

**ANNOUNCEMENT:** Interested Members of the University Community are Invited to attend the Final Oral Examination for the Degree of Master of Science

## DOUG GRZETIC

of the Department of Physics, on Friday, December 2, 2011 at 10:00 a.m. in MacNaughton Building, Room 434 University of Guelph.

Thesis Title: **Polymer Dynamics: A Self-Consistent Field-Theoretic Approach**

Examination Committee: Dr. Paul Garrett, Chair  
Dr. Robert Wickham, Advisor  
Dr. Bernhard Nickel

### ABSTRACT

We develop a self-consistent field theory of polymer dynamics, based on a functional integral approach, which is analogous to the existing equilibrium self-consistent field theory for polymers. We apply a saddle-point approximation to the exact dynamical theory, which generates a set of mean-field equations for the time-dependent density and mean force field. We also develop a method of treating the single-chain dynamics exactly, subject to this mean-field, resulting in a functional Fokker-Planck equation that must be solved along with the mean-field equations in a self-consistent manner. To test the self-consistency, we apply the theory to the simple but non-trivial case of  $n_p$  Brownian particles interacting via a short-range repulsion in a harmonic external potential. Results for the non-interacting case agree with the literature. The interacting case demonstrates physically sensible interaction-dependent dynamics, such as an increased broadening of the density field when the repulsion is increased. We also examine the dynamics of a binary system with two distinct particle species. We calculate the center-of-mass trajectories for colliding distributions of species A and B, and observe that when the difference of repulsion strengths  $\chi$  between like and unlike species is greater than a threshold value (between  $\chi = 0.3$  and  $\chi = 0.4$ ), the two species do not mix (indicating the onset of phase segregation).

By: Doug Grzetic  
Advisor: Dr. Robert Wickham

## CURRICULUM VITAE

### EDUCATIONAL BACKGROUND:

BSc (Honours), Memorial University of Newfoundland, 2009.

### ACADEMIC AWARDS:

2005 Hibernia Engineering Scholarship

2006 NSERC USRA

2007 NSERC USRA

2008 NSERC USRA

2009 MUN Academic Excellence in Physics

2010 OGS

2011 CAP Congress Best Student Talk Competition, 2<sup>nd</sup> Place (DCMMP Division)