Alexander E. Lobkovsky Meitiv
National Center for Biotechnology Information (NCBI)
National Library of Medicine (NLM)
National Institutes of Health (NIH)
Bldg. 38A, Room 5S-514D
8600 Rockville Pike
Bethesda, MD 20894
Email: meitiv@mail.nih.gov

home:
7911 Woodbury Drive
Silver Spring, MD 20910
Telephone: (301) 244-9624

Personal information

Citizenship: US.

Languages: Russian, English.

Degrees

Ph.D., Physics, University of Chicago, August 1996.

B.S. Summa cum laude, Physics, Indiana University, Bloomington, Indiana, 1992.

Experience

IRTA Fellow. National Center for Biotechnology Information, National Institutes of Health, 2008–present.

Visiting Assistant Professor. Physics Department, Georgetown University, 2007–2008.

Research Scientist, Department of Earth Atmospheric and Planetary Science, Massachusetts Institute of Technology, 2005–2007.

Postdoctoral Fellow, Department of Earth Atmospheric and Planetary Science, Massachusetts Institute of Technology, 2002–2005.

Postdoctoral Fellow, Department of Physics, Northeastern University, 2001–2002.

National Research Council Postdoctoral Fellow, National Institute of Standards and Technology, Metallurgy Division, 1999–2001.

Postdoctoral Fellow, Institute for Theoretical Physics, University of California, Santa Barbara, 1996–1999.

Honors

Deans list Indiana University, 1990–1992.

Hugh Brown Memorial Scholarship, 1991.

Honors Division Independent Summer Research Grant, 1992.

First place at the Moscow Math Olympiad, 1989 (similar to the Putnam Competition).

Experience

IRTA Fellow, National Institutes of Health, 2008 – present

How predictable is molecular evolution? One of the most intriguing questions in evolutionary biology is: to what extent evolution is deterministic and to what extent it is stochastic and hence unpredictable? In other words, what happens if "the tape of evolution is replayed:" are we going to see completely different outcomes or the constraints are so strong that history will be repeated. We developed a quantitative measure of evolutionary predictability and explored its properties in populations evolving on rugged fitness landscapes. With E. V. Koonin and Y. I. Wolf.

Universal distribution of evolution rates of protein coding genes Genome-scale distributions of evolutionary rates or protein coding genes are similar in shape across all major kindoms of life. We proposed that protein folding robustness is the dominant factor in the rate variability and thus the constructed a polymer folding model which yielded the variability of folding robustness compatible with the empirical distribution of evolution rates. With E. V. Koonin and Y. I. Wolf.

Visiting Assistant Professor, Georgetown University, 2007 – 2008

Crystallization in quasi-2D granular media Inelasticity introduces a fundamental difficulty in understanding the behavior of granular matter. Analytical methods of equilibrium statistical mechanics are not applicable and a number of theoretical approaches have been developed to understand the effect of inelasticity. Our goal is to test these approaches in a numerical simulation of a confined shaken granular layer which undergoes a discontinuous ordering transition. With J. S. Urbach.

Research Scientist, MIT, 2005 – 2007

Stochastic modeling of the microtubule tip dynamics Constructed and analyzed a stochastic model for the dynamics of the microtubule tips. Cracks play an essential role in explaining the bistable dynamical behavior exhibited by microtubules. With L. A. Mirny.

Onset of granular flow driven by a viscous fluid: Theory Introduced a model of the stochastic onset of granular flow. The crucial features of the onset phenomenon stem from the evolving granular surface packing driven by granular flow.

Onset of granular flow driven by a viscous fluid: Experiment Analyzed an experiment in which surficial granular flow is imaged via an index-matching technique. Determined the threshold condition for flow and the granular flow rule above threshold forcing. With A. Kudrolli and A. Orpe (Clark)

Channelization driven by subsurface flow: Field measurements Performed topographic and hydrologic measurements in the naturally occurring sapping canyons in FL. The data will test theories of channel network evolution and sediment motion. With D. C. Mohrig (U. of Texas) and D. H. Rothman.

