Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Statistical Physics of Population Genetics in the Low Population Size Limit GURINDER ATWAL, Cold Spring Harbor Laboratory — The understanding of evolutionary processes lends itself naturally to theory and computation, and the entire field of population genetics has benefited greatly from the influx of methods from applied mathematics for decades. However, in spite of all this effort, there are a number of key dynamical models of evolution that have resisted analytical treatment. In addition, modern DNA sequencing technologies have magnified the amount of genetic data available, revealing an excess of rare genetic variants in human genomes, challenging the predictions of conventional theory. Here I will show that methods from statistical physics can be used to model the distribution of genetic variants, incorporating selection and spatial degrees of freedom. In particular, a functional path-integral formulation of the Wright-Fisher process maps exactly to the dynamics of a particle in an effective potential, beyond the mean field approximation. In the small population size limit, the dynamics are dominated by instanton-like solutions which determine the probability of fixation in short timescales. These results are directly relevant for understanding the unusual genetic variant distribution at moving frontiers of populations.

Gurinder Atwal
Cold Spring Harbor Laboratory

Date submitted: 14 Nov 2016 Electronic form version 1.4