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

<table>
<thead>
<tr>
<th>Star</th>
<th>Stellar parameters from Lambert et al. (1986)</th>
<th>Results from CO J=1-0 observations at Onsala Space Observatory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(T_{\text{eff}}) (K)</td>
<td>(^{12})C/(^{13})C</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Z Psc</td>
<td>2870</td>
<td>55</td>
</tr>
<tr>
<td>U Cam</td>
<td>2530</td>
<td>97</td>
</tr>
<tr>
<td>Y Tau</td>
<td>2600</td>
<td>58</td>
</tr>
<tr>
<td>BL Ori</td>
<td>2960</td>
<td>57</td>
</tr>
<tr>
<td>UU Aur</td>
<td>2825</td>
<td>52</td>
</tr>
<tr>
<td>VY UMa</td>
<td>2855</td>
<td>44</td>
</tr>
<tr>
<td>Y CVn</td>
<td>2730</td>
<td>3.5</td>
</tr>
<tr>
<td>RY Dra</td>
<td>2500</td>
<td>3.6</td>
</tr>
<tr>
<td>T Lyr</td>
<td>2380</td>
<td>3.2</td>
</tr>
<tr>
<td>UX Dra</td>
<td>2900</td>
<td>32</td>
</tr>
<tr>
<td>V460 Cyg</td>
<td>2845</td>
<td>61</td>
</tr>
<tr>
<td>TX Psc</td>
<td>3030</td>
<td>43</td>
</tr>
<tr>
<td>WZ Cas</td>
<td>2850</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**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 \(T_{\text{mb}} / v_{\text{LSR}} / v_{\exp}\)


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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 (≈ 0.3), and antenna and radome transmission factors. Four of the stars have been detected in CO by other groups independently.

![Graph](image1)

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

![Graph](image2)

Figure 2: CO expansion velocity vs. carbon excess. Abscissa normalized such that $lg e_H$=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: