Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Enhancement of epidemic extinction by random vaccination[1] IRA SCHWARTZ, Naval Research Laboratory, MARK DYKMAN, Michigan State University — We study the probability of epidemic extinction in large populations. We use the susceptible-infected-susceptible (SIS) model since it forms the foundation of many epidemic processes. Fluctuations in the SIS system have two sources. The major source is the randomness of the "reactions" in which the number of susceptibles and/or infected changes. In addition, we assume that vaccination is done at random, leading to the decrease of the number of susceptibles. The vaccination is modeled by a Poisson process. The probability distribution is found from the master equation, which is solved in the eikonal approximation. It is shown that, even in the absence of vaccination, the logarithm of the extinction rate displays scaling dependence on the parameters. It scales as the square of the distance to the parameter value where the average number of infected vanishes. This is very different from the familiar 3/2 scaling law for saddle-node bifurcations. Finally, we show that even weak vaccination can dramatically increase the extinction probability. The correction to the logarithm of the probability becomes exponential in the vaccination rate when this rate is not too small.

[1]Research supported by the Office of Naval Research and Army Research Office

Ira Schwartz
Naval Research Laboratory

Date submitted: 12 Dec 2007 Electronic form version 1.4