THE RADIO SPECTRUM OF THE ORION NEBULA

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Abstract. The radio spectrum of the Orion A (combined spectrum of both the M42 and M43 sources) is established by using more data than previous authors. The frequency range is also substantially expanded by using recent results. A peculiar feature appearing in the produced radio spectrum is discussed.

1. Introduction

Previously, Pariskii (1961), Baars *et al.* (1965), Terzian *et al.* (1968) and McLeod and Doherty (1968) produced flux density spectra for the Orion nebula. The aim of the present paper is to establish a more complete spectrum of the object by using more data and expanding the frequency range over which the previous spectra were established.

2. The Radio Spectrum

The data compiled for the present work are presented in Table I which consists of five columns:

Column (1) gives the number of the collected observational points.
Column (2) specifies the frequency at which the observation was made.
Column (3) specifies the respective wavelength.
Column (4) gives the integrated flux density of the object and specifies the probable error.
Column (5) indicates the reference.

The flux density values have been corrected from the background flux whenever possible.

For observations not quoting errors a 20% probable error has been assumed.

The resulting flux density spectrum is presented in a logarithmic plot of S_ν vs. ν in Figure 1, where S_ν is the integrated flux density in fu and ν is the frequency in MHz. The respective wavelength scale and the flux density directly expressed in W m^{-2} Hz^{-1} are also marked. The bars indicate the probable error cited in Table I. No line has been drawn between the observational points for reasons of clarity.

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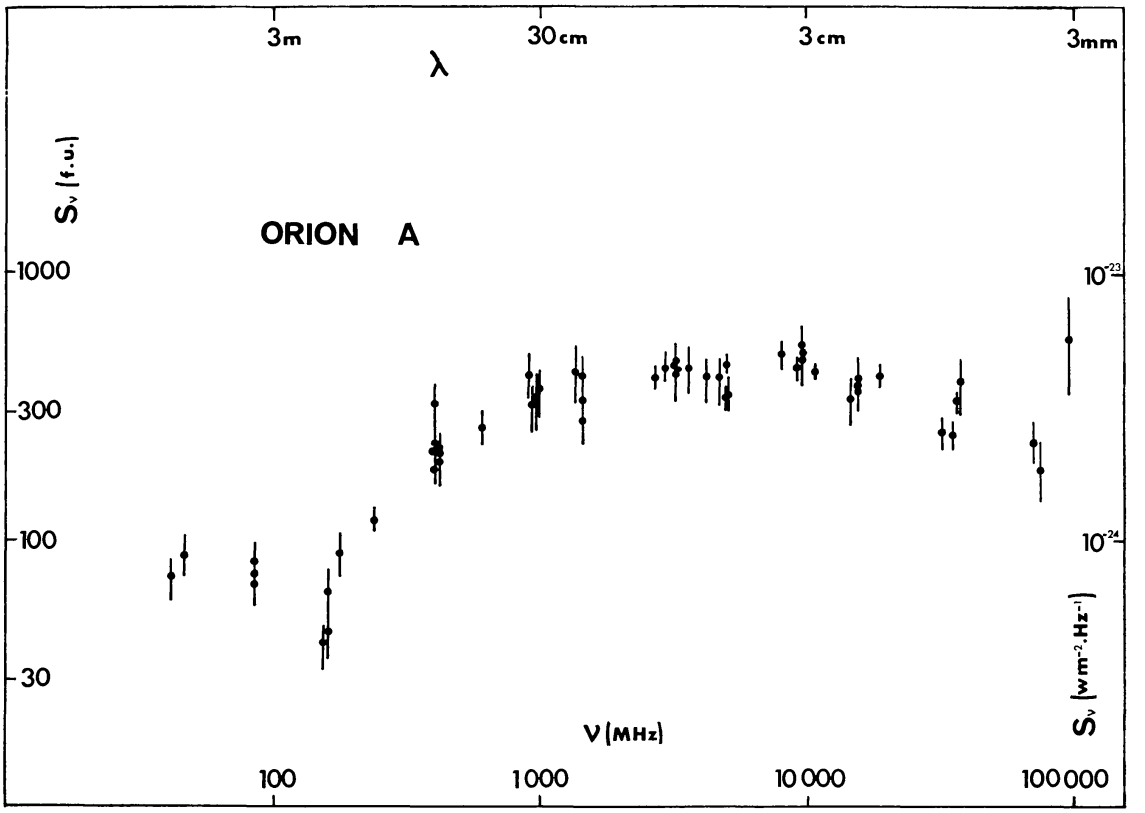

Fig. 1. The radio spectrum of the Orion nebula (M42 and M43).

