

CURRICULUM VITAE

Dr. MICHAEL (MISHA) CHERTKOV

Los Alamos National Laboratory, Theoretical Division, T-13, Los Alamos, NM 87545
chertkov@lanl.gov <http://cnls.lanl.gov/~chertkov/> w:(505)-6658119 fax:(505)-6653003

PERSONAL

Born: September 20, 1967, Moscow

Marital status: married, 3 sons (born 1989,1993,2004)

EDUCATION

1996 Ph.D. Physics, Weizmann Institute of Science

1990 M.Sc. Physics, Novosibirsk State University

EMPLOYMENT

2002- Full Term Technical Staff Member, Theoretical Division, Los Alamos NL

1999-2001 J.R. Oppenheimer Fellow, Theoretical Division, Los Alamos NL

1996-99 R.H. Dicke Fellow, Department of Physics, Princeton University

1993-96 Research Assistant, Weizmann Institute of Science

1990-92 Junior Researcher, Budker Institute, Novosibirsk

AWARDS and ADJUNCT AFFILIATIONS

2008 Visiting Researcher (NM Consortium)

2007 Weston Visiting Professor (Weizmann Institute)

2007 Visiting Scholar (Joint Theory Institute at U of Chicago and ANL)

2004 CNRS Visiting Scholar (Nonlinear Institute, Nice)

1999 J.R. Oppenheimer Fellowship at LANL

1996-99 Consultant (Bell Laboratories, Lucent Technologies)

1996 R.H. Dicke Fellowship at Princeton

1996 Prize of the Feinberg Graduate School

1995 Prize of the Charles Clore Israel Foundation

WORKSHOPS ORGANIZED at the Center for Nonlinear Studies /LANL (2005-)

03/2008 Classical and Quantum Information Theory (Santa Fe)

05/2007 Algorithms, Inference and Statistical Physics (Santa Fe)

08/2006 Two-Dimensional Turbulence (Los Alamos)

07/2005 Multiscale Interactions in Turbulent Flow (Santa Fe)

01/2005 Application of Statistical Physics to Coding Theory (Santa Fe)

POSTDOCS at LANL

2008- Jason Johnson (Ph.D. MIT) - *Computer Science, Machine Learning*

2008- Lenka Zdeborova (Ph.D. Orsay; Director's Fellowship) - *Statistical Physics, Combinatorial Optimization*

2006- Nandakishore Santhi (Ph.D. UCSD)- *Information/Coding Theory*

2006- Razvan Teodorescu (Ph.D. U of Chicago; Director's Fellowship) - *Mathematical/Statistical Physics*

2005-2007 Colm Connaughton (Lecturer at U of Warwick, UK) - *Statistical Physics, Turbulence*

2004-2006 Misha Stepanov (Junior Faculty at UA, Tucson) - *Statistical Physics, Theory of Error-Correction*

2002-2004 Yeo-Jin Chung (Junior Faculty at SMU, Dallas) - *Applied Mathematics, Fiber Optics Communications*

2001-2004 Avner Peleg (Junior Faculty at SUNY, Buffalo) - *Applied Mathematics, Fiber Optics Communications*

RESEARCH GRANTS (PI)

2008-2011 Harnessing Statistical Physics for Computing and Communication (NSF via NM Consortium) \approx 130\$/year

2007-2009 Physics of Algorithms (LDRD/DR) \approx 1.5M\$/year

2006-2008 Novel physics inspired approach to error-correction (LDRD/ER at LANL) \approx 300K\$/year

2006-2007 Prediction of Mixing Induced by Rayleigh-Taylor Instability (WSR at LANL) \approx 200K\$/year

2001-2003 Statistical Physics of Fiber Optics Communications (LDRD/ER at LANL) \approx 190K\$/year

INVITED PRESENTATIONS at CONFERENCES and WORKSHOPS (2008-)

11-12/2008 Population Genetics and Genomics, KITP/UCSB

10/2008 DIMACS Working Group on Message-Passing Algorithms, Rutgers U

06/2008 L.D.Landau Memorial Conference *Advances in Theoretical Physics*, Chernogolovka (Russia)

