The random graph of Erdos and Renyi is one of the oldest and best studied models of a network, and possesses the considerable advantage of being exactly solvable for many of its average properties. However, as a model of real-world networks such as the Internet, social networks or biological networks it leaves a lot to be desired. In particular, it differs from real networks in two crucial ways: it lacks network clustering or transitivity, and it has an unrealistic Poissonian degree distribution. In this paper we review some recent work on generalizations of the random graph aimed at correcting these shortcomings. We describe generalized random graph models of both directed and undirected networks that incorporate arbitrary non-Poisson degree distributions, and extensions of these models that incorporate clustering too. We also describe two recent applications of random graph models to the problems of network robustness and of epidemics spreading on contact networks.

We analyze a mean-field model for a large array of coupled solid-state lasers with randomly distributed natural frequencies. Using techniques developed previously for coupled nonlinear oscillators, we derive exact formulas for the stability boundaries of the phase locked, incoherent, and off states, as functions of the coupling and pump strength and the spread of natural frequencies. For parameters in the intermediate regime between total incoherence and perfect phase locking, numerical simulations reveal a variety of unsteady collective states in which all the lasers' intensities vary periodically, quasiperiodically, or chaotically.