Approved by the Regents
May 16, 2024

PROMOTION RECOMMENDATION
The University of Michigan
College of Literature, Science, and the Arts

Jordan M. Horowitz, assistant professor of biophysics, assistant professor of complex systems, and assistant professor of physics, College of Literature, Science, and the Arts, is recommended for promotion to associate professor of biophysics, with tenure, associate professor of complex systems, with tenure, and associate professor of physics, without tenure, College of Literature, Science, and the Arts.

Academic Degrees:

Ph.D.	2010	University of Maryland
B.A.	2005	Columbia University

Professional Record:

2019-present	Assistant Professor, Program in Biophysics, Center for the Study of Complex Systems, and Department of Physics, University of Michigan
2017-2018	Physics of Living Systems Post-doctoral Fellow, Massachusetts Institute of Technology
2015-2017	Post-doctoral Fellow, Massachusetts Institute of Technology
2013-2015	Post-doctoral Fellow, University of Massachusetts at Boston
2011-2013	Post-doctoral Fellow, Universidad de Complutense de Madrid, Spain

Summary of Evaluation:

Teaching: Professor Horowitz has focused on two courses since joining the faculty at UM. He developed an extension of the Complex Systems curriculum, CSCS 445 ("Introduction to Information Theory for the Natural Sciences"), and taught BIOP 521("Principles of Biophysical Chemistry"), a core course in the Biophysics graduate curriculum. He augmented both courses through CRLT workshops on inclusive assignments, accessibility in Canvas, and flipping the classroom, which he integrated into his teaching. Professor Horowitz developed novel and innovative methods in CSCS 445, including a Canvas-based peer-review system to improve student engagement. He replaced the end-of-semester presentation with a two-stage process: students first prepared a video presentation uploaded to Canvas, where other students then provided feedback according to a rubric; the students then refined their end of semester presentations based on feedback from their peers. Professor Horowitz's classroom teaching has been well received by his students. He has a substantial record of outreach, including NSF-funded (ongoing) work with UM's Museum of Natural History to engage the public with the scientific topics used in his research. This five-year project incorporates scientific communication, hands-on experiences for the public to engage in research, and a career-outreach program aimed at middle schools in three Detroit-area communities.

Research: Professor Horowitz's theoretical work strives to provide inequality relationships that bound the quantity of information or work that is obtainable from systems that are being driven far from equilibrium, including living systems. His work is recognized for providing fundamental bounds on these processes, with a significant current focus on systems of biological interest. The significance of his impact is represented by his robust record of scholarship and reflected in the citations of his work, his publications in high-impact journals, his guest editorial duties, his successful track record of grant writing, his speaking invitations, and his role in meeting organizations. It is anticipated that Professor Horowitz will become a true leader in his research field

of far from equilibrium statistical physics and will continue to have impact on the field through his scholarly writings. Furthermore, Professor Horowitz's impact and visibility within the university environment is expected to increase, in part, through involvement with the newly formed Program in Computing in the Arts and Sciences (PCAS).

Recent and Significant Publications:

Owen, J. A. and Horowitz, J. (2023). Size limits sensitivity in all kinetic networks. *Nature Communications*, *14*(1), 1280.

Owen, J. A., Gingrich, T. R., and Horowitz, J. M. (2020). Universal thermodynamic bounds on nonequilibrium response with biochemical applications. *Physical Review X*, *10*(1), 011066.

Horowitz, J. M. and Gingrich, T. R. (2020). Thermodynamic uncertainty relations constrain non-equilibrium fluctuations. *Nature Physics*, *16*, 15-20.

Li, J., Horowitz, J. M., Gingrich, T. R., and Fakhri, N. (2019). Quantifying dissipation using fluctuating currents. *Nature Communications*, *10*(1), 1666.

