VIGRE REPORT PART II · FALL 2009

JOHN KERL

1. Dissertation research

I presented the progress of my research to the UA mathematical physics seminar on Wednesday, September 9, 2009. I put this in the form of a very early, rough-draft job talk; I received much useful feedback from the audience, particularly from Bob Sims.

My co-advisor Daniel Ueltschi suggested earlier this fall that I write a draft paper of my dissertation results before, rather than after, defending my dissertation. He suggested this for two purposes: (1) for him, as a writer of letters of recommendation on my behalf, to evaluate my ability to work independently and write up my research, and (2) in order for me to be able to list a submitted publication on my job-application materials, rather than the more dubious-sounding "paper in preparation". As of two weeks ago, I have completed this draft and have received some feedback from Daniel; I am awaiting additional feedback from my other co-advisor Tom Kennedy before submitting the paper for publication. I hope to submit it before year's end.

I have completed the worm-algorithm section of my dissertation. The superfluid-fraction, extrapolation, and finite-size-scaling portions are all complete and contained within my draft paper; I need merely to copy, paste, and lightly edit these to form missing dissertation chapters.

As described in the paper, I have quantified ΔT_c for the r_ℓ model on the lattice; the sought-after constant described in my VIGRE application is currently estimated to be 0.665 ± 0.067. The error bar will only shrink as more compute runs complete on the University of Arizona's High-Performance Computing cluster, over the next month or so. The value itself is of interest: it matches (to within experimental uncertainty) the analytical result obtained by Ueltschi and Betz for the small-cycle-weight model with varying point positions. This suggests that fine details of interjump interactions and point positions do not affect the constant of linearity in the shift in critical temperature, although the critical temperatures themselves do differ noticeably.

Let $\ell_{\max}$ be the length of the longest cycle in a permutation; let Nf_I be the number of cycles in macroscopic cycles. For non-interacting and r_2-interacting spatial permutations, $\langle \ell_{\max} \rangle / Nf_I$ is empirically found to be the same (approximately 63%) as for uniformly distributed permutations. For r_ℓ interactions, this is no longer the case. In the paper (and thus in my dissertation), I characterize this phenomenon: The 63% fraction in the non-interacting random-cycle model matches the 1966 result of Shepp and Lloyd for non-spatial permutations; interactions give rise to a weak linear increase in the fraction.

Off-lattice computations will not be pursued for my dissertation work; these are a possible postdoctoral project. For my dissertation, points are held fixed on the lattice, with cycle-length-weighed interactions between permutation jumps. This is an artificial model, of its own probabilistic interest; furthermore, it sheds light on which properties of the random-cycle model do and do not depend on the fine details of point positions or interactions. For the Bose-gas model, one should pursue off-lattice point positions as well as permutation-jump interactions which are derived from the Bose-gas model.

Date: December 9, 2009.

2. Items other than dissertation research

I am currently completing my final course: Probability and Random Processes in Engineering, in the Electrical Engineering department. This satisfies an out-of-department requirement.

The percolation project alluded to in my application, which is an analysis and write-up of work with Janek Wehr in spring 2008, has been on hold this semester in favor of job applications and dissertation work. Nonetheless, I will bring this to a close by the end of the spring semester. The remaining work for the percolation project consists of (1) finite-size-scaling analysis, which I now have a good handle on, and (2) writing up the paper, which will not be difficult.

I have been meeting weekly with Tom Kennedy's bridge group. My contributions have been twofold: (1) mentoring an undergraduate, Howard Cheng, to produce computational results, and (2) analyzing those results. Howard already had facility with the Java programming language; Tom's bridge libraries are in C++, so Howard had the opportunity to learn some C++ programming. We are examining empirical distributions of heights of irreducible bridges for upper-half-plane self-avoiding walks. In particular, it is believed that UPSAWs are decomposable as a concatenation of IID irreducible bridges, and their concatenated heights are expected (following recent work of Alberts) to adhere to a stable distribution. My analysis at present indicates that (a) the distributions do indeed appear to be stable; (b) the stable-distribution parameters are estimatable; (c) I will need to do further work to confirm or deny that the stable-distribution parameters are, to within experimental uncertainty, the ones predicted by Alberts. It has been a pleasure working with Howard; he and I both plan to continue working on this project in the spring semester.

The Joint Meetings of the AMS/MAA will be Jan. 13-16, 2010, in San Francisco. I have a 15-minute talk scheduled for 8 a.m. Wed. Jan. 13, and will be spending much of the rest of my time in the Job Center.

David Landau's Center for Simulational Physics in Athens, Georgia, will be holding a weeklong conference Mon.-Fri. Feb. 22-26 2010. I have applied to participate, and have been accepted. I will focus on my talk on my worm algorithm: this offers an added feature over the algorithm used for the computational results in my dissertation, but it has a stopping-time problem. At the conference I hope to get some ideas about that problem. I also hope to make many professional contacts.

I completed my CV, teaching statement, and research statement in October; since then, I have continued to search for and apply for jobs. Due to the breadth and depth of my experience, I have the opportunity to apply for various types of positions; given the sad state of the current job market, I moreover have the necessity of doing so. I have approximately 40 applications out, several of them with a Dec. 1 application deadline; at least a dozen more will go out with Jan. 1st deadlines. I am considering postdoc, visiting, and tenure-track academic positions, as well as industrial and government-laboratory work. To date I have had three phone interviews, one on-site interview, and two letters of rejection. This is not bad; yet, I will be happy to receive a job offer, and happier yet to receive a marginal offer and be able to turn it down in favor of a better one.