Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Moment Closure Analysis of SIRS Disease Model on Heterogeneous Networks DANIEL T. CITRON, CHRISTOPHER R. MYERS, Cornell University — We perform a moment closure analysis of the stochastic susceptible-infected-recovered-susceptible (SIRS) model of infectious disease dynamics on heterogeneous networks. The SIRS model, which returns previously infected individuals to a susceptible state, supports a nontrivial steady state representing persistent endemic disease. In the context of networks, the heterogeneous mean field (HMF) method can be used to predict how network structure affects the SIRS model by dividing the network into classes with degree-dependent mean field coupling strengths. To verify the accuracy of the HMF, we simulate the SIRS model on heterogeneous networks. In our simulations we find, in disagreement with the HMF, the survival probability of the steady state depends on system size. This discrepancy stems from the fluctuations present in the stochastic model that are ignored by the HMF. We extend the HMF results by applying moment closure to each degree class. Our moment closure analysis provides a probabilistic description of the steady state for each degree class, which can be used to show how stochastic fluctuations and extinction depend on the size of the full network. We suggest that this technique may be used to analyze other stochastic models of dynamical processes.

Daniel T. Citron
Cornell University

Date submitted: 14 Nov 2014 Electronic form version 1.4