Gerald John Lapeyre Jr.

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Education

2001	Ph.D. *Physics*, University of Arizona. Dissertation: "Random Walks on Fluctuating Lattices". Advisors: Prof. Daniel L. Stein and Prof. C. David Levermore.
1987	B.Sc. *Physics*, University of Oregon.

Research interests

Statistical physics	Non-equilibrium statistical physics. Transport, reaction, mixing. Anomalous diffusion. Transport in biological cells.
Quantum computing	Near–term algorithms. Benchmarking and verification. Modeling superconducting circuits. Characterization of quantum entanglement. Distribution of entanglement. Quantum complex networks. Entanglement purification.
Data Science	Machine learning. Collaborative filtering. Content-based predictive tools, classifiers.
Atomic Physics	Ultra-cold, low-dimensional quantum gases.
Precision metrology	Nano-Newton-second impulse measurement.

Recent employment

Apr 2019–Apr 2020	Quantum Software Engineer at Rigetti Computing. Development of and software for variational algorithms (VQE, VQLS, etc.) benchmarking, simulator, QPU control, Hardware modeling. Customer support. Product management support.
2018–2019 2015-2017	Research Scientist at IDAEA/CSIC – Institute of Environmental Assessment and Water Research. Stochastic modeling of reactive transport[2].
2017-2018	Data Scientist at Invendium Ltd. Researched, implemented and deployed in production 1) collaborative-filtering ad recommender. 2) Text-analytics-based ad targeting.
2015-2017	Visiting Scientist at ICFO – The Institute of Photonic Sciences. Advising students and postdocs in stochastic modeling of transport.
2009-2015	Research Fellow at ICFO – The Institute of Photonic Sciences. Stochastic modeling of transport on cell membrane[6]. Characterization of quantum entanglement. Quantum entanglement on complex networks[7].
2007–2009	Researcher in quantum information theory with Prof. Jan Wehr (University of Arizona) and Prof. Maciej Lewenstein (ICFO)[10].

2001-2009	Research engineer/scientist at Zetetic Institute and PM and AM Research, Tucson Arizona. Precision metrology. Ultra-low impulse measurement systems. All phases from design to deployment: designing; building; mathematical modeling of instrument; experimenting; writing all software from instrument control to UI; supervising interns; offsite deployment in production; writing reports[11].

Previous employment

2002	Research associate at University of Massachusetts-Boston. Computational micro-fluidics, motility of individual eukaryotic cells.
2000-2001	Postdoc at Optical Sciences Center, University of Arizona. Theoretical/computational research in low-dimensional quantum gases.
1997	Research assistant at University of Arizona. Computation of dynamic electron densities in semiconductors.
1996	Research assistant at University of Arizona. Ultra-cold quantum gases.
1989-1990	Research assistant at Laboratoire pour l'Utilisation du Rayonnement Electromagnétique, Orsay, France. Designed/used instruments for solid state physics research at synchrotron ring.
1988-1989	Research Assistant at Fritz-Haber Institut, Berlin. Solid state physics instrumentation and research.
1987	Research assistant at Brookhaven National Lab. Solid state physics.

Teaching/Mentoring

2000-2014	Guest lectures in Statistical mechanics, philosophy, seminar series in transport phenomena. University of Arizona.
2013-2014	Mentored students in computational/theoretical physics project including writing resulting paper[3]. ICFO – The Institute of Photonic Sciences.
2013	Completed course for Florida Southwestern State College Online Canvas Certification
2012	Instructor for "Youth and Science" (Joves I Ciencia) summer program for exceptionally highly achieving high school seniors. ICFO, Castelldefels, Spain.
2008	College Algebra, MATH 122. University of Arizona/Pima Community College.
2003	College Algebra, MATH 151. Pima Community College.
1999	Phys 570, Quantum Mechanics. Writing solutions, Recitation section. University of Arizona.
1998	Phys 475/575 Mathematical Methods. Writing solutions, Recitation section. University of Arizona.
1998	Phys 325, Thermal Physics. Grading, Recitation section.
1994-2000	Taught laboratory sections for many physics courses at many levels for both majors and non-majors. University of Arizona.

