Physicae Auscultationes

D. W. Blair

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I. MELTING A

A. Background re: melting

1. *Theories of melting, 3D, 2D, bulk*

a. 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.

or yet another structure.

- or even another

b. 2D large crystallites melt by two-step process via hexatic phase

c. 2D finite crystallites melt from perimeter

if melt from perimeter, dN/dt goes as $N^{1/2}$

2. *Expectations for 2D finite crystallites*

B. Experiment of Savage et. al

1. *Setup*

2. *Tunable Depletion potential*

3. *Results*

a. N vs. t

b. $< psi6 >^2$ *vs. N*

c. C_6 *vs. N, by layer*

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

C. Simulations

1. Motivation

2. GROMACS System

3. Brownian dynamics

4. Simulated Depletion Potential

5. Simulated Lennard-Jones Potential

6. Results

a. N vs. t

b. $< psi6 >^2$ *vs. N*

c. C_6 *vs. N, by layer*

d. mean-square fluctuations in bond lengths

e. N vs. t for Lennard-Jones potential

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

7. Discussion

II. MELTING B

A. Background

1. Hypothesis: thermally-activated defects enhance melting rate in short-range 2D system

B. Simulation Methods

1. Gromacs system

Here's a good test. [1]

2. Brownian Dynamics

3. Characteristics of Simulated Depletion Potential

4. Initial configurations

C. Results

1. N vs t

2. Order vs. N

3. Breakdown by layers

D. Conclusions

III. DIAMETER OF RANDOM CLUSTERS

A. Background

B. Simulations

C. Results

IV. PHASE TRANSITIONS IN COMPUTATIONAL COMPLEXITY

A. Background

1. Constraint Satisfaction Problems (CSP)

a. Examples

kSAT

Graph-coloring

Spin models

error-correcting codes

b. Observation of threshold behavior in CSP

c. Difficulties in tackling phase behavior of CSP

2. Proposal: study complexity of percolation model

B. Percolation

1. The Model

2. Background / applications

C. PRAM

1. Applications in comp sci

2. PRIORITY CRCW

D. Parallel Algorithm for Percolation

E. Results

1. D_2 *vs.* p *for several system sizes* L

2. log(D_2*) vs. log(L)*

3. Distribution of cluster sizes

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

V. BIBLIOGRAPHY

[1] Youjin Deng, Wei Zhang, Timothy M. Garoni, Alan D. Sokal, and Andrea Sportiello. New critical exponents for percolation and the random-cluster model. pages 1–4, 2009.