Mesoscale Priority Research Direction

Quantum design of materials with new functionalities

Opportunity

Competition of quantum and correlation effects, disorder and fluctuations, sets characteristic mesoscales bringing new topological orders and governing the behavior of physical systems. Patterning of low-dimensional and hybrid structures to match these scales brings new functionalities and creates new phenomena. Exploring temperature ranges corresponding mesoscales uncovers new states of matter.

Meso Challenge

The challenge is to achieve macroscopic quantum coherence utilizing microscopic quantum effects and effects of fluctuations the full balance of which defines mesoscales.

Approach

Creating metamaterials and hybrid structures with the desired quantum properties. The key steps are new synthesis and patterning utilizing mesoscale fluctuations and quantum synchronization. Creating a comprehensive theory of non-equilibrium quantum effects including fluctuational and dissipative behavior having predictive power.

Impact

Discovery of the new states of matter and new topological orders that appear on mesoscales will bring fundamental knowledge about the most deep laws of nature where statistical physics and quantum mechanics stand on equal footing and will break the ground for new materials and functionalities that did not exist before.

References:

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Contact: Valerii Vinokur (ANL)