05/2008 CNLS Annual Conference on Information Science and Technology, Santa Fe

03/2008 Collective Dynamics in Information Systems, KITPC, Beijing (China)

01/2008 The 2008 Information Theory and Application Workshop, ITA, UCSD

FIELDS OF INTEREST:

Theoretical, Statistical and Mathematical Physics, Applied Mathematics, Hydrodynamics, Optics, Classical and Quantum Information Theory, Error-Correction Theory, Computer Science, Mathematical Genetics, Bio-Physics

PATENT

U.S. Patent 6701050, issued March 2, 2004: Methods and Optical Fibers that decrease pulse degradation resulting from random chromatic dispersion, Co-author: I. Gabitov.

LIST OF PUBLICATIONS

79. Irreversible Monte Carlo Algorithms for Efficient Sampling, arxiv:0809.0916, co-authors: K. Turitsyn, M. Vucelja.
78. Fermions and Loops on Graphs. II. Monomer-Dimer Model as Series of Determinants, co-author: V. Chernyak.
77. Fermions and Loops on Graphs. I. Loop Calculus for Determinant, co-author: V. Chernyak.
76. Provably Efficient Instanton Search Algorithm for LP-decoding over the BSC, submitted to IEEE IT, arXiv:0808.2515, co-authors: S.K. Chilappagari and B. Vasic.
75. Belief Propagation and Beyond for Particle Tracking, arXiv: 0806.1199, co-authors: L. Kroc, M. Vergassola,
74. Reactive Rayleigh Taylor Turbulence, submitted to JFM, co-authors: V. Lebedev, N. Vladimirova.
73. Belief Propagation and Loop Series on Planar Graphs, JSTAT/2008/P05003, arxiv:0802.3950, co-authors: V. Chernyak, R. Teodorescu.
72. Exactness of Belief Propagation for Some Graphical Models with Loops, submitted to JSTAT, <http://arxiv.org/abs/0801.0341>
71. Non-equilibrium thermodynamics for functionals of current and density, <http://arxiv.org/abs/0712.3542>, co-authors: V. Chernyak, S.V. Malinin, R. Teodorescu.
70. Reducing the Error Floor, invited talk at the Information Theory Workshop '07 on "Frontiers in Coding", September 2-6, 2007; <http://arxiv.org/abs/0706.2926>.
69. Strong effect of weak diffusion on scalar turbulence at large scales, *Physics of Fluids* **19**, 101703 (2007), co-authors: I. Kolokolov, V. Lebedev; <http://arxiv.org/abs/0706.2928>.
68. Self-Similarity and Universality in Rayleigh-Taylor, Boussinesq Turbulence, submitted to *Physics of Fluids*, arXiv:0801.2981, co-author: Natalia Vladimirova.
67. Bethe-Free-Energy Based Decoding of Low-Density Parity-Check Codes on Partial Response Channels, submitted to *IEEE Journal of Selected Areas in Communications*, co-authors: J. A. Anguita, B. Vasic, and M. A. Neifeld.
66. Statistical geometry in homogeneous and isotropic turbulence, *Journal of Turbulence* **8**, 39 (2007), co-authors: Aurore Naso and Alain Pumir.
