Programming Materials to Self-Replicate and Assemble Into Adaptive Geometries

Dr. Rebecca Schulman

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Abstract:
It is a grand challenge to understand how to engineer molecular reaction systems which have the self-assembled, dynamic structure and directed information flow of even the simplest biological cells. Synthetic DNA is a model material for this endeavor: DNA reaction rates and sequence-specific affinities are well-characterized, and we can predict and design the 2- and 3-dimensional structures of the products. I'll describe how we can use synthetic DNA to design an autonomous, enzyme-free system for chemical sequence replication in which the replicated information consists of stripes or arrays of different 14x3 nanometers bricks within a 2D lattice. These replicatable lattice patterns are suitable for waveguide or protein array templates. The cytoskeleton creates dynamic, adaptive structure in eukaryotic cells based on local rules. I'll also describe some work toward creating a rationally engineered, cytoskeleton-like material made from DNA nanotube filaments. One basic construction primitive for this material is the assembly of filaments such that they bridge fixed start and destination points. I'll show how we can template the growth of filaments from a "start" chemical marker, how growing filaments can attach to a "finish" marker, and briefly discuss how we could use this system to create self-guiding wires.

Biography:
Rebecca Schulman is a Miller Research Fellow in the physics department at the University of California Berkeley. She received undergraduate degrees in computer science and mathematics from MIT and a PhD in computation and neural systems at Caltech, where she studied under Erik Winfree. Dr. Schulman applies ideas from chemical engineering, electrical engineering, material science and biophysics to the design of programmable soft materials.

Host: Sr. Assoc. Dean Timothy Pinkston

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