# Michael Kamal

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## Education

1988—1994 Ph.D., Department of Physics, Harvard University.

1984—1988 B.S., Department of Physics, Massachusetts Institute of Technology.

## Work Experience

2001—2006 Broad Institute of MIT/Harvard;
Whitehead/MIT Center for Genome Research
Computational Biologist ('02-'06),
Postdoctoral Researcher ('01-'02).

1994—2000 Goldman, Sachs & Co.
Associate (Fall '94- Summer '98), Vice-President (until Dec '99), and later a consultant in the Quantitative Strategies Group within the Equity Derivatives area.

## Finance

- Priced Equity Derivative structures and exotic options for the Equity Derivatives trading desk.
- Developed analytic software in C for the pricing and risk management of equity derivatives. Worked closely with developers to integrate with other applications.
- Carried out financial research on volatility markets, pricing models that incorporate the volatility skew, trading and risk management. Published extensively and presented research, both internally and to clients. Some of these reports can be found at:

  http://www.ederman.com/new/index.html#quantitative_strategies

  Selected topics:
  - Volatility and variance swaps.
  - Replication errors introduced by discrete hedging.

  - Principal component analysis of the volatility surface and its application to risk management.
- Created a Monte Carlo financial programming language and simulation environment (Monaco) for pricing complicated securities and analyzing hedging strategies — similar in spirit to Matlab, or S-Plus. Implemented using LEX/YACC and C. Wrote an extensive user manual for the software package.
- Carried out risk simulations for GSFP, a AAA-rated subsidiary for fixed-income and equity derivative structures. The models captured credit and market risk within a unified framework.
- Completed the Fixed Income traning program for new associates. Passed the series 7, 3 and 63 examinations.

## Genomics/Computational Biology Research

Leading researcher in application of quantitative and computational modeling to biological problems. Research involves algorithmic development, statistics and the analysis of large, noisy datasets. Selected topics:

- Comparative sequence analysis of mammalian genomes aimed at characterizing the 5% of the human genome that is believed to be functionally important.
- The role of transposable elements ("junk DNA") in genome evolution. I have found examples of classes of related functional elements in the human genome that are derived from transposable elements.
- Epigenomics: the study of heritable information in the genome beyond what is encoded in the DNA sequence itself. We discovered a novel marker (histone modification) associated with embryonic stem cells.
- Patterns of gene expression in the malarial parasite, Plasmodium Falciparum. We are collaborating with malaria experts to help identify those genes that might represent potential vaccine targets and markers for particular life stages of the parasite.

## Physics Research

Carried out theoretical research in several areas of condensed matter physics:

- The role of topological defects in phase transitions. The effect of vortex singularities on the disordering transition of three-dimensional magnetic systems was studied by Monte Carlo simulation.

- Numerical renormalization group methods. Motivated by the discovery of superconductivity in doped fullerenes (C60), new techniques were developed to study interaction effects in finite-size Fermi systems.
- Persistent currents in mesoscopic rings. A combination of numerical studies and analytical arguments showed that electron interactions can enhance the magnitude of currents in small conducting rings threaded by magnetic flux.

## Programming and Software Skills

Extensive programming experience in Perl, Java and C. Familiar with LEX/YACC. Some familiarity with C++. Basic HTML; rudimentary knowledge of PHP, SQL, JavaScript. Experience with Matlab, S-Plus and various bioinformatic packages. Adept at quickly acquiring new software skills.

## Selected Interests Outside Work

- Teaching English to Spanish-speaking immigrants, most recently at the Conciolio Hispano in Cambridge, MA.
- Playing classical guitar, usually with more enthusiasm than talent.
- Opinionated discussions with friends focused on current news and world events.

## Mathematical Finance Articles in Peer-Reviewed Journals

1. "More Than You Ever Wanted to Know About Volatility Swaps (but Less Than Can Be Said)", Kresimir Demeterfi, Emanuel Derman, Michael Kamal and Joseph Zou. *The Journal of Derivatives*, Summer 1999.
2. "When You Cannot Hedge Continuously: The Corrections to Black-Scholes" Emanuel Derman and Michael Kamal. *Risk*, January 1999.
3. "Trading and Hedging Local Volatility", Iraj Kani, Emanuel Derman and Michael Kamal. *The Journal of Financial Engineering*, September 1997.

