Mesoscale Priority Research Direction

Cellular Membranes – Emergent Behavior at the Mesoscale

Opportunity

DOE's signature neutron, photon and computational facilities can interrogate membrane systems across extended scales of length and time

Determining how the properties of a biological membrane emerge from the underlying *static* and *dynamic* structure will explain poorly understood biological phenomena and enable a new level of control in synthetic systems

Meso Challenge

Membranes are intrinsically disordered, dynamic systems whose organization and associated functions begin to emerge *only* at the meso scale (>100 molecules, >5 nm)

References:

Approach

Combine neutrons, x-rays and simulation to provide fully resolved structures of intrinsically disordered systems

Develop functional membrane platforms that emulate biological processes such as transport

Improve computational models for interpretive and predictive capacity

Employ advanced isotopic labeling techniques to exploit neutron and x-ray contrast

Impact

Membrane science will drive applications in materials science, energy, health and security

Bioinspired self-assembly of materials

Improved biofuel production and photosynthetic model systems

Drug delivery, imaging and diagnostics

Sensors for chemical and biological agents

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