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Stochastic amplification in an epidemic model with seasonal forcing

In this talk I will discuss, using the formalism of master equations, the nature of the stochastic dynamics which appears in models of population biology, and in particular childhood epidemics. When they contain a large number of constituents, the behaviour of these models may be analysed using an expansion in the system size. To leading order the deterministic analogues of the models can be compared to the equations which are normally written down on phenomenological grounds, for example the SIR (Susceptible-Infected-Recovered) differential equations. At next-to-leading order a simplified stochastic description is obtained. Attention will focus on systems for which the deterministic description fails to predict cycles, but where large cycles are found at next-to-leading order. These cycles have their origin in fluctuations due to the discrete nature of the system components, and are much larger than would naively be expected because they are amplified by a resonance phenomenon. The application of these ideas to the SIR model with term-time forcing will be described.