Chimera states and synchronization in magnetically driven SQUID metamaterials

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Abstract

One-dimensional arrays of Superconducting QUantum Interference Devices (SQUIDs) form magnetic metamaterials exhibiting extraordinary properties, including tunability, dynamic multistability, negative magnetic permeability, and broadband transparency. The SQUIDs in a metamaterial interact through non-local, magnetic dipole-dipole forces, that makes it possible for multiheaded chimera states and coexisting patterns, including solitary states, to appear. The spontaneous emergence of chimera states and the role of multistability is demonstrated numerically for a SQUID metamaterial driven by an alternating magnetic field. The spatial synchronization and temporal complexity are discussed and the parameter space for the global synchronization reveals the areas of coherence-incoherence transition. Given that both one- and two-dimensional SQUID metamaterials have been already fabricated and investigated in the lab, the presence of a chimera state could in principle be detected with presently available experimental set-ups.

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