Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Scaling laws and universality for the strength of genetic interactions in yeast ANDREA VELENICH, M.I.T., MINGJIE DAI, Harvard University, JEFF GORE, M.I.T. — Genetic interactions provide a window to the organization of the thousands of biochemical reactions in living cells. If two mutations affect unrelated cellular functions, the fitness effects of their combination can be easily predicted from the two separate fitness effects. However, because of interactions, for some pairs of mutations their combined fitness effect deviates from the naive prediction. We study genetic interactions in yeast cells by analyzing a publicly available database containing experimental growth rates of 5 million double mutants. We show that the characteristic strength of genetic interactions has a simple power law dependence on the fitness effects of the two interacting mutations and that the probability distribution of genetic interactions is a universal function. We further argue that the strength of genetic interactions depends only on the fitness effects of the interacting mutations and not on their biological origin in terms of single point mutations, entire gene knockouts or even more complicated physiological perturbations. Finally, we discuss the implications of the power law scaling of genetic interactions on the ruggedness of fitness landscapes and the consequent evolutionary dynamics.

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Date submitted: 10 Nov 2011 Electronic form version 1.4