# Annotated List of Selected Publications

(1) *Entropy, Large Deviations, and Statistical Mechanics.* Grundlehren der mathematischen Wissenschaften, Volume 271, 364 pages. New York: Springer-Verlag, 1985. A standard reference, this monograph has educated a generation of researchers in mathematics, physics, and engineering concerning the theory of large deviations.

(2) *A Weak Convergence Approach to the Theory of Large Deviations* (with Paul Dupuis). Wiley Series in Probability and Statistics, 479 pages. New York: John Wiley & Sons, 1997. This monograph develops a new and original approach to the theory of large deviations that is applicable to key 21st century problems, including the design of high-speed communication and computer networks.

(3) (a) The First and Second Fluid Approximations to the Linearized Boltzmann Equation and (b) The Projection of the Navier-Stokes Equations upon the Euler Equations (with Mark Pinsky). *Journal de Mathématiques Pures et Appliquées* 54:125–156 (1975) and 54:157–182 (1975). These companion papers derive limit theorems that relate the linearized Boltzmann equation with the linear Euler and Navier-Stokes equations. The results have been used by numerous researchers in their study of related linear and nonlinear equations.

(4) Limit Theorems for Sums of Dependent Random Variables Occurring in Statistical Mechanics (with Charles Newman). *Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete* 44:117–139 (1978). This paper proves limit theorems for a basic mean-field model of ferromagnetism. The results are related to topics in Gaussian quadrature, to the theory of moments, and to critical phenomena and phase transitions for models of ferromagnetism and models arising in quantum field theory.

(5) Symmetry Breaking and Random Waves for Magnetic Systems on a Circle (with Theodor Eisele). *Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete* 63:297–348 (1983). The asymptotic behavior of random magnetic systems is studied by techniques of functional integration. When suitably generalized, the results are applicable to the stability analysis of models of turbulence (see paper (12)).

6) Large Deviations for a General Class of Random Vectors. *Annals of Probability* 12:1–12 (1984). This paper generalizes a large deviation theorem proved by J. Gärtner, giving a result that is now standard and that is known as the "Gärtner-Ellis Theorem." This theorem, one of the fundamental tools in the theory of large deviations, has been applied extensively and has inspired important, new generalizations.

(7) Large Deviations for the Empirical Measure of a Markov Chain with an Application to the Multivariate Empirical Measure. *Annals of Probability* 16:1496–1508 (1988). This paper derives the large deviation behavior of a class of random measures that arise naturally in statistical mechanics, information theory, statistics, and other applications. The derivation given here is now standard and has been reproduced in a number of texts on the subject.

(8) Large Deviations for Markov Processes with Discontinuous Statistics, II: Random Walks (with Paul Dupuis). *Probability Theory and Related Fields* 91:153–194 (1992). This paper presents the large deviation analysis of a class of Markov processes that are used in the modeling of high-speed communication and computer networks. The discontinuous statistics arises because of the requirement that buffer sizes and related quantities are nonnegative.

(9) The Large Deviation Principle for a General Class of Queueing Systems, I (with Paul Dupuis). *Transactions of American Mathematical Society* 347:2689– 2751 (1995). This paper gives the most general large deviation analysis of queueing systems in the literature. The results are applicable to a general class of queueing systems that arise in the modeling of communication and computer networks.

(10) Derivation of Maximum Entropy Principles in Two-Dimensional Turbulence via Large Deviations (with Christopher Boucher and Bruce Turkington). *Journal of Statistical Physics*, 98:1235–1278 (2000). This paper derives maximum entropy principles for two important statistical models of turbulence. Such principles are the basis for numerical computations of coherent structures.

(11) Large Deviation Principles and Complete Equivalence and Nonequivalence Results for Pure and Mixed Ensembles (with Kyle Haven and Bruce Turkington). *Journal of Statistical Physics* 101:999–1064 (2000). This paper gives definitive results on the equivalence and nonequivalence of the microcanonical and canonical ensembles both at the thermodynamic level and at the level of equilibrium macrostates.

(12) Nonequivalent Statistical Mechanical Ensembles and Refined Stability Theorems for Most Probable Flows (with Kyle Haven and Bruce Turkington). *Nonlinearity* 15:239–255 (2002). Applying results in paper (11), this paper proves the stability of a class of two-dimensional steady-mean flows corresponding to microcanonical equilibria. Applications have been made to the stability of the jetstreams and vortices in the Jovian atmosphere, the best known example of which is the Great Red Spot. In February 2002 this article was selected for inclusion on the Journal Information Page for *Nonlinearity* as a Featured Article. “Featured Articles are chosen by the journal for their high quality and interest to readers.”

(13) A Statistical Approach to the Asymptotic Behavior of a Class of Generalized Nonlinear Schrödinger Equations (with Richard Jordan, Peter Otto, and Bruce Turkington). *Communications in Mathematical Physics* 244:187–208 (2004). A statistical relaxation phenomenon is studied for a general class of dispersive wave equations of nonlinear Schrödinger-type which govern non-integrable, non-singular dynamics. In a bounded domain the solutions of these equations have been shown numerically to tend in the long-time limit toward a Gibbsian statistical equilibrium state consisting of a ground-state solitary wave on the large scales and Gaussian fluctuations on the small scales. The main result of the paper is a large deviation principle that expresses this concentration phenomenon precisely in the relevant continuum limit. Some supporting Monte Carlo simulations of these ensembles are also included to show the dependence of the concentration phenomenon on the properties of the dispersive wave equation, especially the high frequency growth of the dispersion relation.

(14) The Generalized Canonical Ensemble and Its Universal Equivalence with the Microcanonical Ensemble (with Marius Costeniuc, Hugo Touchette, and Bruce Turkington). *Journal of Statistical Physics* 119:1283–1329 (2005). This paper extends the results in paper (11) by studying the equivalence and nonequivalence of the microcanonical and generalized canonical ensembles both at the thermodynamic level and at the level of equilibrium macrostates. Among other results, we show that if the microcanonical and standard canonical ensembles are not equivalent, then one can often find a generalized canonical ensemble satisfying a strong form of equivalence that we call universal equivalence.