65. Searching for low weight pseudo-codewords, invited talk at the 2007 Information Theory and Application Workshop, proceedings ITA CALIT2, UCSD, cs.IT/0702024, co-author: Mikhail Stepanov.
64. Pseudo-codeword Landscape, Proceedings of ISIT 2007, June 2007, Nice, cs.IT/0701084, co-author: Mikhail Stepanov.
63. Loop Calculus and Belief Propagation for q-ary Alphabet: Loop Tower, Proceedings of ISIT 2007, June 2007, Nice, cs.IT/0701086, co-author: Vladimir Chernyak.
62. Dynamics of Energy Condensation in Two-Dimensional Turbulence, co-authors: C. Connaughton, I. Kolokolov and V. Lebedev, *Phys.Rev.Lett.* **99**, 084501 (2007).
61. Loop Calculus Helps to Improve Belief Propagation and Linear Programming Decodings of Low-Density-Parity-Check Codes, co-author: Vladimir Chernyak, invited talk at 44th Allerton Conference (September 27-29, 2006, Allerton, IL), arXiv:cs.IT/0609154.
60. Statistics of entropy generated by a gradient flow over polymer, co-authors: Konstantin Turitsyn, Vladimir Chernyak, Alberto Puliafito, *Phys.Rev.Lett.* **78**, 180603 (2007), nlin.CD/0609051.
59. Improving convergence of belief propagation decoding, co-author: Mikhail G. Stepanov, cs.IT/0607112, Proceedings of 44th Allerton Conference (September 27-29, 2006, Allerton, IL).
58. Path-integral analysis of fluctuation theorems for general Langevin processes, co-authors: Vladimir Chernyak and Christopher Jarzynski, cond-mat/0605471, JSTAT/2006/P08001.
57. Loop series for discrete statistical models on graphs, co-author: Vladimir Chernyak, cond-mat/0603189, JSTAT/2006/P06009.
56. Scale dependence of the coarse-grained velocity derivative tensor: influence of large scale shear on small-scale turbulence, *Journal of Turbulence* **7**, 41 (2006), co-authors: A. Naso, A. Pumir.
55. An Efficient Pseudo-Codeword-Search Algorithm for Linear Programming Decoding of LDPC Codes, arXiv:cs.IT/0601113, *IEEE Transactions on Information Theory* **54**, 1514 (2008), co-author: Mikhail Stepanov.
54. Loop Calculus in Statistical Physics and Information Science, *Phys. Rev. E* **73**, 065102(R) (2006), cond-mat/0601487, co-author: Vladimir Chernyak.
53. Instanton analysis of Low-Density-Parity-Check codes in the error-floor regime, arXiv:cs.IT/0601070, Proceeding of ISIT 2006, July 2006 Seattle, co-author: Mikhail Stepanov.
52. The error-floor of LDPC codes in the Laplacian channel, Proceedings of 43rd Allerton Conference (September 28-30, 2005, Allerton, IL), arXiv:cs.IT/0507031, co-author: Mikhail Stepanov.
51. Diagnosis of weakness in error correction: a physics approach to error floor analysis, *Phys. Rev. Lett.* **95**, 228701 (2005)+cond-mat/0506037 (long version), co-authors: Mikhail Stepanov, Vladimir Chernyak, Bane Vasic.

