Carbon-chain molecules in molecular outflows and Lupus I region ? New producing region and new forming mechanism

Wu Y.

Liu X.

Chen X.

Lin L.

Yuan J.

Zhang C.

Liu T.

Shen Z.

Li J.

Wang J.

Qin S.-L.

Kim K.-T.

Liu H.

Zhu L.

Madones D.

Inostroza N.

Henkel C.

Zhang T.

Li D.

Esimbek J.

Liu Q.

Using the new equipment of the Shanghai Tian Ma Radio Telescope, we have searched for carbon-chain molecules (CCMs) towards five outflow sources and six Lupus I starless dust cores, including one region known to be characterized by warm carbon-chain chemistry (WCCC), Lupus I-1

(IRAS 15398-3359), and one TMC-1 like cloud, Lupus I-6 (Lupus-1A). Lines of HC3N J = 2 ? 1, HC5N J = 6 ? 5, HC7N J = 14 ? 13, 15 ? 14, 16 ? 15, and C3S J = 3 ? 2 were detected in all the targets except in the outflow source L1660 and the starless dust core Lupus I-3/4. The column densities of nitrogen-bearing species range from 1012 to 1014 cm?2 and those of C3S are about 1012 cm?2. Two outflow sources, I20582+7724 and L1221, could be identified as new carbon-chain-producing regions. Four of the Lupus I dust cores are newly identified as early quiescent and dark carbon-chain-producing regions similar to Lup I-6, which together with the WCCC source, Lup I-1, indicate that carbon-chain-producing regions are popular in Lupus I which can be regard as a Taurus-like molecular cloud complex in our Galaxy. The column densities of C3S are larger than those of HC7N in the three outflow sources I20582, L1221, and L1251A. Shocked carbon-chain chemistry is proposed to explain the abnormal high abundances of C3S compared with those of nitrogen-bearing CCMs. Gas-grain chemical models support the idea that shocks can fuel the environment of those sources with enough S+ thus driving the generation of S-bearing CCMs.

ISM: abundance

ISM: jets and outflows

ISM: kinematics and dynamics

ISM: molecules

Stars: formation