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Prevalence of Asymmetry-Induced Synchronization in Oscillator Networks[1]

TAKASHI NISHIKAWA, Northwestern University

A counterintuitive scenario has recently been discovered in which, in order to stabilize complete synchrony of all oscillators—a symmetric state—in a symmetric network, the oscillators must become nonidentical and thus break the system symmetry. This phenomenon, which is termed asymmetry-induced symmetry (AIS) and can be regarded as the converse of symmetry breaking, calls for a systematic investigation into how often such behavior is observed in complex systems. In this talk, I will present a general scheme for constructing AIS systems and demonstrate that AIS is the norm rather than exception in coupled oscillator networks that can be viewed as multilayer networks. In this construction, oscillator heterogeneity stems from the heterogeneity of interlayer connections, and the master stability function formalism is used to establish synchronization stability properties. Since a network in complete synchrony is the basic building block of more general complex networks with clusters of synchronous oscillators, our results suggest the prevalence of networks in which observing synchrony in a cluster requires that the cluster break its symmetry, and thus have implications beyond the class of fully symmetric networks.

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