50. Dynamical generalization of non-equilibrium work relation, *Phys. Rev. E* **71**, 025102 (2005), co-authors V. Chernyak and C. Jarzynski.
49. Polymer Statistics in a Random Flow with Mean Shear, *Journal of Fluid Mechanics* **531**, 251-260 (2005), co-authors: Igor Kolokolov, Vladimir Lebedev and Konstantin Turitsyn.
48. Effects of surface tension on immiscible Rayleigh-Taylor turbulence, *Phys. Rev. E* **71**, 055301 (2005), co-authors: Igor Kolokolov, Vladimir Lebedev.
47. Error correction on a tree: An instanton approach , *Phys. Rev. Lett.* **93**, 198702-1 (2004), co-authors: Vladimir Chernyak, Mikhail Stepanov, Bane Vasic.
46. Outage probability for soliton transmission, *Euro. Phys. Lett* **66**, 499 (2004), co-authors: Vladimir Chernyak, Igor Kolokolov, and Avner Peleg.
45. Phenomenology of Rayleigh-Taylor Turbulence, *Phys. Rev. Lett.* **91**, 115001 (2003).
44. PMD induced fluctuations of Bit-Error-Rate in optical fiber systems, *Journal of Lightwave Technology* **22**, 1155 (2004), co-authors: Vladimir Chernyak, Ildar Gabitov, Igor Kolokolov, and Vladimir Lebedev.
43. Periodic and Quasi-Periodic Compensation Strategies of Extreme Outages caused by Polarization Mode Dispersion and Amplifier Noise, *JETP Lett.* **78**, 198-201 (2003), <http://arXiv.org/abs/physics/0303015>, co-authors: Vladimir Chernyak, Igor Kolokolov, and Vladimir Lebedev.
42. Compensation for Extreme Outages caused by Polarization Mode Dispersion and Amplifier noise, *Optics. Express.* **11**, 1607 (2003), <http://www.opticsexpress.org/abstract.cfm?URI=OPEX-11-14-1607>, co-authors: Vladimir Chernyak, Igor Kolokolov, and Vladimir Lebedev.
41. Extreme Outages due to Polarization Mode Dispersion, *Optics. Lett.* **28**, 2159 (2003), co-authors: Vladimir Chernyak, Igor Kolokolov, and Vladimir Lebedev.
40. Probability of anomalously large Bit-Error-Rate in long haul optical transmission, *Phys. Rev. E* **68**, 066619 (2003), co-authors: Vladimir Chernyak, Igor Kolokolov and Vladimir Lebedev.
39. Passive Compensation of Polarization Mode Dispersion via Periodic Control of Birefringent Disorder, *JOSA B* **21**, 486 (2004), co-authors: I. Gabitov, I. Kolokolov and T. Schäfer.
38. Inter-channel interaction of optical solitons, *Phys. Rev. E* **68**, 026605 (2003), co-authors: A. Peleg and I. Gabitov.
37. Inelastic collisions of pulses in optical fibers, *JOSA B* **21**, 18 (2004), co-authors: A. Peleg and I. Gabitov.
36. Shedding and interaction of solitons in weakly disordered optical fibers, *Phys. Rev. E.* **67**, 036615 (2003), co-authors: Y. Chung, A. Dyachenko, I. Gabitov, I. Kolokolov, and V. Lebedev.
35. Boundary effects on chaotic advection-diffusion chemical reactions, *Phys. Rev. Lett* **90**, 134501 (2003), co-author: V. Lebedev.
34. Decay of scalar turbulence revisited, *Phys. Rev. Lett* **90**, 034501 (2003), co-author: V. Lebedev.
33. Pinning method of pulse confinement in optical fiber with random dispersion, *JOSA B* **19**, 2538 (2002), co-authors: I. Gabitov, P. Lushnikov, J. Moeser, Z. Toroczka.
32. Solitons in Optical Medium with Disorder and Anisotropy, *Pis'ma v ZhETF* **74**, 608 (2001), co-authors: I. Gabitov, I. Kolokolov, V. Lebedev.
31. Shedding and Interaction of Solitons in Imperfect Medium, *Pis'ma v ZhETF* **74**, 391 (2001) [*JETP Letters* **74**, 357 (2001)], co-authors: I. Gabitov, I. Kolokolov, V. Lebedev.
30. Pulse confinement in optical fibers with random dispersion, *Proc. Natl. Acad. Sci. USA* **98**, 14208 (2001), co-authors: I. Gabitov, J. Moeser.
29. The Lagrangian view of energy transfer in turbulent flow, *Euro. Phys. Lett.* **56**, 379 (2001), co-authors: A. Pumir, B. Shraiman.
28. Geometry of Lagrangian Dispersion in Turbulence, *Phys. Rev. Lett.* **85**, 5324 (2000), co-authors: A. Pumir, B. Shraiman.
27. Turbulence in Polymer Solutions, *Proceedings of IUTAM 99 symposium on Geometry and Statistics of Turbulence*, editors T. Kambe, T. Nakano and T. Miyauchi, *Fluid Mechanics and Its application Bookseries*, ISBN 0-7923-6711-1, Kluwer Academic Publisher, 2001.
26. Polymer Stretching by Turbulence, *chao-dyn/9911011*, *Phys. Rev. Lett.* **84**, 4761 (2000).
25. Small-scale turbulent dynamo, *chao-dyn/9906030*, *Phys. Rev. Lett.* **83**, 4065 (1999), co-authors: G. Falkovich, I. Kolokolov and M. Vergassola.
24. Lagrangian Tetrad Dynamics and Phenomenology of Turbulence, *Physics of Fluids* **11**, 2394 (1999), Co-authors: A. Pumir, and B. Shraiman.
23. Passive advection in nonlinear medium, *chao-dyn/9809010*, *Physics of Fluids* **11**, 2257 (1999).
22. On how a joint interaction of two innocent partners (smooth advection & linear damping) produces a strong intermittency, *chao-dyn/9803007*, *Physics of Fluids* **10**, 3017 (1998).
21. Propagation of a Huygens front through turbulent medium, *chao-dyn/9709028*, *Phys. Rev. Lett.* **80**, 2837 (1998), Co-author: V. Yakhot.

