VIGRE APPLICATION PART III · SPRING 2010
STATEMENT OF INTELLECTUAL MERIT AND BROADER IMPACT

JOHN KERL

Ultimately, one hopes to increase understanding of Bose-Einstein condensates through the three-pronged approach of theory, simulation, and physical experiment. Realistically, one must admit that the simulations done for this dissertation work involve a simplified model, somewhat far from the Bose gas. The more immediately relevant benefits of this dissertation include its careful and thorough explication of methods, which I hope will serve as a template for future work by other researchers investigating this or other probability models. My hard industrial software experience, combined my mathematical training at the UA and the expert guidance of Daniel Ueltschi and Tom Kennedy, uniquely position me to complete this project. This thorough an experimental investigation of the random-cycle model has not, to our knowledge, ever been undertaken. The worm algorithm, in particular, is a novel adaptation of a path-integral Monte Carlo technique to a new probability model. My dissertation is largely complete; the portions which are incomplete are clearly identified and well-contained. CPU time on the University of Arizona's ICE high-performance computing cluster has been scheduled and is adequate to obtain desired results in time for a March 2010 dissertation defense. Available resources are matched by low risk.

My conference attendance will enable me to make important professional contacts; my work with undergraduate Howard Cheng and junior graduate Shane Passon serves to spread my successful, hard-won software techniques. A rough draft of my dissertation, just like the rest of my writings and lecture notes, is already available on the Internet. With Daniel Ueltschi, I will submit my results for publication after my graduation. Following Daniel and Tom's advice, I am currently completing a draft of this paper, which will fit neatly into the end of my dissertation. While it is possible that the work done here will increase understanding of Bose-Einstein condensates in unforeseeable ways, it is more likely that the careful, thorough elucidation of Markov chain Monte Carlo, thermalization, autocorrelation, and finite-size scaling techniques will have a greater impact on the research community.

Date: April 6, 2009.