Postdoctoral Fellow, MIT, 2002 – 2005

Channelization driven by subsurface flow: Data analysis Explained regimes of granular motion in a table-top experiment in which subsurface water flow erodes a pile of glass beads. Verified the total shear stress on the bed controls the onset of erosion. Introduced the concept of a generalized Shields number which includes gravitational forces.

Channelization driven by subsurface flow: Model of channel evolution Used the time-resolved experimental height data obtained via laser-aided imaging to construct an effective theory of channel evolution. The theory has far reaching consequences for a broad range of problems in geomorphology. With A. Kudrolli (Clark U.) and D. H. Rothman.

Postdoctoral Fellow, Northeastern University, 2001 – 2002

Coarse grained model of dynamic fracture instability Analyzed dynamic fracture instability within a coarse grained in a theory of mode III fracture. Within our model, the crack undergoes a tip splitting instability at a critical speed dependent on the dissipation in the bulk. With A. Karma.

Dynamics of Ising interfaces Derived an intuitive representation of kinetic Ising interfaces and obtained an equation of motion for the density of kinks. The formalism is extensible to more complex situations such as the presence of impurities. With D. J. Srolovitz (Princeton).

NRC Postdoc, NIST, Gaithersburg, Maryland, 1999 – 2001

Diffusion in a lamellar system with screw dislocations Explained the origin of super-diffusion in a lamellar phase with screw dislocations. Given the density of positive and negative screw dislocations, we analytically calculated the statistics of transport. With V. Gurarie (U. of Colorado).

Premelting of grain boundaries Explored the behavior of grain boundaries near the melting temperature using a modification of the traditional phase field model of solidification which includes the effect of crystal orientation in the solid phase. Found that high angle grain boundaries can undergo a discontinuous premelting transition at a temperature below the melting point.

Dynamics of crystalline grains Performed a matched asymptotic expansion of a phase field model of grain boundary dynamics. In this model, a degree of crystallinity order parameter is coupled to the crystal orientation order parameter. The resulting Allen-Cahn type evolution equation for the orientation order parameter is singular and must be interpreted within an extended gradient framework. The model predicts grain rotation. With J. A. Warren, R. Kobayashi and G. McFadden.

Postdoctoral Fellow, Institute for Theoretical Physics, UCSB, 1996 – 1999

Expanding hole in a viscoplastic medium Studied a simple situation in which both stress concentration as well as inhomogeneous plastic flow occur. Found that conclusions of conventional plasticity emerge in a static limit only for a certain range of parameters of the dynamic plasticity model. The very existence of the yield surface, for example, depends on a basic parameter which measures sensitivity of plastic flow to applied stress. With J. S. Langer.

Dynamics of elastic boundaries Studied motion of elastic boundaries such as cracks or earthquake faults subject to simple physically motivated boundary conditions. Found that under quite general assumptions travelling kinks exist on the boundary. If the boundary is disordered, it's threshold dynamics is governed by the creation and annihilation of these kink solutions. With S. Ramanathan.

The dynamic ductile to brittle transition Constructed a one dimensional model of decohesion. Found that, if the decohering membrane obeys the dynamic viscoplasticity constitutive relations, there is a sharp transition as a function of the yield stress. With J. S. Langer.

Plasticity of amorphous materials Developed a phenomenological model of plasticity based on the notion of generalized defects. The model incorporates strain hardening and plastic yield stress observed in molecular dynamics simulations and is well suited to fully dynamic calculations in fracture mechanics. With M. L. Falk and J. S. Langer.

Fracture stability Numerically solved the singular integral equation which determines fracture stability of a crack described by a cohesive-zone model. Established important limitations of cohesive-zone models. Defined classes of fracture mechanics problems which may be addressed with a cohesive-zone model. With J. S. Langer.

