

Abstract Submitted  
for the MAR10 Meeting of  
The American Physical Society

**Spontaneous Emergence of Modularity in an Evolving System: Nucleation of Biology from Chemistry** MICHAEL DEEM, JUN SUN, JIANKUI HE, Rice University — We investigate the selective forces that promote the emergence of modularity in nature. We demonstrate the spontaneous emergence of modularity in a population of individuals that evolve in a changing environment. We show that the level of modularity correlates with the rapidity and severity of environmental change. The modularity arises as a synergistic response to the noise in the environment in the presence of horizontal gene transfer. We suggest that the hierarchical structure observed in the natural world may be a broken symmetry state, which generically results from evolution in a changing environment. To support our results, we analyze experimental protein interaction data and show that protein interaction networks became increasingly modular as evolution proceeded over the last four billion years. We also discuss a method to determine the divergence time of a protein.

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Date submitted: 23 Nov 2009

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