

Detections of long carbon chains CH₃CCCCH, C₆H, *linear*-C₆H₂ and C₇H in the low-mass star forming region L1527

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Long carbon chains CH₃CCCCH, C₆H, *l*-C₆H₂, and C₇H were detected in the low-mass star forming region L1527, showing a warm carbon chain chemistry (WCCC), by using Green Bank 100 m telescope. The $K = 0, 1,$ and 2 lines of the $J = 11-10$ transition of CH₃CCCCH were detected, and the column density and the gas kinetic temperature were determined to be $5.6 \times 10^{12} \text{ cm}^{-2}$ and 20 K, respectively. The ${}^2\Pi_{1/2}$ state of C₆H, locating 15.04 cm^{-1} higher than the ${}^2\Pi_{3/2}$ state, was detected for the first time except for the circumstellar envelope IRC+10216. The column densities of the ${}^2\Pi_{1/2}$ and ${}^2\Pi_{3/2}$ states of C₆H in L1527 were derived to be 1.6×10^{11} and $1.1 \times 10^{12} \text{ cm}^{-2}$, respectively, leading the temperature of 11 K between the two states. In the present observations, the $K_a = 0$ line of para species of *l*-C₆H₂ was detected, although the detection was limited for the $K_a = 1$ line of ortho species so far except for IRC+10216. The column densities of the ortho and para species of *l*-C₆H₂ were independently obtained to be 1.3×10^{11} and $0.6 \times 10^{11} \text{ cm}^{-2}$, respectively. C₇H was detected for the first time except for IRC+10216. The column density of C₇H was estimated to be $6.2 \times 10^{10} \text{ cm}^{-2}$ from the $J = 24.5-23.5$ and $25.5-24.5$ lines. These results of detections would suggest that C₇H and C₆H₂ are remarkably abundant species in L1527 although they are long carbon chains. These species can be good probes of chemical composition for heavy molecules in WCCC regions.

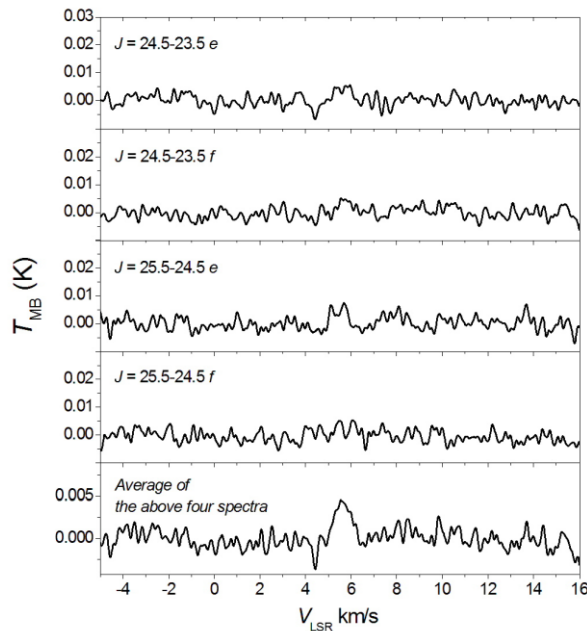


Figure 1: The $J = 24.5-23.5$ and $25.5-24.5$ rotational transitions of C₇H (${}^2\Pi_{1/2}$) observed by the Green Bank 100 m telescope .