Graduate student, University of Chicago, 1992 – 1996

Strongly deformed thin elastic plates and shells	Performed computer simulations of thin elastic sheets distorted by external forces and identified a novel ridge singularity. Determined scaling properties of an idealized ridge singularity in the limit of the vanishing sheet thickness by an energy scaling argument and an asymptotic analysis of von Kármán thin plate equations. Qualitatively established the degree to which ridges in a crumpled sheets may differ from an idealized ridge.
Acoustic emission from a crumpled elastic sheet	Analyzed noise emitted from crumpled mylar sheets under slow large scale deformation. The sound consisted of well-defined clicks with stretched exponential relaxation and a power law distribution of amplitudes. With E. M. Kramer.
Surface Energy of Dipolar Crystals	Using Ewald summation methods as well as continuum electrostatics found that surface energies of dipolar crystals exhibit cusps with novel logarithmic behavior. These results should be relevant to determination of droplet dynamics in Electrorheological Fluids.
Shape of Dielectric Fluid Drop in Electric Field	Established that dielectric fluid drops undergo a shape transition in an electric field. Found that sharp conical vertices at which the electric field diverges algebraically develop above a threshold field. With Hao Li and Thomas C. Halsey.

References

Dr. Eugene V. Koonin
National Center for Biotechnology Information
National Library of Medicine
National Institutes of Health
Bldg. 38A, Room 5N503
8600 Rockville Pike
Bethesda, MD 20894
Tel. 301-435-5913
Fax 301-435-7794
`koonin@ncbi.nlm.nih.gov`

Prof. Daniel H. Rothman
Earth Atmospheric and Planetary Science
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139
Tel. 617-253-7861
Fax 617-253-1699
`dhr@mit.edu`

Prof. James S. Langer
Department of Physics
University of California
Santa Barbara, CA 93106
Tel. 805-893-7597
Fax 805-893-8838
`langer@physics.ucsb.edu`

Prof. Thomas A. Witten
Department of Physics
The University of Chicago
5640 S. Ellis Ave.
Chicago, IL 60637-1436
Tel. 773-702-0947
Fax 773-702-2172
`t-witten@uchicago.edu`

Publications

A. P. Petroff, O. Devauchelle, D. M. Abrams, A. E. Lobkovsky, A. Kudrolli and D. H. Rothman, “Geometry of valley growth,” J. Fluid Mech., **673**, p. 245 (2011).

O. Devauchelle. A. P. Petroff, A. E. Lobkovsky, and D. H. Rothman, “Longitudinal profile of channels cut by springs,” J. Fluid Mech., **667**, p. 38 (2011).

A. E. Lobkovsky, Y. I. Wolf and E. V. Koonin, “Universal distribution of protein evolution rates as a consequence of protein folding physics,” Proc. Nat. Acad. Sci. USA, 107, p. 2983 (2010).

A. E. Lobkovsky, F. V. Reyes and J. S. Urbach, “The effects of forcing and dissipation on phase transitions in thin granular layers,” Euro. Phys. J., **179**, p. 113 (2009).

D. M. Abrams, A. E. Lobkovsky, A. P. Petroff, K. M. Straub, B. McElroy, D. C. Mohrig, A. Kudrolli and D. H. Rothman, “Growth laws for channel networks incised by groundwater flow,” Nature Geoscience, **2**, p. 193 (2009).

B. Smith, A. Kudrolli, A. E. Lobkovsky and D. H. Rothman, “Channel erosion due to subsurface flow,” Chaos, **18**, p. 041105 (2008).

A. E. Lobkovsky, A. V. Orpe, R. Molloy, A. Kudrolli and D. H. Rothman, “Erosion of a granular bed driven by laminar fluid flow,” J. Fluid Mech., **605**, p. 47 (2008)

A. E. Lobkovsky, B. E. Smith, A. Kudrolli, D. C. Mohrig and D. H. Rothman, “Erosive dynamics of channels incised by subsurface water flow,” J. Geophys. Res., **112**, p. F03S12 (2007).

