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**Dynamics of finite-size networks of coupled oscillators** MICHAEL BUICE, CARSON CHOW, NIH — Mean field models of coupled oscillators do not adequately capture the dynamics of large but finite size networks. For example, the incoherent state of the Kuramoto model of coupled oscillators exhibits marginal modes in mean field theory. We demonstrate that corrections due to finite size effects render these modes stable in the subcritical case, i.e. when the population is not synchronous. This demonstration is facilitated by the construction of a non-equilibrium statistical field theoretic formulation of a generic model of coupled oscillators. This theory is consistent with previous results. In the all-to-all case, the fluctuations in this theory are due completely to finite size corrections, which can be calculated in an expansion in 1/N, where N is the number of oscillators. The N $\rightarrow$ infinity limit of this theory is what is traditionally called mean field theory for the Kuramoto model. We also demonstrate this approach with a system of pulse coupled theta neurons and describe the stability of the population activity.

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