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EDUCATION

- Ph.D.* The Ohio State University, Physics March 2000
Dissertation: Topics in the statistical physics of disordered and inhomogeneous systems.
Thesis advisor: Professor David G. Stroud
- M.S.* Indian Institute of Technology (IIT) Kanpur, India, Physics May 1993

PROFESSIONAL EMPLOYMENT

- Postdoctoral Research Scientist, NEC Laboratories, America 09/02 - present
- Postdoctoral Researcher, Department of Physics, University of California at Davis 04/00-08/02
- Research Assistant, Department of Physics, The Ohio State University 04/95-03/00
- Visiting Scientist, Theory Department, Fritz-Haber Insitute, Berlin 10/96-12/96
- Teaching Assistant, Department of Physics, The Ohio State University 10/93-03/95

RESEARCH EXPERIENCE

Postdoctoral Research, NEC Laboratories 09/02 - present

Protein-DNA interactions: The binding of special proteins called transcription factors to DNA is crucial for genetic regulation. Used bioinformatics tools to characterize the interaction of transcription factors with DNA in bacterial genomes and to make several novel discoveries: 1) The discovery of genetic elements (small RNAs) crucial for quorum sensing in *V. Cholerae*. Experiments are currently underway at Princeton University to verify these predictions. 2) Prediction of transcriptional regulation for small RNAs in *E. coli* on a genomewide basis. These results make predictions for several regulatory interactions which have not been discovered so far. 3) The discovery of regulation of a new metabolic pathway by the arginine repressor in the bacteria *B. subtilis* and *B. Halodurans*.

Modeling protein oscillations: In *E. coli*, accurate cell division depends on the localization and oscillations of the Min proteins: MinC, MinD and MinE. Analytically solved a 1D model for the protein oscillations thereby accounting for key unexplained experimental features relating to the localization of Min proteins.

Postdoctoral Research, University of California at Davis

04/00 - 08/02

Modeling of prion diseases: Prion diseases, such as Mad-Cow disease and Creutzfeldt-Jakob disease in humans, increasingly represent a serious public health threat. Collaborated in developing a statistical mechanical model which simulates the universal features of prion disease, models 'species barriers' to prion infection and assesses a related treatment protocol. Analytically solved the model in the low concentration limit and explored the connection between aggregation morphology and incubation time distributions.

Valence Tautomerism: Complex organic molecules showing valence tautomerism (i.e. spin crossover coupled with electron transfer) are potential candidates for molecular switches. Investigated the energetics of such molecules using large-scale density functional theory calculations elucidating the nature of charge transfer in the crossover phenomenon. Proposed a domain model to account for the extraordinarily large entropy values inferred from experiments.

Doctoral Research, The Ohio State University

04/95 - 03/00

Liquid Semiconductors: Pure semiconductor crystals are commonly grown from the liquid state; hence an understanding of liquid semiconductors is essential. Investigated and made predictions for the structural, dynamic and transport properties of liquid semiconductors using large-scale density functional theory calculations. This work was carried out in coordination with a large NASA microgravity experiment.

Fractional Vortices: The XY model has been extensively studied as a model for many physical systems including high- T_c superconductors. Proposed a novel set of excitations in the XY model called 'fractional vortices'. Used this concept to provide an elegant solution to finding the ground state of the XY model with antiferromagnetic defects and related the results to recent experiments on high- T_c superconductors.

Small-world Networks: Small-world networks represent a mathematical model for a diverse group of real-life networks ranging from the Internet to food-webs in ecosystems. Proved exact results for this model and studied its scaling properties. Demonstrated that in the limit of large system sizes and small disorder, the properties of the network can be obtained from a single distribution function thereby considerably reducing computational effort.

PUBLICATIONS

E. Almaas, R. V. Kulkarni and D. Stroud, "Scaling of the random walk on small-world networks" *Phys. Rev. E* **68** 056105 (2003)

M. Chandran and R. V. Kulkarni, "Fractionalization of a flux quantum in a one-dimensional parallel Josephson junction array with alternating p-bonds" *Phys. Rev. B* **68** 104505 (2003)

D. L. Mobley, D. L. Cox, R. R. P. Singh, R. V. Kulkarni, A. Slepoy, "Simulations of oligomeric intermediates in prion diseases" *Biophys. J.*, **85** 2213-2223 (2003)

R. V. Kulkarni, A. Slepoy, R. R. P. Singh, D. L. Cox and F. Pazmandi "Theoretical modeling of prion disease incubation" *Biophys. J.* **85** 707-718 (2003)

D. L. Cox, R. G. Endres, R. V. Kulkarni, M. X. Labute and R. R. P. Singh, "Electron correlation effects in biological molecules" *Int. J. Mod. Phys. B*, **16** 3377 (2002)

E. Almaas, R. V. Kulkarni and D. Stroud, "Characterizing the structure of small-world networks" *Phys. Rev. Lett.* **88** 0981011 (2002)