Invited conference talks

2015 May 14	*Confinement and Disordered Confinement in Anomalous Diffusion.* Stochastic Modeling of Anomalous Dynamics in Complex Physical and Biological Systems. Hugo Steinhaus Center, Wrocław University of Technology

2014 September 7	*Local and global geometry in entanglement percolation.* Quantum Technologies Conference V. Jagiellonian University, Kraków, Poland
2013 September	*Entanglement Distribution on Networks.* Quantum Technologies Conference IV, Warsaw. University of Warsaw
2013 May	*Entanglement Distribution on Complex Networks.* IQC workshop on quantum computation and complex networks. Institute for Quantum Computing, University of Waterloo
2010 October	*Entanglement Percolation: beyond pure bi-partite states.* Complex Quantum Systems. Instituto de Física Interdisciplinar y Sistemas Complejos IFISC (UIB-CSIC). Palma de Mallorca, Spain

Other invited and contributed talks and presentations

2020 February	*Variational Algorithms on a Hybrid Quantum / Classical computer.* Seminar. ICFO, Barcelona.
2018 August	*Symbolic Computation in Julia.* JuliaCon 2018. University College of London.
2017 July 14	*Julia: A solution to the two language problem.* Barcelona Supercomputer Center CASE Seminar.
2016 September 16	*Anomalous kinetics in reaction-subdiffusion systems arising from physical and chemical environments.* 29th Marian Smoluchowski Symposium on Statistical Physics. Zakopane, Poland.
2016 June 8	*Anomalous diffusion in disordered confinement.* XXV Sitges Conference on Statistical Mechanics. Barcelona.
2016 May 23-17	*Subdiffusion in coupled continuous time random walks.* (poster) 617. WE-Heraeus Seminar on Quantifying Complex Transport with Levy Walks. Physikzentrum, Bad Honnef, Germany.
2016 March	*Disordered confinement and anomalous diffusion.* APS March Meeting. Baltimore.
2015 September	*Weak ergodicity breaking and Brownian motion.* 28th Marian Smoluchowski Symposium on Statistical Physics. Krakow.
2015 July	*Brownian motion (and more) in disordered media.* 7th International Conference on Unsolved Problems on Noise. Barcelona.
2015 May	*Non-ergodic subdiffusion from Brownian motion in an inhomogeneous medium.* (poster) Random Walks and Nonlinear Dynamics in the Life of Cells. MPIPKS. Dresden.
2015 March	*Non-ergodic diffusion on quenched, scale-free disorder in two dimensions.* APS March Meeting. San Antonio.
2014 June 8	*Geometry in entanglement percolation.* (selected contributed talk) 11th Central European Quantum Information Processing Workshop. Znojmo, Czech Republic.
2014 June	*Weak ergodicity breaking.* Bar-Ilan University.
2014 May 29	*Non-ergodic transport in physical and biological systems.* Institute of Environmental Assessment and Water Research (IDAEA-CSIC). Barcelona.
2014 May 16	*Single particle tracking, charge transport, and weak ergodicity breaking.* Theoretical Physics Group, Department of Physics and Astronomy, University of Potsdam.

2014 March	*Non-ergodic subdiffusion from Brownian motion in disordered media.* (poster) Single Protein Dynamics *in Cellulo.* OIST. Okinawa.
2014 March	*Single particle tracking, charge transport, and ergodicity breaking.* Department of Physics Condensed Matter Seminar. Montana State University, Bozeman.
2014 March	*Disorder, trapping, and transport in cell membranes.* Dynamical Systems Seminar, Department of Applied Mathematics. University of Colorado-Boulder.
2014 March	*Disorder and ergodicity in anomalous diffusion.* Colloquium, Department of Physics and Astronomy. Denver University.
2014 March	*Role of Local and Global Geometry in Quantum Entanglement Percolation.* (poster) APS March meeting. Denver.
2014 March	*Disorder and ergodicity in anomalous diffusion.* (poster) APS March Meeting. Denver.
2014 March	*Disorder and ergodicity in anomalous diffusion.* Colloquium, Department of Physics and Astronomy, Denver University.
2014 February	*The role of local and global geometry in quantum entanglement percolation.* (poster) QIP Quantum Information Processing. Barcelona.
2013 August	*Entanglement Distribution in Complex Networks.* (selected contributed talk) WE-Heraeus Seminar on Classical and Quantum Transport in Complex Networks. Physikzentrum, Bad Honnef, Germany.
2013 June	*Entanglement Distribution in Complex Networks.* Central European Workshop on Quantum Optics. Stockholm.
2013 June	*Entanglement Distribution in Complex Networks.* (poster) Central European Quantum Information Processing Workshop. Valtice, Czech Republic..
2012 September	*Entanglement Percolation.* Department of Physics Condensed Matter Seminar. Montana State University, Bozeman.
2011 June	*Entanglement Distribution on Networks.* Quantum Information. Centro de Ciencias de Benasque. Benasque, Spain.
2010 October	*Quantum Coherence in Biology.* local seminar summary of workshop: Control of Quantum Correlations in Tailored Matter. Heinrich-Fabri-Institut. Blaubeuren, Germany.
2010 February	*Entanglement Percolation: Distributing entanglement on quantum networks.* Quantum Optical Information Technology Meeting. Universidad Politecnica de Valencia. Valencia, Spain.
2009 October 21	*Entanglement on Graphs: Percolation and Complex Networks.* ICONS seminar. Institute of Photonic Sciences.
2003 December	*Random Walks on Fluctuating Lattices.* Mathematical Physics Seminar, Department of Mathematics. University of Arizona.
2001 April	*Percolation model of nucleation in phase change media.* Optical Data Storage Center, University of Arizona.

