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The prebiotic building blocks of peptides

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Small molecules such as formamide (NH_2CHO), methyl isocyanate (CH_3NCO) and acetamide (CH_3CONH_2) belong to a select group of interstellar molecules considered to be relevant precursors to the formation of peptide structures. On Earth, the peptide bond is the chemical link between amino acids that forms proteins, the engines of life. Recent detections of NH_2CHO , CH_3NCO and $\text{CH}_3\text{C}(\text{O})\text{NH}_2$ with ALMA towards the low-mass, sun-like, protostar IRAS 16293-2422B, make it likely that such building blocks were available in the earliest formational stages of the Solar System. [1,2,3] How these species form and are related to each other is largely unknown, however.

In this presentation, the formation of peptide-like molecules on icy surfaces of interstellar dust grains is discussed. To this end, $\text{CH}_4:\text{HNCO}$ mixtures frozen at 20 K are UV irradiated and analysed with Infrared spectroscopy and temperature programmed desorption - mass spectrometry. The experiments show the simultaneous formation of a variety of peptide-like molecules, including NH_2CHO , CH_3NCO and $\text{CH}_3\text{C}(\text{O})\text{NH}_2$. From the experimental data, a reaction network is constructed which shows that these molecules are related through a series of similar reactions, mainly starting from atomic nitrogen (N), NH and NH_2 . A comparison between laboratory and observational data shows that the formation of peptide-like molecules in the interstellar medium can be explained by reactions taking place on icy dust grains.

[1] A. Coutens et al., *Astronomy & Astrophysics*, 590 (2016)

[2] N.F.W. Ligterink et al., *Month. Not. Roy. Astron. Soc.* 469 (2017)

[3] N.F.W. Ligterink et al., *Month. Not. Roy. Astron. Soc.* 480 (2018)

Summary

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