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Least Unit Action and Maximum Total Action for Complex Flow Networks GEORGI GEORGIEV, Assumption College and Tufts University, ALEXANDER CASEY, HYUNSEUNG LEE, JOHANNA THOMSON, Assumption College — There are two types of complex systems: those that exist until an external energy gradient is equilibrated and those that increase the energy gradient and drive themselves further out of equilibrium. To the first type belong dissipative structures, such as Bernard cells, vortices and others. The second type exhibits continuous self-organization and increased robustness, as in biological and social networks. Represented as flow networks, those systems have two attractors: a decrease in unit physical action, which is the action necessary for one element of the system to cross one edge, and an increase in total physical action, which is the sum of the actions of all elements in the system. The increase of total action drives series of phase transitions decreasing the unit action. The decrease of unit action creates a region of space where the probability increases for matter and energy from the environment to be included in the system. The positive feedback between the least unit action and the maximum total action leads to a process of exponential growth of both of them characterizing developing systems and is ubiquitous in nature. We present data for sample systems that follow those two trends.

Georgi Georgiev
Assumption College

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