20. Intermittent dissipation of a passive scalar in turbulence, *chao-dyn/9709005*, Phys. Rev. Lett. **80**, 2121 (1998), Co-authors: G. Falkovich, and I. Kolokolov.
19. Inverse versus direct cascades in turbulent advection, *chao-dyn/9706016*, Phys. Rev. Lett. **80**, 512 (1998), Co-authors: I. Kolokolov, and M. Vergassola.
18. Inverse cascade and intermittency of passive scalar in 1d smooth flow, *chao-dyn/9706017*, Phys. Rev. E **56**, 5483 (1997), Co-authors: I. Kolokolov, and M. Vergassola.
17. Instanton for random advection, *chao-dyn/9606011*, Phys. Rev. E **55**, 2722 (1997).
16. Non-universality of the scaling exponents of a passive scalar convected by a random flow, Phys. Rev. Lett. **76**, 3707 (1996), *chao-dyn/9601016*, Co-authors: G. Falkovich, and V. Lebedev.
15. Anomalous scaling exponents of a white-advection passive scalar, Phys. Rev. Lett. **76**, 2706 (1996), *chao-dyn/9509007*, Co-author: G. Falkovich.
14. Theory of random advection in two dimensions, Int. J. Mod. Phys. B **10**, 2273 (1996), Co-authors: G. Falkovich, I. Kolokolov, and V. Lebedev.
13. The fourth-order correlation function of a randomly advected passive scalar, JETP Lett **61**, 1012 (1995), *chao-dyn/9508002*, Co-authors: E. Balkovsky, I. Kolokolov, and V. Lebedev.
12. Normal and anomalous scaling of the fourth-order correlation function of a randomly advected passive scalar, Phys. Rev. E **52**, 4924 (1995), *chao-dyn/9503001*. Co-authors: G. Falkovich, I. Kolokolov, and V. Lebedev.
11. Equilibrium and nonequilibrium mean-field dynamics of quantum spin cluster., Sov.Phys.JETP **79**, 824 (1994), Co-author: I. Kolokolov.
10. Exact field-theoretical description of passive scalar convection in N-dimensional long-range velocity field, Phys.Lett.A **192**, 435 (1994), Co-authors: A. Gamba and I. Kolokolov.
9. Equilibrium dynamics of a paramagnet cluster, Phys.Rev.B **51**, 3974 (1995), Co-author: I. Kolokolov.
8. Statistics of a passive scalar advected by a large-scale 2D velocity field: analytic solution, Phys.Rev.E **51**, 5609 (1995), Co-authors: G. Falkovich, I. Kolokolov and V. Lebedev.
7. Passive scalar convection in a 2D long-range delta-correlated velocity field: exact results, Journ. of Phys. A **27**, 4925 (1994), Co-authors: Y. V. Fyodorov and I. Kolokolov.
6. Structural instability of two-dimensional turbulence, Physica D **78**, 11 (1994), Co-author: G. Falkovich.
5. Long-time dynamics of the infinite-temperature Heisenberg magnet, Phys. Rev. B **49**, 3592 (1994), Co-author: I. Kolokolov.
4. Functional integral and effective Hamiltonian t-J-V model of strongly correlated electron system, J. of Stat. Phys. **69**, 231 (1992), Co-author: V.I. Belinicher.
3. High-temperature phase of the 2D Coulomb gas model near the Kosterlitz- Thouless phase transition, Phys. Lett. A **162**, 402(1992).
2. The supersonic motion of a phase transition front, Sov. Solid. State **32**, 550 (1990), Co-author: A.Z.Patashinski.
1. The motion of a phase transition front in deep metastability, Sov. Solid. State **32**, 287 (1990), Co-author: A.Z.Patashinski.