# Contents

# 1 test 1

## 1.1 test 2

### 1.1.1 test 3

- test 4

# 2 Melting A

## 2.1 Background re: melting

### 2.1.1 Theories of melting, 3D, 2D, bulk

- 3D crystallites w/ stable surfaces melt from within via Born melting
  In this case, melting can be viewed as nucleation and growth of fluid phase within the solid.
- 2D large crystallites melt by two-step process via hexatic phase
- 2D finite crystallites melt from perimeter
  - if melt from perimeter, dN/dt goes as $N^{1/2}$

#### 2.1.2 Expectations for 2D finite crystallites

### 2.2 Experiment of Savage et. al

#### 2.2.1 Setup

#### 2.2.2 Tunable Depletion potential

#### 2.2.3 Results

- N vs. t

- $< psi6 >^2$ vs. N

- $C_6$ vs. N, by layer

- No dependence of fast-melting feature on initial cluster size or melting rate

### 2.3 Simulations

#### 2.3.1 Motivation

#### 2.3.2 GROMACS System

#### 2.3.3 Brownian dynamics

#### 2.3.4 Simulated Depletion Potential

#### 2.3.5 Simulated Lennard-Jones Potential

#### 2.3.6 Results

- N vs. t

- $< psi6 >^2$ vs. N

- $C_6$ vs. N, by layer

- mean-square fluctuations in bond lengths

- N vs. t for Lennard-Jones potential

- Phase diagram showing lack of fluid phase with short-range potential

#### 2.3.7 Discussion

# 3 Melting B

## 3.1 Background

### 3.1.1 Hypothesis: thermally-activated defects enhance melting rate in short-range 2D system

## 3.2 Simulation Methods

### 3.2.1 Gromacs system

### 3.2.2 Brownian Dynamics

### 3.2.3 Characteristics of Simulated Depletion Potential

### 3.2.4 Initial configurations

## 3.3 Results

### 3.3.1 N vs t

### 3.3.2 Order vs. N

### 3.3.3 Breakdown by layers

## 3.4 Conclusions

# 4 Diameter of Random Clusters

## 4.1 Background

## 4.2 Simulations

## 4.3 Results

# 5 Phase Transitions in Computational Complexity

## 5.1 Background

### 5.1.1 Constraint Satisfaction Problems (CSP)

- Examples
  - kSAT
  - Graph-coloring

  - Spin models

  - error-correcting codes

- Observation of threshold behavior in CSP

- Difficulties in tackling phase behavior of CSP

### 5.1.2 Proposal: study complexity of percolation model

## 5.2 Percolation

### 5.2.1 The Model

### 5.2.2 Background / applications

## 5.3 PRAM

### 5.3.1 Applications in comp sci

### 5.3.2 PRIORITY CRCW

## 5.4 Parallel Algorithm for Percolation

## 5.5 Results

### 5.5.1 $D_2$ vs. p for several system sizes L

### 5.5.2 $\log(D_2)$ vs. $\log(L)$

### 5.5.3 Distribution of cluster sizes

- logarithmic or power law? (power law –¿ algorithm will often fail)