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The Origin of Life: One Phase Transition or Two?

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Some aspects of the transition from non-living to living matter are best understood within the context of the theory of phase transitions. A good example is the emergence of homochirality, where stereoisomers of left- and right-handed molecules are believed to have undergone spontaneous symmetry breaking from a racemic mix of both forms to a homochiral set of all left or all right-handed akin to symmetry breaking in the physics of non-equilibrium second order phase transitions. This is among the leading explanations for the observed single chirality of all left-handed amino acids in proteins and all right-handed sugars in DNA and RNA. In this talk, building on earlier theoretical work of Laurent et al., I discuss evidence of an earlier phase transition in the origin of life that would have preceded this transition in which life started as achiral networks of interacting molecules that underwent a phase transition to chiral-dominated molecular networks. This transition is first order, suggesting a phase of early evolution in the emergence of life of couple phase transitions with relic evidence of this structure in modern metabolism. I discuss implications for the experimental approaches to origins of life chemistry and also deeper theoretical implications for the role of chirality and chiral symmetry breaking in a more fundamental understanding of what life is.

Keyword-3

Keyword-2

Keyword-1

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