

IRAS Identification of Complete Samples of Cool Carbon Stars: Results for a Region in Carina

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Abstract. Results for a near-infrared objective-prism survey for faint cool carbon stars in a Carina region centred at $l = 290^\circ$, $b = 0^\circ$ are presented. A total of 37 identified carbon stars in area of about 16 square degrees were found, of which 4 are new discoveries. Accurate positions, IRAS identifications, infrared fluxes and colours, and associations of the stars in the sample are given.

1. Introduction

Interest in the study of the space distribution of Asymptotic Giant Branch (AGB) stars has grown primarily because it is believed they are relevant to our understanding of the late stages of stellar evolution, and the formation and evolution of stellar systems. AGB stars are evolved objects of low effective temperature and high luminosity, which represent a stellar population in an evolutionary stage between main sequence and white dwarf stars. During the AGB phase a star can lose a significant amount of its initial mass, surrounding itself with a circumstellar envelope (CSE) which sometimes may be dense enough as to preclude its observation in visible light (Jura & Kleinmann 1989).

M, C, and S stars together represent the largest fraction of known AGB stars, and they are found mainly in the galactic disk. However, a marked difference exists between galactic distribution of M stars and the cooler C stars, in the sense that the number density ratio C/M is not constant throughout the galactic disk (C/M increase towards the outer regions of the Galaxy), contrary to what is to be expected from an evolutionary relationship between these stars (Blanco 1965, 1989; Fuenmayor 1981).

Usually, low-dispersion surveys made in the near-infrared neglect to identify the late M-type stars, their number being overwhelming on the same plates where C and S stars are found. Therefore, most of the determinations of the space density ratios between M and C stars given in the literature have not been directly determined. In this paper we present the results of a deep search of carbon stars in a Carina region at $l = 290^\circ$, as part of a project to survey

selected regions along the galactic plane to determine accurate positions, spectral types and IRAS identifications for AGB stars.

2. Observations

The region under study covers an area of 16 square degrees centred at RA = 11 h 10 m and dec = -61° (1950), with galactic coordinates $l = 290^\circ$, $b = 0^\circ$. Two CTIO plates, listed in Table I, were used for this search. Identification of carbon stars were made under a binocular Zeiss microscope. Carbon stars are identified on near-infrared emulsions by the presence of the CN strong bandheads at $\lambda\lambda$ 7945, 8125, 8320 Å. No attempt was made to classify the carbon stars thus found into subclasses, but most of these stars correspond to N-type, which are among the reddest and coolest carbon stars. XY coordinates of the identified stars, together with standard stars, were made using a Zeiss PSK machine at CIDA by measuring the position of the telluric A band on the unwidened spectra. Plate coordinates were converted into equatorial coordinates using a concentric plate-projection method devised by Stock (1981). The PPM catalogue was used as the source for standard positions. Accurate positions were thus obtained with a mean error of 0.1 arcsec. Near-infrared I magnitudes were estimated directly from the density of the spectral image. Carbon stars were identified almost up to the plate limiting magnitude $I = 13$. Cross identifications were performed with both IRAS Point Source Catalog and the IRAS Low Resolution Spectra Catalog as well. Software implemented at the SUMA Computer Center at ULA and CIDA was used to search catalogues.

Table I. CTIO Plates used in this Survey

Plate No.	Emulsion	Filter	Exposure	Prism
CTIO 21368	IV-N+	RG-68	60 min	4°
CTIO 21378	IV-N	RG-68	15	4°

3. A Complete Sample of Carbon Stars in a Region in Carina

In Table II a list of a complete sample of 37 cool carbon stars identified in the region under study is presented. Columns 2 and 3 denote the equatorial coordinates at the equinox 1950. The estimated I magnitude is given in column 4. IRAS 12 μm magnitude with no colour correction is given in column 5. In columns 6 and 7 IRAS colour indices [12 – 25] and [25 – 60] are shown. Columns 8 and 9 show the results for cross identifications with the IRAS Point Source Catalogue (1989) and Stephenson's General Catalogue of Galactic Cool Carbon Stars (CCCS) (1989), respectively. Stars marked 23 through 26 are new identifications.

Table II. A list of cool carbon stars in a region in Carina

No. (1)	R.A. (2)	(1950) Dec. (3)	I (4)	[12] (5)	[12-25] (6)	[25-60] (7)	IRAS SOURCE (8)	CCCS (9)
1	10 50 27.49	-62 35 28.4	12.1	4.22	1.31	3.02	10504-6235	2884
2	10 50 27.84	-59 57 10.6	12.9	3.01	0.86	4.54	10504-5956	2883
3	10 50 40.49	-63 0 2.4	12.6	4.54	0.90	3.55	10506-6259	2887
4	10 50 53.07	-62 4 18.7	10.7					2888
5	10 51 31.60	-60 41 28.9	11.9	3.95	2.82	4.04	10515-6041	2889
6	10 51 55.60	-61 11 31.6	10.3	3.53	2.15	4.39	10519-6111	2894
7	10 54 34.45	-60 47 9.7	10.7					2903
8	10 55 58.18	-61 38 27.1	12.1					2913
9	10 56 32.45	-62 19 4.1	10.3	3.66	0.50	3.52	10565-6219	2915
10	10 56 47.47	-62 23 5.1	8.7	1.13	0.21	0.76	10567-6222	2916
11	10 57 2.90	-60 16 3.7	12.1					2917
12	10 59 13.93	-62 42 49.0	10.7	4.20	0.97	3.60	10592-6242	2929
13	10 59 43.14	-61 21 4.7	12.9					2933
14	11 0 6.20	-61 37 17.0	12.2	4.07	2.56	3.88	11001-6137	2935
15	11 0 39.47	-59 13 54.8	12.1					2939
16	11 0 49.75	-60 39 38.1	12.1					2940
17	11 0 57.61	-61 17 28.8	11.8	0.85	1.01	2.68	11009-6117	2941
18	11 2 33.59	-59 53 54.3	10.7					2948
19	11 3 29.78	-61 5 3.0	9.9					2950
20	11 3 51.60	-60 44 23.4	12.9					2952
21	11 4 33.88	-61 15 21.2	12.1					2955
22	11 4 42.48	-58 18 43.1	9.2	3.32	0.38	3.79	11047-5818	2956
23	11 6 4.72	-61 19 29.4	12.1					
24	11 8 46.46	-58 38 26.2	12.9					
25	11 14 8.14	-58 35 32.7	11.4					
26	11 14 23.57	-58 45 46.8	12.9					
27	11 18 19.93	-59 14 47.4	12.9					2997
28	11 18 26.62	-60 27 5.3	12.3					2999
29	11 19 4.77	-60 1 34.1	9.1	3.05	0.54	2.97	11190-6001	3002
30	11 19 50.58	-59 22 41.2	11.4					3003
31	11 23 58.03	-59 12 2.7	11.2	4.45	0.82	4.28	11239-5911	3017
32	11 24 34.28	-60 52 51.6	10.4	3.09	0.67	3.60	11245-6052	3019
33	11 25 29.67	-59 2 35.9	11.8	4.66	1.30	3.69	11255-5902	3024
34	11 26 1.86	-60 37 32.1	12.3	3.90	0.85	4.42	11260-6037	3028
35	11 26 41.97	-59 27 18.7	11.4	4.33	0.70	4.23	11267-5927	3032
36	11 27 57.10	-62 2 22.4	12.1					3039
37	11 28 2.94	-62 4 17.8	12.9	3.63	0.82	5.22	11280-6203	3040

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