Extended Stays

2019	*University of Potsdam.* Theory of anomalous reaction-diffusion. Host: Prof. Ralf Metzler. one week.
2014	*Bar-Ilan University.* Theory of anomalous transport. Host: Prof. Eli Barkai. three weeks.

2010	*Max-Planck-Institute for Quantum Optics.* Theory of quantum complex networks. Host: Prof. J.I. Cirac. one week.
2007	*Aerospace Corporation.* Experimental ultra-low impulse metrology. Host: Dr. W. Lotshaw. one week.
2006	*Naval Research Laboratory.* Experimental ultra-low impulse metrology. Host: Dr. T. Ting. four weeks.

Refereed publications

[1]   G. John Lapeyre Jr. and Marco Dentz. "Unified approach to reset processes and application to coupling between process and reset". *ArXiv e-prints* (Mar. 2019). arXiv: 1903.08055 [cond-mat.soft].

[2]   G. John Lapeyre Jr. and Marco Dentz. "Reaction-diffusion with stochastic decay rates". *Phys. Chem. Chem. Phys.* **19** (2017), pp. 18863–18879. arXiv: 1603.04753 [cond-mat.soft].
Selected as a 2017 PCCP Hot article.

[3]   Bartłomiej Szczygieł, Marek Dudyński, Kamil Kwiatkowski, Maciej Lewenstein, Gerald John Lapeyre Jr., and Jan Wehr. "Percolation thresholds for discrete-continuous models with non-uniform probabilities of bond formation". *Phys. Rev. E.* **93** (2016), p. 022127. arXiv: 1509.07401.

[4]   Carlo Manzo, Juan A. Torreno-Pina, Pietro Massignan, Gerald J. Lapeyre Jr., Maciej Lewenstein, and Maria F. Garcia Parajo. "Weak ergodicity breaking of receptor motion in living cells stemming from random diffusivity". *Phys. Rev. X* **5** (Feb. 2015), p. 011021. arXiv: 1407.2552.

[5]   Gerald John Lapeyre Jr. "Role of local and global geometry in entanglement percolation". *Phys. Rev. A* **89** (Jan. 2014), p. 012338. arXiv: 1311.6706.

[6]   P. Massignan, C. Manzo, J. A. Torreno-Pina, M. F. García-Parajo, M. Lewenstein, and G. J. Lapeyre Jr. "Non-ergodic subdiffusion from Brownian motion in an inhomogeneous medium". *Phys. Rev. Lett.* **112** (Apr. 2014), p. 150603. arXiv: 1401.6110.

[7]   S. Perseguers, Jr. G. J. Lapeyre, D. Cavalcanti, M. Lewenstein, and A. Acín. "Distribution of entanglement in large-scale quantum networks". *Reports on Progress in Physics* **76** (2013), p. 096001. arXiv: 1209.5303.

[8]   G. J. Lapeyre Jr., S. Perseguers, M. Lewenstein, and A. Acín. "Distribution of entanglement in networks of bi-partite full-rank mixed states". *QIC* **12** (2012), p. 0501. arXiv: 1108.5833.

[9]   S. Perseguers, D. Cavalcanti, G. J. Lapeyre, M. Lewenstein, and A. Acín. "Multipartite entanglement percolation". *Phys. Rev. A* **81** (2010), p. 032327. arXiv: 0910.2438.