Service: Professor Horowitz has participated in meaningful service in both the Program in Biophysics and the Center for Complex Systems, serving on the seminar committees of both units, on the graduate admissions committee in Biophysics for the past two years, and on the faculty search committee in Complex Systems in 2020. Professor Horowitz is an active proponent of DEI efforts, serving on the Biophysics DEI Committee and as the Rackham Faculty Ally for Diversity. In 2020, he helped organize a town hall for graduate students and post-doctoral researchers to communicate openly about the climate in Biophysics and took the lead in organizing a yearly workshop on community building, mental health, and DEI for the unit. In 2022, he and a junior faculty colleague conceived, developed, and secured funding for a new Student Ambassador program in Biophysics to encourage enrollment of graduate students from Minority Serving Institutions (MSI) and small/rural colleges by organizing visits by the Student Ambassadors to their MSI *alma maters* and providing guidance and mentorship to help them prepare for their visits. Professor Horowitz's external service resembles that of a senior faculty member, highlighting his position as an established leader in the research community. He was a member of the Irwin Oppenheim Award Selection Committee for the American Physical Society, is a member of organizing committees for four conferences, has served as a guest editor, and is a reviewer for a wide range of research journals.

External Reviewers:

Reviewer (A): "I was struck by the sophistication of the analysis done on the experimental measurements—a sophistication that traces back to Dr. Horowitz and his previous theoretical work on these topics. Collectively, this kind of effort is defining the state of the art for analysis of nonequilibrium biological systems."

Reviewer (B): "To cut to the chase—I am very impressed by both breadth and depth in Dr. Horowitz [sic] scholarship. The breadth resulted from application of non-equilibrium thermodynamics principles to a wide range of biological and active-matter systems. The depth resulted from Dr. Horwitz's ability to focus on a particular fundamental question—how energy dissipation impacts emergent behaviors on the system level."

Reviewer (C): "[Professor Horowitz] is a first-rate scientist with a track record of outstanding theoretical results, such as his work on thermodynamic uncertainty relations."

Reviewer (D): "An excellent example of this kind of analysis is [Professor Horowitz's] most recent paper in Nature Communications, 'Size limits the sensitivity of kinetic schemes.' In it he shows how

a biological system can respond very sensitively to changes in the concentration of a protein that it can detect via a binding reaction, when the system is pushed far from equilibrium."

Reviewer (E): "The series of works, mostly in collaboration with Dr. T. R. Gingrich, on dissipation bounds and their use for the evaluation of entropy production in non-equilibrium system have turned Stochastic Thermodynamics in a useful tool for understanding and controlling thermodynamical systems at the mesoscopic scale."

Reviewer (F): "I tell you all of this because I find that Horowitz is one of the people most deeply engaged in developing fundamental insights into this broad area. Perhaps even more importantly, it is not enough for him to construct profoundly interesting theoretical musings. He is also engaging with the world of measurements (such as in collaboration with Nikta Fakhri at MIT) with the ambition of figuring out what to measure and how to take the results of those measurements and confront them with what theory has to say."

Summary of Recommendation:
Professor Horowitz's work utilizes the mathematical framework of nonequilibrium statistical physics to discover bounds on the information and energy requirements for processes that occur far from equilibrium, with a specific focus on energy and information flow and utilization in living systems. His work is documented in visible publications that are well cited by the community (h-index of 34, with fourteen publications since beginning his tenure at Michigan, including highly cited papers; *Nature Physics 2020*, with 361 citations; and four more papers cited more than forty times each), and is providing field-leading research in far from equilibrium processes in living systems. The Executive Committee of the College of Literature, Science, and the Arts and I recommend that Assistant Professor Jordan M. Horowitz be promoted to the rank of associate professor of biophysics, with tenure, associate professor of complex systems, with tenure, and associate professor of physics, without tenure, College of Literature, Science, and the Arts.

Anne Curzan, Dean
Geneva Smitherman Collegiate Professor of
English Language and Literature, Linguistics,
and Education
Arthur F. Thurnau Professor
College of Literature, Science, and the Arts

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