

Towards the Universal Life Detection System

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Introduction: Is life ubiquitous in the Universe or our solar system? In this paper I outline an approach to construct a simple device that allows the unambiguous detection and classification of molecules and molecular fragments as naturally occurring from non-living and those derived from living systems. Not only will this approach allow us to determine with a very high probability, if the molecule or molecular fragment is synthesised in a living system, but allow us to differentiate between different biologies (genesis 1 vs. genesis 2).

Approach: Life processes uses and produces molecules and polymers that are more complex than those naturally occurring using the laws of combinatorial chemistry. As both the molecular weight, complexity, and relative abundance of these types of molecules increase with respect to the environment, it can be postulated[1] that molecules derived from living systems will have a distinct signature in a three dimensional space. By constructing a device that can separate an environmental sample (solid, liquid, gas or mixture of these) using chromatography followed by mass spec and ms-ms fragmentation of the molecular ions, it will be possible to plot molecular weight against abundance and complexity, see Figure 1.

Discussion: Whilst several life detection systems have been proposed,[2] researchers have mostly focused on Earth-like biology. However the realisation that life is a machine that can, by using energy and simple resources, make more complex molecules has not been explored in this way.[1] Since the probability of high molecular weight molecules with high complexity naturally occurring effectively tends zero, the discovery of high molecular weight molecules with above 'noise' abundance (the noise floor will be determined in the sample rate / repetition) and high complexity would be an unambiguous indication that these molecules were produced by a biology.

References:

- [1] Cronin, L. (2013) *Advances in Artificial Life ECAL 12*, 1066-1067.
- [2] Simmonds, P. G. (1970) *Applied Microbio.*, 567.

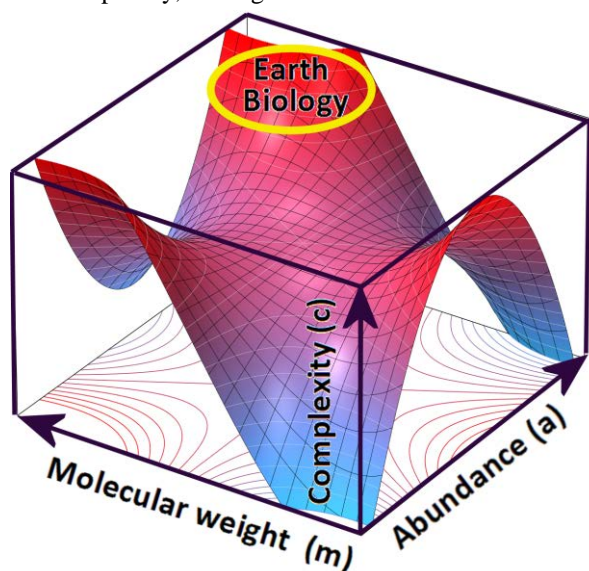


Figure 1: Figure 1: Saddle plot as a rough approximation of how the 'life' map could appear. Only data that falls in one domain, shown by the yellow ellipse has, has the correct properties to be derived from life.