MAR07-2006-007016
Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Symmetry and the Self-Organized Evolution of Canalization in Boolean Networks[1]

KEVIN BASSLER, University of Houston

Canalization of genetic regulatory networks have been argued to be favored by evolutionary processes due to the stability that it can confer to phenotype expression. Using an N-K Boolean network model of a genetic regulatory network, we explore whether a significant amount of canalization can arise in purely random networks in the absence of evolutionary pressures. We use a mapping of the Boolean functions in the Kauffman N-K model for genetic regulatory networks onto a k-dimensional Ising hypercube to show that the functions can be divided into different classes strictly due to geometrical constraints. The classes can be counted and their properties determined using results from group theory and isomer chemistry. We demonstrate that partially canalized functions completely dominate all possible Boolean functions, particularly for higher K. This indicates that partial canalization is extremely common, even in randomly chosen networks, and has implications for how much information can be obtained in experiments on native state genetic regulatory networks. Furthermore, we demonstrate that a highly canalized state evolves spontaneously from a competition between the nodes. Network finite-size effects are found to be important to that evolutionary process.

[1]Supported by the NSF through grant #DMR-0427538