TABLE I

Orion nebula – Radio spectrum

1 No.	2 Frequency ν (MHz)	3 Wavelength λ (m, cm or mm)	4 Flux density S_ν (fu) (1 fu = 10^{-26} W m^{-2} Hz^{-1})	5 References
1	42.2	7.10 m	73.7 ± 15	Haynes and Hamilton (1968)
2	47.3	6.35 m	89.0 ± 18	Haynes and Hamilton (1968)
3	85.5	3.55 m	69 ± 14	Mills *et al.* (1958)
4	86.0	3.50 m	85.0 ± 17	Risbeth (1958)
5	86.0	3.50 m	74 ± 15	Mills *et al.* (1956)
6	153	1.96 m	41.6 ± 9	Hamilton and Haynes (1967)
7	159	1.90 m	65 ± 13	Risbeth (1958)
8	159	1.90 m	45 ± 9	Edge *et al.* (1959)
9	178	1.80 m	90 + 18	Conway *et al.* (1963)
10	240	1.25 m	120 ± 12	Menon and Terzian (p.c.) (1964)
11	400	75 cm	230 ± 46	Seeger *et al.* (1956)
12	400	75 cm	325 ± 65	Seeger *et al.* (1961)
13	400	75 cm	220 ± 44	Howard *et al.* (1965)
14	405	74 cm	188 ± 9	Menon and Terzian (p.c.) (1965)
15	408	73.5 cm	200 ± 40	Long *et al.* (1963)

Table I (Continued)

1 No.	2 Frequency ν (MHz)	3 Wavelength λ (m, cm or mm)	4 Flux density S_ν (fu) (1 fu = 10^{-26} W m^{-2} Hz^{-1})	5 References
16	408	73.5 cm	213 ± 17	Mills and Shaver (1968)
17	408	73.5 cm	213 ± 43	Parkes Catalogue[a]
18	600	50 cm	268 ± 40	Piddington and Trent (1956)
19	910	33 cm	420 ± 84	Denisse *et al.* (1957)
20	960	31 cm	342 ± 10	Harris and Roberts (1960)
21	960	31 cm	360 ± 72	Wilson and Bolton (1960)
22	960	31 cm	343 ± 68	Conway *et al.* (1963)
23	1370	22 cm	430 ± 86	Westerhout (1958)
24	1410	21.3 cm	289 ± 58	Parkes Catalogue[a]
25	1420	21 cm	420 ± 84	Hagen *et al.* (1954)
26	1420	21 cm	331 ± 50	Hagen *et al.* (1954)
27	2700	11 cm	411 ± 41	Altenhoff *et al.* (1961)
28	2930	10.3 cm	454 ± 55	Sloaneker and Nichols (1960)
29	3130	9.6 cm	412 ± 62	Kuzmin *et al.* (1960)
30	3200	9.4 cm	426 ± 43	Haddock *et al.* (1954)
31	3200	9.4 cm	450 ± 90	Pariskii (1961)
32	3200	9.4 cm	460 ± 12	Medd (p.c.) (1964)
33	3600	8.3 cm	450 ± 90	Pariskii (1961)
34	4170	7.2 cm	410 ± 82	Yokoi *et al.* (1966)
35	4700	6.4 cm	410 ± 82	Golnev *et al.* (1965)
36	5000	6 cm	342 ± 23	Mezger and Henderson (1967)
37	5000	6 cm	470 ± 33	Baars *et al.* (1965)
38	5000	6 cm	344 ± 69	Gardner and Morimoto (1968)
39	8000	3.7 cm	502 ± 60	Menon (1961)
40	9360	3.2 cm	450 ± 30	Lazarevskii *et al.* (1963)
41	9400	3.2 cm	540 ± 108	Kaidanovskii *et al.* (1955)
42	9400	3.2 cm	480 ± 96	Zakharenkov *et al.* (1963)
43	9520	3.15 cm	480 ± 96	Haddock and McCullough (1955)
44	10700	2.8 cm	434 ± 20	McLeod and Doherty (1968)
45	14500	2 cm	343 ± 69	Baars *et al.* (1965)
46	15350	1.95 cm	390 ± 79	Terzian *et al.* (1968)
47	15350	1.95 cm	400 ± 80	Schraml and Mezger (1969)
48	15550	1.94 cm	365 ± 21	Gordon (1969)
49	18750	1.6 cm	420 ± 42	Kuzmin and Salomonovich (1963)
50	31400	9.55 mm	253 ± 37	Johnston and Hobbs (1969)
51	35000	8.5 mm	250 ± 30	Tolbert (1965)
52	36500	8.2 mm	330 ± 30	Sorochenko and Berulis (1970)
53	37000	8.1 mm	500 ± 100	Kuzmin and Salomonovich (1963)
54	69800	4.3 mm	233 ± 40	Hobbs *et al.* (1969)
55	72800	4.1 mm	182 ± 45	Kaifu *et al.* (1973)
56	94000	3.2 mm	585 ± 200	Tolbert (1965)

[a] Parkes Catalogue = Bolton *et al.* (1964); Price and Milne (1965); Day *et al.* (1966).
(p.c.) = private communication cited in Baars *et al.* (1965).

3. Conclusions

The resultant radio spectrum is the combined spectrum of the two radio sources M42 and M43 of the Orion nebula. The gradual transition with decreasing frequency from a shape characterizing an optically thin region to that of an optically thick region confirms the assumption for an inhomogeneous structure of the region (McLeod and Doherty, 1968). A separate spectrum of the M42 source alone, however desirable, is very difficult to be established in view of the proximity of the M43 source and the resolution problems of the various observations (Johnston and Hobbs, 1969).

The most interesting feature of this radio spectrum is an absorption-like feature around the 150 MHz range. Further observations around this frequency range could provide vital information either in establishing this feature as having physical significance or in rejecting it as caused by observational errors.

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