Biologically Assembled Quantum Electronic Arrays

Objective
• To direct biological assembly of nanostructures exhibiting quantum many-body phenomena
  – Many-body phenomena are those which cannot be described by single particle approximations such as density functional theory.

Approach
• Use DNA- and protein-directed assembly of nanostructures as model systems to study many-body quantum effects
• Investigate chemical modifications of the nanostructure surfaces to separately control (i) binding to biological molecules and (ii) solubility of nanostructures in a biological (aqueous) environment

Technical Successes
• Modified trimer proteins with externally accessible cistine (binds easily to metals) and demonstrated binding to metal nanoparticles
• Designed chemical moieties for separately controllable nanostructure binding and solubility

MURI website: http://www.ece.umn.edu/groups/muri/index.htm

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Potential Scientific Impact
• May accelerate the study of many-body phenomena in nanostructures by providing a readily engineerable fabrication process
• Provides an avenue to develop a fundamental understanding of quantum many-body physics

Potential Payoff for the Army
• Understanding the mechanisms used by biological systems for nanoparticle assembly can lead to reduced manufacturing costs for military electronics.
• An understanding of quantum many-body physics may lead to new ideas for technological developments using new states of matter.