Deterministic and stochastic sampling of coupled Kerr parametric oscillators

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The vision of building computational hardware for problem optimization has spurred large efforts in the physics community. In particular, networks of Kerr Parametric Oscillators (KPOs) are envisioned as simulators for finding the ground states of Ising Hamiltonians. It was shown, however, that KPO networks can feature large numbers of unexpected solutions that are difficult to sample with the existing deterministic (i.e., adiabatic) protocols.

I will briefly review various aspects of coupled KPOs with weak and strong driving [1-3]. The number of available states depends strongly on the coupling strength, the nonlinearity, and the detuning of the parametric drive. I will demonstrate both deterministic and stochastic methods to sample these states and to characterize their symmetries. The discussion of these results opens exciting questions for future research of complex, fluctuating nonlinear systems.

References:

[1] G. Margiani et al., arXiv:2210.14731 (2022).
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[3] T. Heugel et al., *Phys. Rev. Lett*. **123**, 124301 (2019).