

# NSF Applied Math Collaborative Grant

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# 1 Introduction

## 1.1 Surface tension and HAP

## 1.2 Boundary Integral Equation Method

## 1.3 PDE and variational

# 2 Mathematical model for self-assembly: mechanical and rheological properties

## 2.1 Clustering behavior as a function of attraction repulsion

### 2.1.1 1D analogy

### 2.1.2 Mathematical heuristics

### 2.1.3 Experimental results

## 2.2 Consequences of symmetry breaking

### 2.2.1 Asymmetric shapes

### 2.2.2 Asymmetrical boundary conditions

## 2.3 Mechanical and rheological properties of particle mats

### 2.3.1 Thermal fluctuation

# 3 Long-range, generalization of surface tension

## 3.1 Boundary layer theory

## 3.2 $\Gamma$ -convergence for energies

## 3.3 Conjectured maximal overlap

## 3.4 Curve shortening with HAP

# 4 Statistical mechanical derivation of Helfrich hamiltonian

# 5 Maxwell stress tensor results

## 5.1 Linearized Debye-Hückel theory

## 5.2 Electro-static and related problems

## 5.3 Techniques for extending to 3D

## 5.4 Particle docking