A SEARCH FOR C_4 AND C_5 IN THE (MOLECULAR) CARBON-RICH SIGHTLINE TOWARD HD 204827

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The simplest carbon-chain molecule C_2 was discovered in the interstellar medium in 1977[a]. Fourteen years later, J. P. Maier and others reported the first detection of C_3 in three diffuse cloud sightlines[b]. A followup survey at lower resolution[c] detected C_3 in 15 lines of sight with E_{B-V} ranging from 0.33 to 1.12 and noted that the sightline toward HD 204827 showed particularly high C_2 and C_3 column densities. This result was confirmed by a survey at higher resolution[d].

The next-longest carbon chains, C_4 and C_5, have not yet been detected in the interstellar medium. A low resolution search was performed by Oka et al.[c], and a more sensitive high resolution search has been reported[e] towards ζ Ophiuchi using the 3789 Å band of C_4 and the 5109 Å band of C_5. While ζ Ophiuchi is a very bright star (V=2.56), its C_3 column density (1.5×10^{12} cm^{-2}) is considerably lower than that towards HD 204827 (1.15×10^{13} cm^{-2}). Consequently, we decided to attempt a sensitive search for C_4 and C_5 in this carbon-rich sightline. The relative faintness (V=7.94) of the source was overcome by the large aperture (10-m) of the Keck telescope and a long (two nights) integration. Unfortunately, this work has not yielded a detection. A detailed interpretation of this non-detection in terms of carbon chain chemistry in diffuse clouds is hampered both by uncertainties in the oscillator strengths of the transitions as well as by the comparatively immature state of chemical models of diffuse cloud chemistry (relative to models of dense cloud chemistry). We encourage further theoretical and modelling efforts along these lines.

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