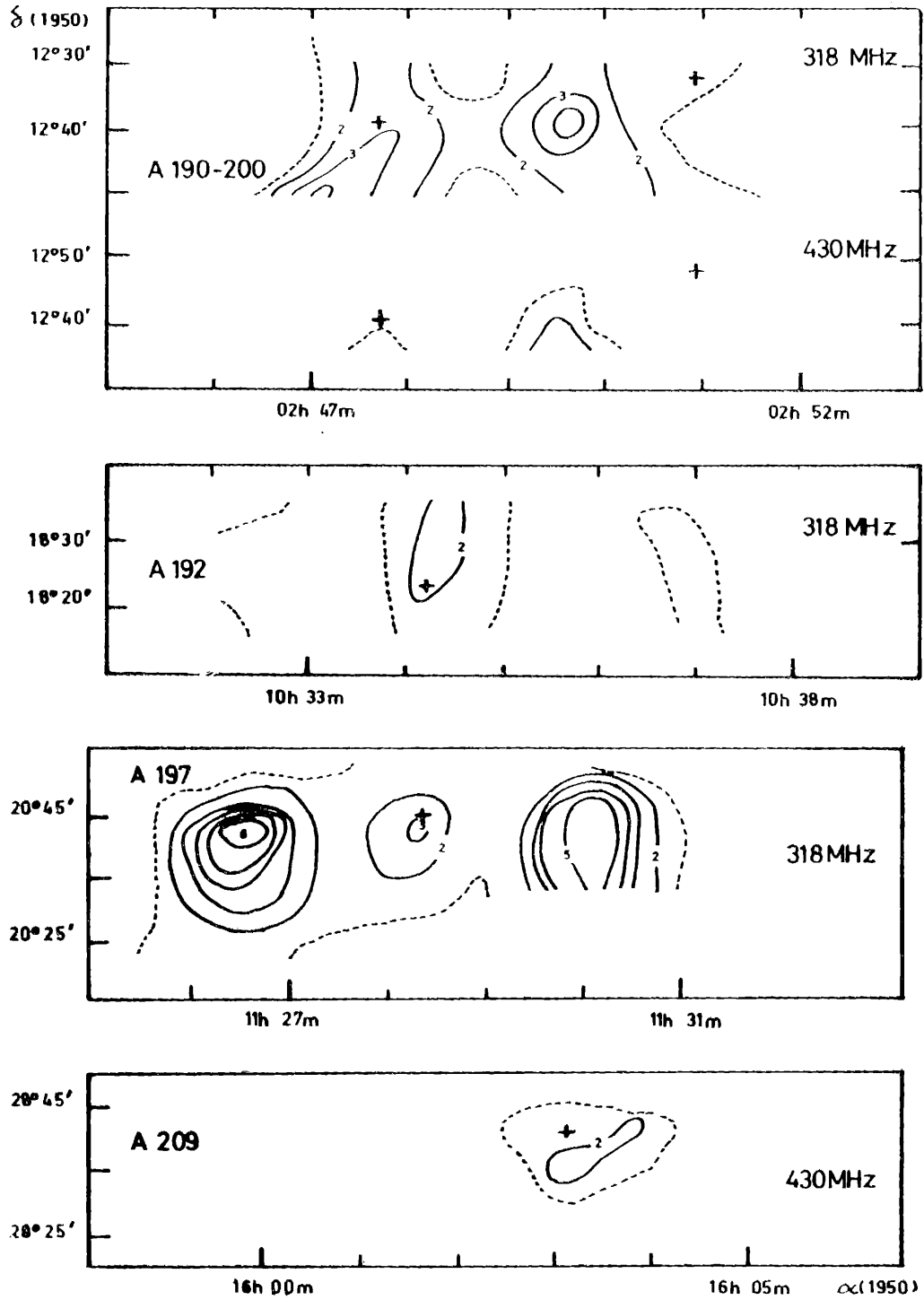


Figura 2 g

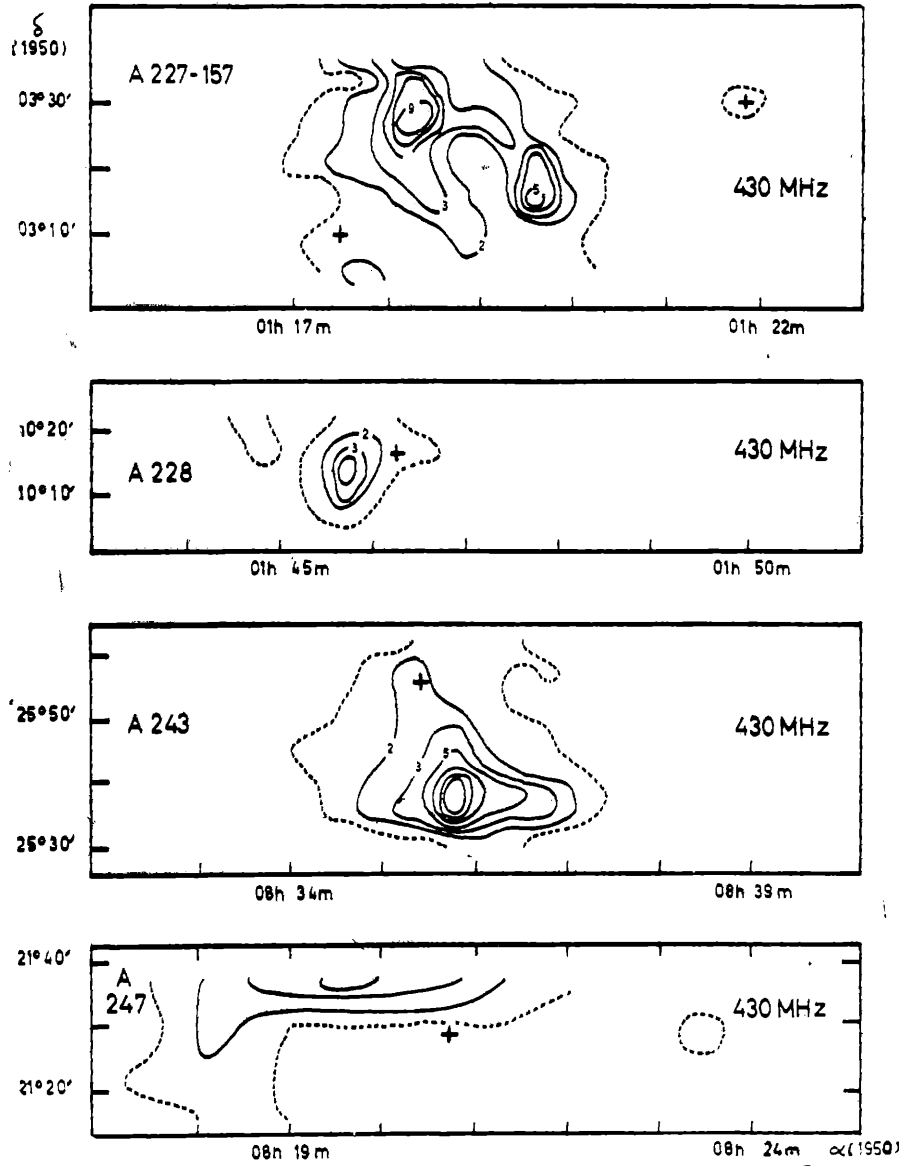


Figura 2 h

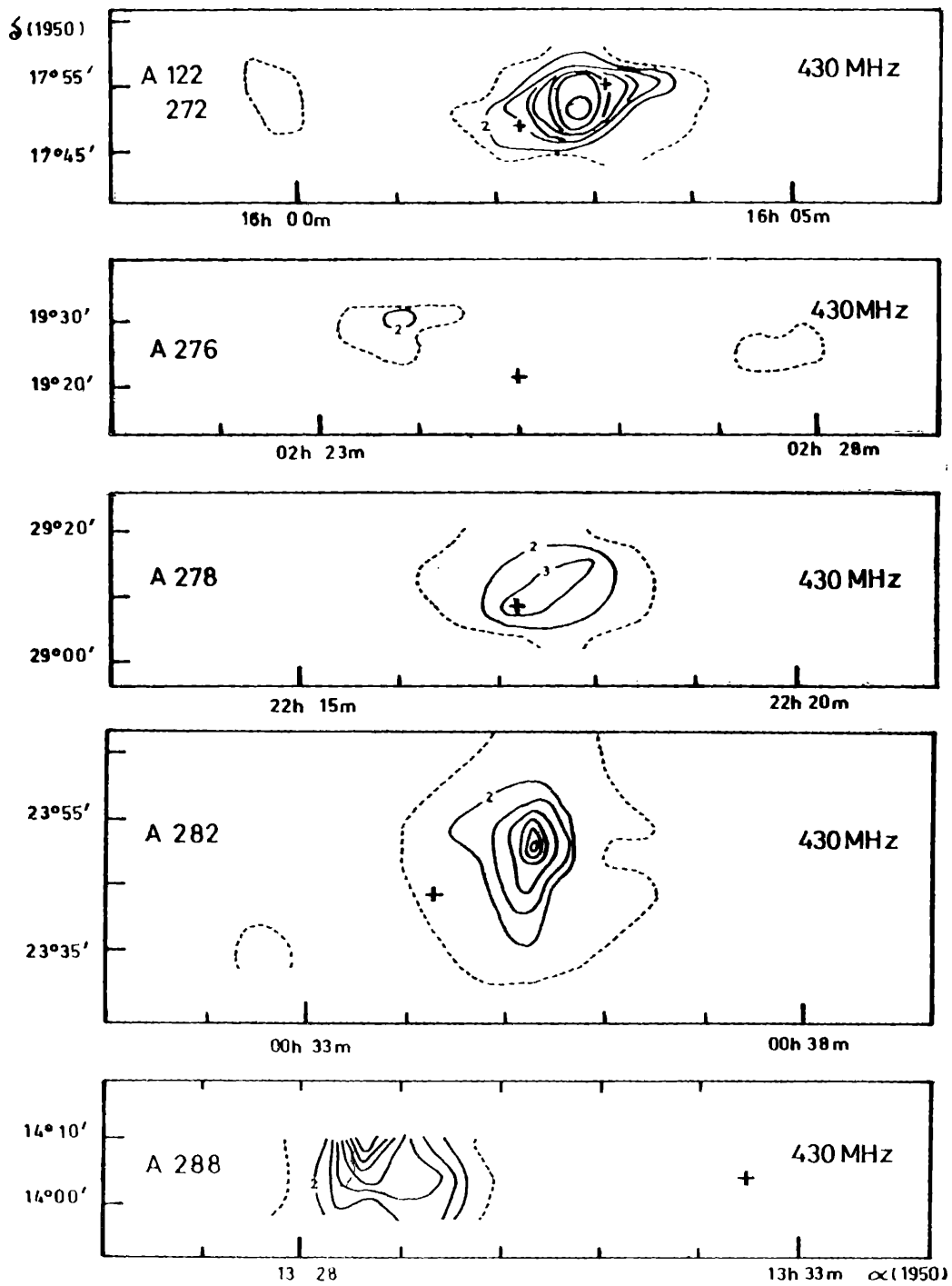


Figura 2 i

TABLE I

Arp Number	Radiosource R.A. (1950.0)			Position Dec.		Flux		Other identifications	Notes
	h	m	s	o	'	318	430		
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 id. A 28
A 42									
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 id. A 28
A 56									
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 <sup>m</sup> 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	Observations at
								4C+29.20	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			Position		Flux		Other identifications	Notes
	R.A. h m s	(1950.0)		Dec. o ' "	318	430			
A 119									Several sources with maxima outside observed región id. A 119
A 128									
A 130	00	00	35	16	13.3	(.6)			
A 134									Virgo A 5° to the N.
A 133	11	55	40	25	11.7	1.1			Scintillate (see Fig. 1)
	11	58	10	25	16.7	2.8		OM+297,4C+25.37 PKS 1158+25.2	
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 166	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	
A 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 200	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)		
A 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 extended
	08	23	24	21	28		.3		
	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			Position (1950.0)		Flux		Other identifications	Notes
	h	m	s	o	'	Dec. 318	430		
	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 ( $\delta \leq -85^\circ$ )**

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*Abstract:* Data from the observation of the 21-cm neutral hydrogen line are presented for the region  $297^\circ \leq l \leq 309^\circ$ ,  $-22^\circ \leq b \leq -32^\circ$ , and  $-90 \leq v \leq 90$  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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En este trabajo se presentan los resultados observacionales en la línea de 21 cm del hidrógeno neutro, de la región comprendida entre  $297^\circ \leq l \leq 309^\circ$ ,  $-22^\circ \leq b \leq -32^\circ$ , y en el rango de velocidades  $-90 \leq v \leq 90$  Km/s.

Esta región galáctica corresponde a la zona del polo sur celeste, aproximadamente al sur de  $-85^\circ$ . 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.