

Complex organic chemistry in star-forming regions

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Complex organic molecules may play a key role in the emergence of life. They are detected in various astrophysical environments (e.g., low- and high-mass star-forming regions, prestellar cores, outflows, comets). In particular, they are found to be highly abundant in the warm inner regions of protostars, where planets are expected to form. These molecules may survive during the star formation process and be incorporated into asteroids and comets, which could deliver them to planetary embryos through impacts.

The formation mechanisms of complex organic molecules are however debated. Observations and chemical modelling are helpful to constrain how these species form. In particular, measurements of isotopic fractionation (especially deuteration) and relative abundance ratios of isomers or related species can help to distinguish between different routes. The detection of less abundant isotopologues and isomers can, however, be difficult. With the Atacama Large (Sub-)Millimeter Array (ALMA), it is now possible to detect them. The Protostellar Interferometric Line Survey (PILS) is a large spectral survey of the solar-type protostar IRAS 16293-2422 carried out with ALMA [1]. In the framework of this program, the deuterated forms of formamide (NH₂CHO) and glycolaldehyde (CH₂OHCHO) were detected for the first time [1,2]. Ethylene oxide (C₂H₄O) and propanal (CH₃CH₂CHO), the isomers of acetaldehyde (CH₃CHO) and acetone (CH₃COCH₃) respectively, were also found for the first time towards a low-mass protostar [3]. In the first part of this talk, I will present the results of these recent studies and I will discuss the possible formation pathways of these species.

In the second part, I will show the results obtained with the gas-grain chemical code UCL Chem to constrain the formation pathways of a few complex O-bearing species (e.g., glycolaldehyde, ethylene glycol, methyl formate) detected in various star-forming regions [4].

References

- [1] J. K. Jørgensen, M. H. D. van der Wiel, A. Coutens et al., 2016, A&A in press
- [2] A. Coutens, J. K. Jørgensen, M. H. D. van der Wiel et al., 2016, A&A 590, L6
- [3] J. M. Lykke, A. Coutens, J. K. Jørgensen et al., submitted to A&A
- [4] V. M. Rivilla, M. T. Beltran, R. Cesaroni, et al. 2016, A&A in press