M. R. Horton, S. Manley, S. R. Arevalo, A. E. Lobkovsky, A. P. Gast, “Crystalline protein domains and lipid bilayer vesicle shape transformations,” J. Phys. Chem. B, **111** (4), p. 880 (2007).

M. Upmanyu, D. J. Srolovitz, A. E. Lobkovsky, J. A. Warren and W. C. Carter, “Simultaneous grain boundary migration and grain rotation,” Acta Materialia, **54**, p. 1707 (2006)

A. Karma and A. E. Lobkovsky, “Low-temperature dynamics of kinks on Ising interfaces,” Phys. Rev. E, **71**, no. 3, p. 36114 (2005).

A. E. Lobkovsky, B. Jensen, A. Kudrolli and D. H. Rothman, “Threshold phenomena in erosion driven by subsurface flow,” J. Geophys. Res. **109**, p. F04010 (2004).

A. E. Lobkovsky and A. Karma, “Unsteady Crack Motion and Branching in a Phase-Field Model of Brittle Fracture,” Phys. Rev. Lett. **92**, no. 24, p. 245510 (2004).

A. E. Lobkovsky, A. Karma, M. I. Mendelev, M. Haataja and D. J. Srolovitz, “Grain shape, grain boundary mobility and the Herring relation,” Acta Materialia, **52**, no. 2, p. 285 (2004).

J. A. Warren, R. Kobayashi, A. E. Lobkovsky and W. C. Carter, "Extending phase field models of solidification to polycrystalline materials," Acta Materialia **51**, no. 20, p. 6035 (2003)

V. Gurarie and A. E. Lobkovsky, "Tracer diffusion in a dislocated lamellar system," Phys. Rev. Lett. **88**, 178301 (2002).

A. E. Lobkovsky and J. A. Warren, "Phase field model of premelting of grain boundaries" Physica D **164**, no. (3-4) p. 202 (2002).

A. E. Lobkovsky and J. A. Warren. "Sharp interface limit of a phase-field model of crystal grains," Phys. Rev. E **6305**, p. 1605 (2001).

A. E. Lobkovsky and J. A. Warren, "Phase-field model of crystal grains," J. Cryst. Growth, **225**, p. 282 (2001).

A. E. Lobkovsky and J. A. Warren, "A Phase Field Model of the Premelting of Grain Boundaries in Pure Materials," MRS Proceedings v. 652 (2000).

J. S. Langer and A. E. Lobkovsky, "Rate-and-state theory of plastic deformation near a circular hole," Phys. Rev. E. **60**, p. 6978 (1999).

A. E. Lobkovsky and J. S. Langer, "Dynamic ductile to brittle transition in a one-dimensional model of viscoplasticity," Phys. Rev. E **58**, p. 1568 (1998).

A. E. Lobkovsky and J. S. Langer, "Critical Examination of Cohesive-zone Models in the Theory of Dynamic Fracture," J. Mech. Phys. Solids **46**, p. 1521 (1998).

A. E. Lobkovsky and T. A. Witten, "Properties of Ridges in Elastic Membranes," Phys. Rev. E **55**, p. 1577 (1997).

A. E. Lobkovsky, "Boundary Layer Analysis of the Ridge Singularity in a Thin Plate," Phys. Rev. E **53**, p. 3750 (1996).

E. M. Kramer and A. E. Lobkovsky, "Universal Power Law in the Noise from a Crumpled Elastic Sheet," Phys. Rev. E **53**, p. 1465 (1996).

A. E. Lobkovsky, S. Gentges, H. Li, D. Morse and T. A. Witten, "Stretching Ridges in Crumpled Sheets," Science **270**, p. 1482 (1995).

A. E. Lobkovsky and T. C. Halsey, "Surface Energy Anisotropy for Dipolar Lattices," J. Chem Phys., **103**, p. 3737 (1995).

H. Li, T. C. Halsey and A. E. Lobkovsky, "Singular Shape of a Fluid Drop in an Electric or Magnetic Field," Europhys. Lett., **27**, p. 575 (1994).

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