Formamide (NH_2CHO) in star-forming regions: A crucial precursor of prebiotic material

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Understanding the origin of life on Earth represents one of the hot topics in modern science. One of the big questions is whether the original mechanism that led from simple molecules to life was connected to metabolism or to genetics, both intimately linked in living beings. Formamide (NH_2CHO) contains the four most important elements for biological systems, and it has recently been proposed as a prebiotic precursor of both metabolic and genetic material, suggesting a common chemical origin for the two mechanisms [1].

Even though formamide was first detected in molecular clouds in 1971 [2], dedicated studies have started only very recently, as its potential as a key prebiotic molecule has become more evident. These studies report the presence of formamide in massive hot molecular cores [3,4], one low-mass protostar [5], and the comet Hale-Bopp [6]. In the past months, the IRAM Large Program ASAI, dedicated to astrochemical studies of star-forming regions, has revealed new discoveries of NH_2CHO [7], including its detection, for the first time, in outflow shock spots [8]. The presence of formamide in such a variety of star-forming environments, as well as on a Solar System comet, suggests that it could have been exogenously delivered onto a young Earth in the past.

In this contribution, we will present our new ASAI results on formamide, and compare them to previous studies, to try to understand its formation mechanisms in the interstellar medium. We will discuss the different chemical pathways that have been proposed, which include gas-phase as well as gas-grain reactions, and we will explain why we favor the latter. Lastly, we will emphasize the importance of joining efforts with experts on both theoretical and experimental chemistry in order to make progress.

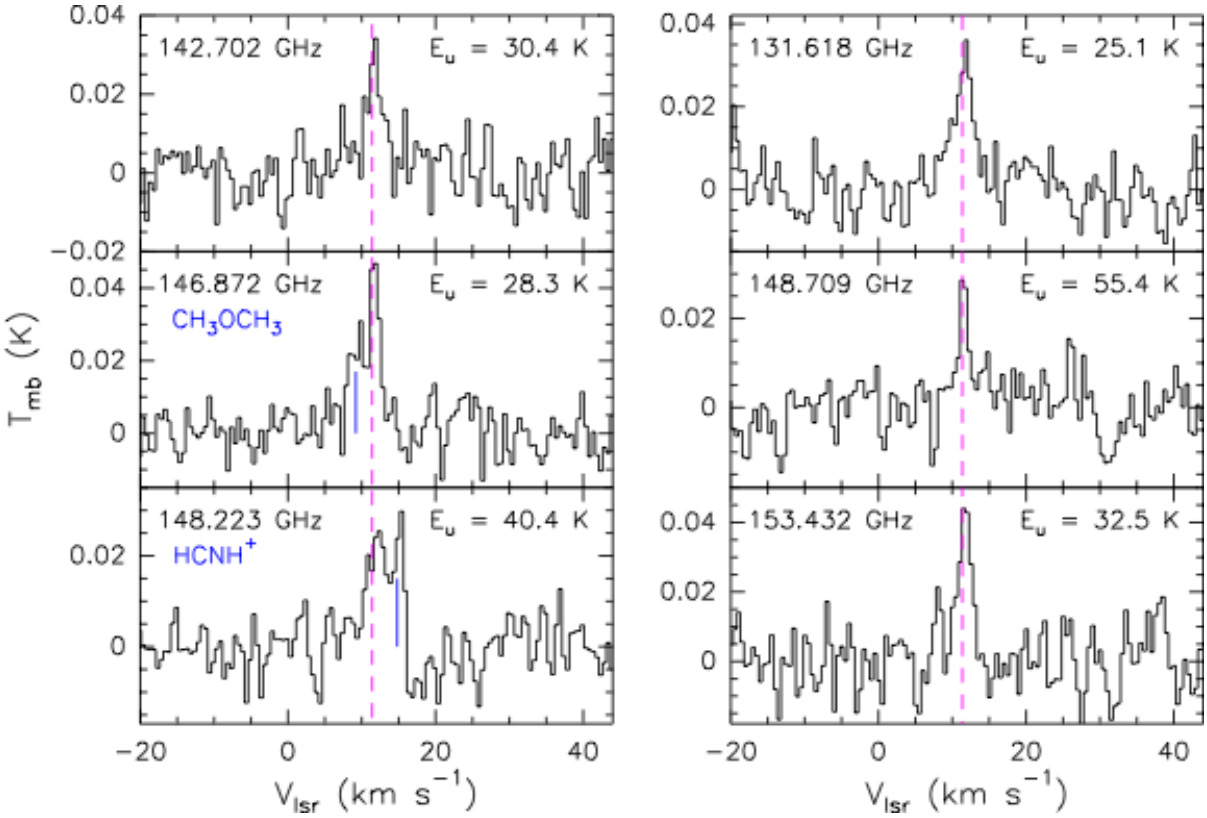

Figure 1: Some of the NH_2CHO lines detected in the intermediate-mass star-forming region OMC-2 FIR 4.

References

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