CHEMICAL COMPOSITION AND CIRCUMSTELLAR SHELLS OF CARBON STARS - ANY OBVIOUS RELATIONS ?

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Evidence for circumstellar absorption around the warm N-type carbon star TX Piscium was found in a high-resolution IUE spectrum by Eriksson et al. (1986). This investigation also included the search, with a positive result, for CO J=1-0 emission from the circumstellar shell. From the Mn I absorption and CO emission a column density of about 10^{20} - 10^{22} H atoms per cm^2 was estimated, as well as a mass loss rate around 10^{-7} - 10^{-6} $M_\odot$ per year.

Lambert et al. (1986) have recently determined CNO abundances and $^{12}C/^{13}C$ ratios for 30 bright, galactic N-type stars. From this sample we have selected twelve stars with different chemical profiles to survey

TABLE I Stellar parameters from Lambert et al. (1986) / Results from CO J=1-0 observations at Onsala Space Observatory

Star	T_{eff} (K)	$^{12}C/^{13}C$	lg C-O/O	[N/H]	[O/H]	T_{mb} (K)	v_{LSR} (km/s)	v_{exp} (km/s)	Notes
Z Psc	2870	55	-1.85	-.39	-.23	0.20	12.8	4.2	
U Cam	2530	97	- .52	-.42	-.42	∿0.2	∿10	∿18	1,2
Y Tau	2600	58	-1.40	-.17	-.19	∿0.25	∿15	∿13	1,3
BL Ori	2960	57	-1.41	+.05	-.29	?			1
UU Aur	2825	52	-1.20	+.15	-.18	0.46	6.7	12.4	4
VY UMa	2855	44	-1.22	-.31	-.29	≤0.2			
Y CVn	2730	3.5	-1.06	-.12	-.40	0.36	19.7	9.1	5
RY Dra	2500	3.6	- .74	-.05	-.38	0.15	- 4.9	10.9	
T Lyr	2380	3.2	- .54	-.83	-.50	≤0.08			
UX Dra	2900	32	-1.34	-.12	-.21	0.19	13.7	7.1	
V460 Cyg	2845	61	-1.21	-.06	-.32	0.27	26.3	13.1	
TX Psc	3030	43	-1.57	-.27	-.10	0.25	13.1	12.5	
WZ Cas	2850	4.5	-2.00	+.01	+.07	≤0.08			

Notes:

1. Interstellar lines
2. Previously detected:
   ZDC: 0.16 / 8.5 / 22.0 J=1-0
3. Previously detected:
   ZDC: 0.17 / 15.9 / 10.1 J=1-0
4. Previously detected:
   ZD: 0.66 / 3.6 / 11.5 J=2-1
   ZDC: 0.26 / 7.6 / 12.4 J=2-1
   K: 0.06 / 7.0 / 13.4 J=1-0
5. Previously detected:
   ZD: 0.37 / 23.7 / 6.3 J=2-1
   KM: (0.06 / 21.7 / 7.9) J=1-0
   WS: 0.35 / 21.1 / 7.3 J=2-1

In 2-5 the numbers given are T_{mb} / v_{LSR} / v_{exp}

K Knapp(1986): Princeton Obs. preprint 167
KM Knapp & Morris(1985): Ap.J. 292, 640
WS Wannier & Sahai(1985): JPL preprint 106
ZD Zuckerman & Dyck(1986):Ap.J. 304, 394
ZDC Zuckerman,Dyck & Claussen(1986):ApJ 304,401

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their possible CO emission in the J=1-0 transition with the Onsala 20 m telescope. The observations were performed in December 1985 and April 1986. We detected CO emission from eight of the stars; the results are presented in Table I and two examples are displayed in Figure 1. The main beam brightness temperature, T_{mb}, is the antenna temperature divided by the main beam efficiency^{mb} ($\simeq 0.3$), and antenna and radome transmission factors. Four of the stars have been detected in CO by other groups independently.

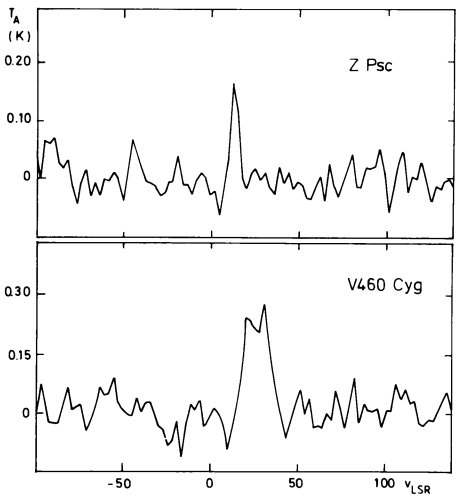

Figure 1: CO J=1-0 emission profiles for two N-type stars in our sample.

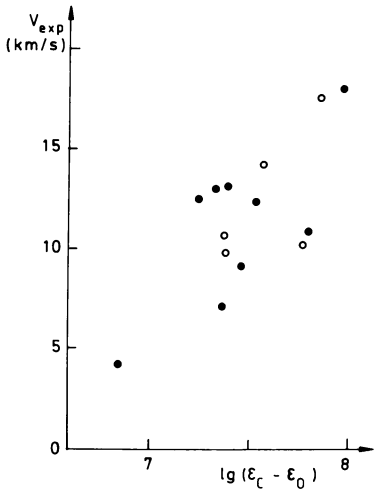

Figure 2: CO expansion velocity vs. carbon excess. Abscissa normalized such that lg ε_H=12. Open symbols are from other investigations.

We have investigated whether the shell emission and expansion velocities correlate with the chemical parameters, the effective temperatures or the flux excess at 11 μm as measured on IRAS low resolution spectra. No significant correlations were found. However, there may be a tentative correlation between the expansion velocity and the carbon excess (relative to oxygen), Figure 2. This correlation, which has the right direction if radiation forces on dust grains is an important mass loss mechanism, is worth further study.

References:

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