## Genomics/Computational Biology Publications

1. "A family of conserved noncoding elements derived from an ancient repeat", Xiaohui Xie,Michael Kamal, Eric S Lander, *Proc Natl Acad Sci USA* In press.
2. "A bivalent chromatin structure marks key developmental genes in embryonic stem cells", Bradley E. Bernstein, Tarjei S. Mikkelsen, Xiaohui Xie, Michael Kamal, Dana J. Huebert, James Cuff, et al., *Cell* 125, 315-26 (2006).
3. "DNA sequence of chromosome 17 and analysis of rearrangement in the human lineage.", Michael C. Zody, et al, *Nature* 440(7087),1045-9 (2006).
4. "A large family of ancient repeat elements in the human genome is under strong selection", Michael Kamal, Xiaohui Xie, Eric S Lander, *Proc Natl Acad Sci USA* 103,2740-2745 (2006).
5. "Genomic maps and comparative analysis of histone modifications in human and mouse", Bradley E. Bernstein*, Michael Kamal*, Kerstin Lindblad-Toh, Stefan Bekiranov, Dione K. Bailey, Dana J. Huebert, Scott McMahon, Elinor K. Karlsson, Edward J. Kulbokas III, Thomas R. Gingeras, Stuart L. Schreiber and Eric S. Lander, *Cell* 120, 169-81 (2005).
6. "DNA sequence and analysis of human chromosome 18.", Chad Nusbaum, Michael C Zody, Mark L Borowsky, Michael Kamal, Chinnapa Kodira, et al, *Nature* 437(7058),551-5 (2005).
7. "Genome sequence, comparative analysis and haplotype structure of the domestic dog.", Kerstin Lindblad-Toh,Clare M. Wade, Tarjei S. Mikkelsen, Elinor K. Karlsson, David B. Jaffe, Michael Kamal, Michele Clamp, et al,*Nature* 438(7069),803-19 (2005).
8. "Analytical evolutionary model for protein fold occurrence in genomes, accounting for the effects of gene duplication, deletion, acquisition and selective pressure", M. Kamal, N. Luscombe, J. Qian, M. Gerstein, *Power laws, scalefree networks and genome biology*, Ed. E. V. Koonin, Y. I. Wolf, and G. P. Karev. Landes Bioscience-Springer , New York, 2005,
9. "Finishing the euchromatic sequence of the human genome", International Human Genome Sequencing Consortium, *Nature* 431(7011),931-45 (2004).
10. "Integrated Analysis of Protein Composition, Tissue Diversity, and Gene Regulation in Mouse Mitochondria", Vamsi K. Mootha, Jakob Bunkenborg, Jesper V. Olsen, Majbrit Hjerrild, Jacek R. Wisniewski,

Erich Stahl, Marjan S. Bolouri, Heta N. Ray, Smita Sihag, Michael Kamal, Nick Patterson, Eric S. Lander, and Matthias Mann, *Cell* 115, 629-40 (2003).

11. "The Genome Sequence of the Filamentous Fungus Neurospora crassa", J. Galagan et al., et al., *Nature* 422(6934),859-68 (2003).
12. "Initial sequencing and comparative analysis of the mouse genome", R.H. Waterston, et al., *Nature* 420(6915), 520-62 (2002).

## Physics Publications

1. "Surface and thermodynamic interatomic force fields for silicon clusters and bulk phases", J.R. Chelikowsky, J.C. Phillips, M. Kamal, M. Strauss. *Physical Review Letters* 62, 292-295 (1989).
2. "New O(3) Transition in three dimensions", M. Kamal and G. Murthy. *Physical Review Letters* 71, 1911-1914 (1993).
3. "Numerical Renormalization Group for finite Fermi systems", T. Tokuyasu, M. Kamal and G. Murthy. *Physical Review Letters* 71, 4202-4205 (1993).
4. "Enhancement of Persistent Currents by Hubbard Interactions: Avioded Level Crossings Interpretation", M. Kamal, Z. H. Musslimani and A. Auerbach. *J. Phys. I France*, Vol. 5, 1487-1499 (1995).