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The emergence of interstellar molecular complexity explained by interacting networks

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Abstract-

Recent years have witnessed the detection of an increasing number of complex organic molecules in interstellar space, some of them being of prebiotic interest. Disentangling the origin of interstellar prebiotic chemistry and its connection to biochemistry and ultimately, to biology is an enormously challenging scientific goal where the application of complexity theory and network science has not been fully exploited. Encouraged by this idea, we present a theoretical and computational framework to model the evolution of simple networked structures toward complexity. In our environment, complex networks represent simplified chemical compounds and interact optimizing the dynamical importance of their nodes. We describe the emergence of a transition from simple networks toward complexity when the parameter representing the environment reaches a critical value. Notably, although our system does not attempt to model the rules of real chemistry nor is dependent on external input data, the results describe the emergence of complexity in the evolution of chemical diversity in the interstellar medium. Furthermore, they reveal an as yet unknown relationship between the abundances of molecules in dark clouds and the potential number of chemical reactions that yield them as products, supporting the ability of the conceptual framework presented here to shed light on real scenarios. Our work reinforces the notion that some of the properties that condition the extremely complex journey from the chemistry in space to prebiotic chemistry and finally, to life could show relatively simple and universal patterns.

Index Terms-

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