

Population Genetics as a Model for a Laser Dynamics

by

Dr. Hernando Garcia

Physics Department

Southern Illinois University

Edwardsville, Illinois, USA

ABSTRACT

We propose the use of a simple set of evolutionary dynamic equations to describe laser behavior near threshold. In this model stimulated emission can be viewed as a mechanism for reproduction of information (replication). The emission of randomly oriented photons with different \mathbf{k} vectors can be viewed as mechanisms for diversity. Selection occurs when photons with the appropriate cavity wave-vector will reproduce faster than others (amplified). In this scenario the wave-vector can be classified as a phenotype because it is the result of the interaction of the photon with the environment (laser cavity) and its frequencies as a genotype. As in any evolutionary landscape there should be a limit for reproduction, in the case of the laser, it manifests itself through ratio of the difference between the gain and losses (mirror reflection losses, absorption in the gain media) and the saturation parameter of the laser cavity. Finally, spontaneous emission can be viewed as a mechanism for mutations (noise in the information transfer) under the right conditions, and this will contribute to the selection mechanism.