CHRISTOPHER JARZYNSKI

Biography

CONTACT INFORMATION

Office Phone: 301-405-4439
Office Address: IPST 2106
Email: cjarzyns@umd.edu

Distinguished University Professor

Education

A. B., Physics (with high honors), Princeton University, Princeton, NJ–1987

Ph. D., Physics, University of California, Berkeley–1994

Institute for Nuclear Theory, University of Washington, Postdoc–1994-1996

Los Alamos National Laboratory, Postdoc–1996-1999

Professional Experience

Technical Staff Member, Los Alamos National Laboratory 1999-2006

Associate Professor (with tenure), University of Maryland, 2006-2010

Professor, University of Maryland 2010-present

Director, Institute for Physical Science and Technology, UMD 2014-present

Research Interests

My research group and I focus on statistical mechanics and thermodynamics at the molecular level, with a particular emphasis on far-from-equilibrium phenomena. We have worked on topics that include the application of statistical mechanics to problems of biophysical interest; the analysis of artificial molecular machines; the development of efficient numerical schemes for estimating thermodynamic properties of complex systems; the relationship between thermodynamics and information processing. We also have interests in dynamical systems, quantum thermodynamics, and quantum and classical shortcuts to adiabaticity.

Major Recognitions and Awards

Fulbright Fellowship, Warsaw, Poland 1987-1988

Raymond and Beverly Sackler Prize in the Physical Sciences Tel Aviv, Israel 2005

Outstanding Referee for American Physical Society Journals 2009

Fellow, American Physical Society 2009

Fellow, American Academy of Arts and Sciences, 2016

Lars Onsager Prize in Theoretical Statistical Physics, American Physical Society, 2019

Significant Professional Services and Activities

American Chemical Society, American Physical Society

Editorial Board, Journal of Statistical Mechanics: Theory and Experiment, 2008-present

Editorial Board, Journal of Statistical Physics, 2008-2010

Associate Editor, Journal of Statistical Physics, 2011-present

Mentoring

Seven postdocs, eleven graduate students and four undergraduate students mentored at the University of Maryland (since 2006).

Research

In the Jarzynski group, we develop theoretical tools for understanding nonequilibrium behavior, and computational methods for estimating thermodynamic properties, and we construct and analyze simple models that provide insight into complex phenomena. We also study dynamical systems, and quantum dynamics and thermodynamics. The following descriptions provide a flavor of the research that goes on in the group.

Thermodynamics of small systems

While the laws of thermodynamics were developed nearly two centuries ago to describe steam engines, recently there has been exciting progress in understanding how these laws apply to nanoscale systems, especially away from thermal equilibrium. At microscopic length scales, random, thermal fluctuations are prevalent, and the energy of interaction between a system and its surroundings cannot be neglected. We investigate how these and other features can be integrated into a broad theoretical framework that describes the thermodynamics of small systems.[1,2]

Thermodynamics of information processing

This topic dates back to the famous "Maxwell's demon" thought experiment described by James Maxwell in 1867. Recent years have seen renewed theoretical and experimental interest in the thermodynamics of information processing. We study the interplay between information processing and the second law of thermodynamics, and we develop simple models illustrating how a mechanical Maxwell's demon might operate.[3,4]

Shortcuts to adiabaticity: controlling quantum, classical and stochastic systems

The quantum adiabatic theorem provides a powerful tool for controlling the evolution of a quantum system, as long as we act on it very slowly. Shortcuts to adiabaticity are tools that promise the same degree of control, without the requirement of slow driving. We have develeped novel approaches for constructing shortcuts to adiabaticity, not only in quantum but also in classical and stochastic systems.[5,6]

1. C. Jarzynski, "Equalities and inequalities: Irreversibility and the second law of thermodynamics at the nanoscale", Annu. Rev. Condens. Matter Phys. 2:329-51 (2011).

2. C. Jarzynski, "Stochastic and macroscopic thermodynamics of strongly coupled systems", Phys. Rev. X 7, 011008 (2017).

3. D. Mandal and C. Jarzynski, "Work and information processing in a solvable model of Maxwell's demon", Proc. Natl. Acad. Sci. (USA) 109, 11641-45 (2012).

4. Z. Lu, D. Mandal and C. Jarzynski, "Engineering Maxwell's demon", Physics Today 67 (8), 60 (August, 2014).

5. S. Deffner, C. Jarzynski and A. del Campo, "Classical and quantum shortcuts to adiabaticity for scale-invariant driving, Phys. Rev. X 4, 021013 (2014).

6. A. Patra and C. Jarzynski, "Shortcuts to adiabaticity using flow fields", arXiv:1707.01490 (2017).

The Department of Chemistry & Biochemistry
0107 Chemistry Building
8051 Regents Drive
College Park, MD 20742
f 301.314.9121 • p 301.405.1788