Phase oscillator network with random and frustrated interaction

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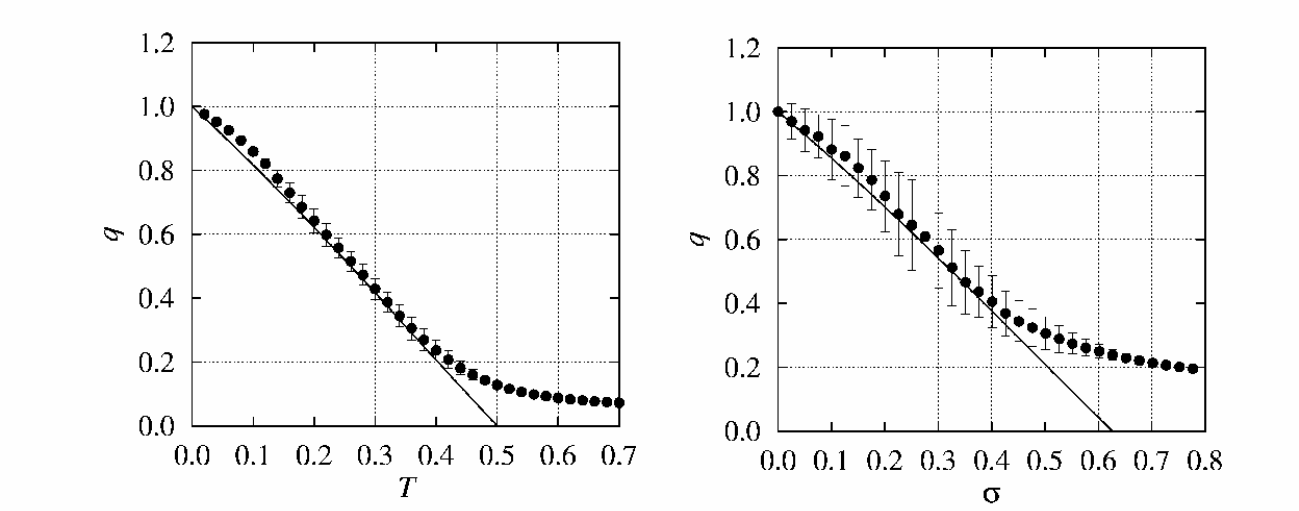

Parameter dependences of sample average of spin glass order parameter q. Left panel: XY model. Abscissa axis is temperature T, number of XY spins is $N = 500$. Right panel: Oscillator network. Abscissa axis is standard deviation σ of natural frequency distribution, number of phase oscillators is $N = 100$.

The construction of the statistical mechanics for the many active matters ensemble is one of the main themes of non-equilibrium statistical physics. We have been studying phase oscillator networks focusing on how synchronization phenomena depend on dimensionality, topology of the system, interaction range, types of randomness, and so on. In particular, in the case of the random and frustrated interaction, a peculiar state, which is called the quasi entrainment (QE) state, has been found.

The behaviors of the QE state are similar to those of the spin glass state in magnetic systems. So far, a self-consistent equation for the spin glass order parameter q has not yet been obtained and also any numerical method to calculate it has not been reported for the phase oscillator network. Recently, we have established a method to calculate q and are analyzing the QE state in detail.

Keywords : Synchronization-desynchronization phase transition, Phase oscillator network, SK-type interaction, Spin glass, Phase unwrapping