[10] G. J. Lapeyre Jr., J. Wehr, and M. Lewenstein. "Enhancement of entanglement percolation in quantum networks via lattice transformations". *Phys. Rev. A* **79** (2009), p. 042324. arXiv: 0807.1118.

[11] Kevin Kremeyer, G. John Lapeyre, and Steven Hamann. "Compact and robust laser impulse measurement device, with ultrashort pulse laser ablation results". In: *Beamed Energy Propulsion: Fifth International Symposium on Beamed Energy Propulsion*. **997**. American Institute of Physics, (2008), pp. 147–158. URL: https://aip.scitation.org/doi/abs/10.1063/1.2931886.

[12] Kunal K. Das, G. John Lapeyre, and Ewan M. Wright. "Interference of a hard-core boson gas on a ring". *Phys. Rev. A* **65** (2002), p. 063603. arXiv: cond-mat/0202189.

[13] G. J. Lapeyre, M. D. Girardeau, and E. M. Wright. "Momentum distribution for a one-dimensional trapped gas of hard-core bosons". *Phys. Rev. A* **66** (2002), p. 023606. arXiv: 1303.5637.

[14] Ewan M. Wright, Poul S. Jessen, and G. John Lapeyre. "Two-dimensional motion of cold atoms in a near-resonant annular laser beam: artificial two-dimensional molecules". *Optics Communications* **129** (1996), pp. 423–432.

[15] M. E. Kordesch, W. Engel, G. J. Lapeyre, E. Zeitler, and A. M. Bradshaw. "The application of photoemission microscopy to the study of heterogeneous reactions over metal single-crystal surfaces". *Applied Physics A* **49** (1989), pp. 399–402.

Selected computational competencies

Main current languages   Julia, Python, C

Data science   Collaborative filtering (Python), Text-analytics

Numerical methods   stochastic simulation, Monte Carlo, exact enumeration of graphs, importance sampling, density estimation, optimization, cluster analysis, box-counting, maximum likelihood estimation, integration, automated expansions, transform inversion, linear algebra, etc.

Lines of code   [>50K–100K] C, C++, Julia, Common Lisp, Perl Data Language, [>10K] Python, [>5K] Mathematica, Maxima

Proficient in   regular expressions, user interfaces, JavaScript/HTML, Tk, SQL, Fortran, Matlab, JSON, YAML, bash, awk, git, make, PostScript driver

Data pipeline   Implemented in Python RESTful and message-queue APIs to send/receive JSON. Python interfaces to MySQL and Mongo dbs. Built high-capacity, stable servers using MySQL, NGINX, gunicorn, flask, supervisor

Parallel and Cluster   OMP, message passing, Oracle Grid Engine

Symbolic methods   Symbolic code generation for numeric computation. Development of general-purpose symbolic languages (Julia, Lisp, Python). Quantum information libraries

Selected open-source contributions

Quantum Computation   Contributions to several existing projects: pyquil, qvm, forest-benchmarking, Cliffords.jl, MathieuFunctions.jl, QSimulator.jl

Julia   Julia community, Julia core issues, Julia core code, Online empirical distribution functions, Lambert W function, Generalized Gamma distribution, Permutation library, Mittag-Leffler function, Zeros of Bessel function, General-purpose symbolic math language, Inverse Laplace transform, Voronoi Cells

Python   Message queue consumer class

Maxima and Common Lisp   Mathematica compatibility functions, translator, and port of quantum information library, Quantum information library, Numerous enhancements and modernizations of Maxima in Lisp: Support for indexable (Mathematica-like) expressions; Efficient and fundamental list– and combinatorics functions on indexable expressions. Uniform argument checking and error API; Third party package management; Foreign function interfaces.

Perl Data Language   Optimization with dynamically compiled cost function, Time-series windowing functions, Finite-impulse filters, Infinite-impulse filters, Matlab file format support, Basis splines

Linux   Ported 30 scientific packages for Debian Linux project from older Unix platforms.

Natural languages

English   Native language.
German   Good conversation, reading. EU level B2.
Spanish   Good conversation, reading, writing.
French   Good conversation, reading.
Catalan   Intermediate reading.

Service

Referee for: *Physical Review Letters*, *Physical Review X*, *Physical Review A*, *Physical Review B*, *Physical Review E*, *Computer Physics Communications*

Awards

1990–1993   U.S. Department of Education Graduate Fellow.