Gas-phase formation routes of simple prebiotic molecules in the interstellar medium

Nadia Balucani[1,2,3], Cecilia Ceccarelli[2,3]

Simple prebiotic molecules, such as formamide or glycolaldehyde, have been detected in the gas-phase of various regions of the interstellar medium. Some difficulties in assessing their formation routes under the harsh conditions of interstellar objects have progressively brought the current astrochemical models to privilege grain-surface over gas-phase chemistry to explain their formation. In this scenario, grain-surface chemistry is not only responsible for the hydrogenated molecules of the pre-collapse phase, but also for the whole set of the observed complex organic molecules, some of which have a clear prebiotic character (see, for instance Ref. [1]).

Nevertheless, as recently pointed out by a theoretical investigation of two gas-phase reactions leading to formamide and cyanomethanimine (two simple molecules with a notable potential in prebiotic chemistry) [2,3], many gas-phase routes have actually been overlooked and not considered in the astrochemical models, while their inclusion with the parameters determined in laboratory experiments or via accurate theoretical calculations could be decisive in reproducing the observed abundances.

In this contribution, we report on our recent effort in searching for new formation routes of prebiotic molecules, such as formamide, in the gas-phase by: 1) extensive literature search of previously overlooked bimolecular reactions; 2) testing the new formation routes in astrochemical models. The approach is the same recently used [4] to address the formation of methylformate starting from the parent molecule dimethylether via a set of bimolecular reactions which were studied in laboratory experiments in the 80's but completely ignored in previous astrochemical models.

[1] R.T. Garrod and E. Herbst, 2006, A&A, 457, 927
[2] F. Vazart, C. Latouche, D. Skouteris, N. Balucani, V. Barone, 2015, ApJ, accepted.
[3] F. Vazart, C. Latouche, D. Skouteris, N. Balucani, V. Barone, in preparation.
[4] N. Balucani, C. Ceccarelli and V. Taquet, 2015, MNRAS, 449, L16–L20

[1] Dipartimento di Chimica, Biologia e Biotecnologie, Università degli Studi di Perugia, Perugia, Italy
[2] Univ. Grenoble Alpes - CNRS, IPAG, F-38000 Grenoble, France
[3] INAF, Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, I-50125, Firenze, Italy