M. X. LaBute, R. V. Kulkarni, R. G. Endres and D. L. Cox "Strong electron correlations in cobalt valence tautomers" *J. Chem. Phys.* **116** 3681 (2002)

A. Slepoy, R. R. P. Singh, F. Pazmandi, R. V. Kulkarni and D. L. Cox, "Statistical mechanics of prion diseases" *Phys. Rev. Lett.* **87** 058101 (2001)

R. V. Kulkarni, E. Almaas, K. D. Fisher and D. Stroud, "Fractional vortices in the XY-model with p-bonds" *Phys. Rev. B* **62** 12119 (2000)

R. V. Kulkarni and D. Stroud, "*Ab Initio* molecular dynamics simulation of liquid Ga_xAs_{1-x} alloys" *Phys. Rev. B* **62** 4991 (2000)

R. V. Kulkarni, E. Almaas and D. Stroud, "Exact results and scaling properties of small world networks" *Phys. Rev. E* **61**, 4268 (2000)

S. V. Khare, R. V. Kulkarni, D. Stroud and J. W. Wilkins, "First principles study of the energetics and STM images of Si ad-dimers on Ge(001)" *Phys. Rev. B* **60**, 4456 (1999)

R. V. Kulkarni and D. Stroud, "*Ab Initio* molecular dynamics simulation of liquid Ga-Ge alloys" *Phys. Rev. B* **57**, 10476 (1998)

R. V. Kulkarni, W. G. Aulbur, and D. Stroud, "*Ab Initio* molecular dynamics study of the structural and transport properties of liquid germanium" *Phys. Rev. B* **55**, 6896 (1997)

PREPRINTS

R. V. Kulkarni, C. Tang and N. Wingreen "Computational studies of sRNA regulation in *E. coli*" (to be submitted to *PNAS*)

R. V. Kulkarni, K. C. Huang and N. Wingreen "Pattern formation in *E. Coli*: diffusion and self-catalyzed membrane attachment of MinD protein" (to be submitted to *Phys. Rev. Lett.*)

K. Mok, D. Lenz, R. V. Kulkarni, C. Tang, N. Wingreen and B. Bassler "Discovery of regulatory RNAs controlling quorum sensing in *V. Cholerae* and *V. Harveyi*" (to be submitted to *Cell*)

INVITED TALKS

"Computational studies of regulation of small RNAs in bacteria", INVITED presentation to be delivered at the 2004 March Meeting of the American Physical Society, Montreal, CA

"Statistical mechanics and stochastic modeling of prion diseases", INVITED presentation delivered at the 2002 March meeting of the American Physical Society, Indianapolis, IN, March 4-8, 2002.

"Fractional vortices in the XY model with antiferromagnetic bonds," INVITED presentation delivered at the CLC conference 2001, Lake Tahoe, CA, February 8-11, 2001.

"Fractional vortices in the XY model with p-bonds," INVITED presentation delivered at the Physics by the Bay 2000 conference, Berkeley, CA, September 15, 2000.

"*Ab Initio* simulations of structural and electronic properties of liquid semiconductors," INVITED presentation delivered at the 1999 Centennial meeting of the American Physical Society, Atlanta, GA, March 20-26, 1999.

PRESENTATIONS

"Theoretical modeling of prion disease incubation" Keystone Symposia meeting on Prion Diseases, Breckenridge, CO, April 2-6, 2003.

Invited participant in the ICAM conference "Physical principles of amyloid aggregation" University of California at San Francisco, San Francisco, CA, November 29-December 01, 2001.

"*Ab Initio* study of Co complexes exhibiting valence tautomerism" 2001 March meeting of the American Physical Society, March 12-16, 2001, Seattle, Washington.

"Fractional vortices in the XY model with pi-bonds," 2000 March Meeting of the American Physical Society, Minneapolis, MN, March 20-24, 2000.

"On the properties of small-world networks," General Colloquium presented at the Santa Fe Institute, Santa Fe, NM, September 7, 1999.

"Polarization Density Functional theory and the dielectric properties of semiconductors," ES98 (Electronic Structure '98) conference, Philadelphia, PA, May 29-June 1, 1998.

"Comments on the geometric phase approach to macroscopic polarization of insulators," 1998 March Meeting of the American Physical Society, Los Angeles, CA, March 16-20, 1998.

"*Ab Initio* molecular dynamics simulation of liquid Ga-Ge alloys," 1998 March Meeting of the American Physical Society, Los Angeles, CA, March 16-20, 1998.

"*Ab Initio* study of neural defects on GaAs(110) surfaces," 1997 March Meeting of the American Physical Society, Kansas City, MO, March 18-22, 1997.

"Diffusion in liquid Germanium using *ab initio* molecular dynamics," 1996 March Meeting of the American Physical Society, St. Louis, MO, March 18-22, 1996.

PROFESSIONAL AFFILIATIONS

American Physical Society	06/95-present
American Association for the Advancement of Science	10/98-present
New York Academy of Sciences	04/98 to 04/99

REFERENCES

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