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WKB theory of stochastic epidemics in well-mixed populations[1]

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Stochastic effects in disease transmission can eliminate the disease from small communities. In one scenario this happens after the disease already reached an endemic state. In another scenario the disease can fade out immediately after an epidemic outbreak. I will review a recent progress in theoretical analysis of these and related problems [1-3]. In a probabilistic language, spread of a disease can be described by a master equation with specified transition rates. When the population size is sufficiently large, one can use a dissipative version of WKB approximation thus reducing the problem to that of finding "optimal paths" to disease extinction. These are special instanton-like trajectories of an underlying classical Hamiltonian. Further analytical progress in multi-population systems is possible when either disparity of transition rates, or proximity to a bifurcation, causes time scale separation. I will illustrate these points on the examples of the stochastic SI (Susceptible-Infected) and SIS (Susceptible-Infected-Susceptible) models of epidemiology.

[1] M.I. Dykman, I.B. Schwartz, and A.S. Landsman, Phys. Rev. Lett. **101**, 078101 (2008).
[2] A. Kamenev and B. Meerson, Phys. Rev. E **77**, 061107 (2008).
[3] B. Meerson and P.V. Sasorov, Phys. Rev. E **80**, 041130 (2009).

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