Session Title: Platform E: Molecular Mechanics and Force Spectroscopy

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Abstract Title: Employing Optical Tweezers to Study the Mechanics of Filamentous Bacteriophage Harnessed as Nanomaterial Scaffolds

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In the first optical trapping demonstration with biological systems by Ashkin and Dziedzic, *E. coli* and tobacco mosaic virus were manipulated in solution by laser light. Since then, this technique has been extended to study the biophysics of many cells, biopolymers, and molecules. In light of recent success in genetically endowing benign viruses with the ability to assemble and grow nanomaterials, our aim is to study the properties of single filamentous bacteriophage in solution, ultimately to predict its behavior throughout the assembly and mineralization process.
M13 bacteriophage is a flexible, filamentous macromolecule, composed of 5 different structural proteins that package around its ssDNA into dimensions of approximately 880nm in length and 6-7nm in diameter. This virus species is of particular interest for its use as a vehicle in peptide library screening, for its ability to deliver DNA and innocuously transform bacteria, for its insight into the viral infection process, and, most recently, for its nanomaterial synthesis. Despite this, flexibility and mechanics of filamentous bacteriophage in solution are topics for debate. Reported persistence lengths range from approximately 700-850nm, based on bent rod quantitative models, to 2.2 microns, measured by dynamic light scattering, to as large as 6.6 microns, from electron microscopy.
In this work, we present the first attempt to mechanically probe the entropic behavior and elasticity of *single* M13 bacteriophage in solution by optical tweezers. Genetically engineering recognition peptides onto capsid proteins at the ends of the virus provides a platform for assembling single virus tethers in solution. We manipulate the free ends of the filaments via polystyrene beads and consequently generate force-extension curves. Preliminary results and modeling reveal persistence lengths of yet lower than previously reported, suggesting an increased degree of filament flexibility in solution.

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