Formation of Organic Species in Space – A Case Study of Acetamide

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About 200 different molecules have been detected in interstellar medium (ISM) and most of these contain hydrogen, helium, oxygen, carbon, and nitrogen, which are the most common elements in our galaxy. A great number of molecules that have been detected in the past have helped to gain insight into prebiotic chemistry which enabled the evolution of life on our planet. However, the understanding of chemical evolution is far from complete. To explore the processes which lead to the formation of organic molecules in space and eventually the evolution of life, special methods are necessary to model the extreme conditions and describe the corresponding reactions. In this work, a new method based on the molecular formula of a species to determine its possible formation reaction pathways in ISM will be introduced by using acetamide as a case study. Acetamide (C_2H_5NO) has been detected in interstellar medium (ISM) and it is considered as a precursor for amino acids. The possible formation reaction pathways of acetamide in ISM are determined based on its molecular formula. All constitutional isomers of acetamide (198 structures, 91 unique species) with the same molecular formula (C_2H_5NO) but with different connectivity were created and studied under the extreme conditions of dense molecular clouds. Acetamide was found to be the most stable of the C_2H_5NO isomer family. Based on the stability of the uni- and bimolecular species, eight reactions were proposed which could led to the formation of acetamide in ISM. The described method can also be applied to explore the formation of other organic species.

This research was enabled in part by support provided by SHARCNET (www.sharcnet.ca/) and Compute Canada (www.computecanada.ca). AR acknowledge the National Talent Programme, Hungary, for the financial support. BF thanks the support by the ÚNKP-20-4 New National Excellence Program of The Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund. The GITDA (Governmental Information-Technology Development Agency, Hungary) is gratefully acknowledged for allocating computing resources used in this work.