William C. Gilpin

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Education

Stanford University, PhD in Applied Physics, 2019
Stanford University, MS in Applied Physics, 2016
Princeton University, AB in Physics with High Honors, 2014

Fellowships & Grants

NSF-Simons Independent Fellow at Harvard, 2019–2021.
Miller Fellowship at UC Berkeley, 2019–2021 *(declined)*.
National Geographic Young Explorers Grant, 2017.
NDSEG Graduate Research Fellowship, 2016-2019.
National Science Foundation Graduate Research Fellowship, 2014-2017.
Stanford EDGE-STEM and H&S Fellowships, 2014-2019
Princeton ODOC, Class of 1984, and Fred Fox Fellowships. 2013
NSF REU: Harvard NNIN/SEAS, 2012, 2013; Mote Marine Laboratory, 2011
Princeton Class of 1930 scholarship, 2010 - 2014.
Sarasota Area Ivy League Scholarship, 2010 - 2014.

Prizes

American Physical Society US-India Travel Grant, 2018
Bio-X Travel Award (APS March Meeting), 2018
Grand prize, National Science Foundation "Vizzies" visualization competition, 2017
Featured winner, Physics Today "Backscatter" photography contest [url]
Grand prize, Nikon Small World in Motion video contest, 2016 [article] [video]
Milton van Dyke Award/Grand prize, APS Gallery of Fluid Motion, 2016. [video]
Nikon Small World photograph finalist, 2016 [image]
American Physical Society Travel Award, 2016.
Princeton physics, Kusaka Memorial Prize, 2014.
Princeton physics, Allen G. Shenstone Prize, 2013.
Sigma Xi induction, 2014.
National AP Scholar, 2010.

Upcoming

W. Gilpin. "Self-organized avalanches in globally-coupled phase oscillators" *Submitted*. [arXiv]

W. Gilpin, V. N. Prakash, M. Prakash. "Rapid behavioral transitions produce chaotic mixing by a planktonic microswimmer" *Submitted*. [arXiv]

W. Gilpin. "Deep reconstruction of strange attractors from time series" *Submitted*. [arXiv]

Selected Publications

W. Gilpin. "Cryptographic hashing using chaotic hydrodynamics" ***The Proceedings of the National Academy of Sciences***, 2018. [pdf]
KCBS (radio interview) | stanford homepage | phys.org | futurity | scishow

W. Gilpin, M. S. Bull, M. Prakash. "The multiscale physics of cilia and flagella" ***Nature Reviews Physics***, 2020. [pdf] [cover]

W. Gilpin, V. N. Prakash, M. Prakash "Vortex arrays and ciliary tangles underlie the feeding-swimming tradeoff in starfish larvae" ***Nature Physics***, 2017. [pdf]
See *News and Views*, *Nature Physics*, 2017 [url]
new york times | nature | stanford homepage | popular science | cbs | smithsonian | reuters | yahoo | vox | phys.org | business insider | scientific american

W. Gilpin, M. W. Feldman, K. Aoki "An ecocultural model predicts Neanderthal extinction through competition with modern humans." ***The Proceedings of the National Academy of Sciences***, 2016. [pdf]
newsweek | science | daily mail | stanford homepage | ars technica | huffington post | national geographic | phys.org | yahoo | international business times | ifl

W. Gilpin. "Cellular automata as convolutional neural networks" **Physical Review E**, 2019. [pdf]

Additional Publications

W. Gilpin, Y. Huang, D. Forger "Learning dynamics from large biological datasets: Machine learning meets systems biology" ***Current Opinion in Systems Biology***, 2020. [pdf]

W. Gilpin, M. W. Feldman. "Cryptic selection forces and dynamic heritability in generalized phenotypic evolution" ***Theoretical Population Biology***, 2018. [url] [pdf]

W. Gilpin, M. W. Feldman. "A phase transition induces chaos in a predator-prey ecosystem with a dynamic fitness landscape" ***PLOS Computational Biology***, 2017. [pdf]

W. Gilpin, V. N. Prakash, M. Prakash. "Flowtrace: simple visualization of coherent structures in biological fluid flows" ***Journal of Experimental Biology***, 2017. [pdf] [code] [cover art]

J. Y. Wakano*, **W. Gilpin*** *(*co-first)*, S. Kadowaki, M. W. Feldman, K. Aoki. "Ecocultural range-expansion scenarios for the replacement or assimilation of Neanderthals by modern humans" ***Theoretical Population Biology***, 2017. [pdf]

W. Gilpin, V. N. Prakash, M. Prakash. "Dynamic vortex arrays created by starfish larvae" ***Physical Review Fluids***, 2017. [pdf]
See feature in APS *Physics*, 2017 [url]

W. Gilpin, V. N. Prakash, M. Prakash "Boundary effects on currents around ciliated larvae" ***Nature Physics***, 2017. [pdf]

W. Gilpin, "PyPDB: A Python API for the Protein Data Bank." ***Bioinformatics***, Oxford University Press, 2015. [pdf] [code]

W. Gilpin, S. Uppaluri, C. Brangwynne "Worms under pressure: bulk mechanical properties of *C. elegans* are independent of the cuticle" ***Biophysical Journal***, 2015. [pdf] [video]

K. Bayat, W. K. C. Sun, **W. Gilpin**, M. Farrokh Baroughi, M & Lončar. "Formation of Nitrogen vacancy center ensembles in Diamond Nanowires." ***CLEO: Science and Innovations***, Optical Society of America, 2014. [pdf]

Career

Harvard University, Independent Fellow 2019–present. NSF-Simons Center for Mathematical Biology.
Osmosis Education, Content Specialist 2018–present. Write and develop free educational videos about undergraduate level physics and chemistry for an audience of ∼1.3 million YouTube subscribers.
Stanford University, Prakash Lab, 2014–2019. Dissertation research on soft matter physics and mathematical biology.
Stanford University, Feldman Group, 2015–2019. Mathematical models of catastrophes in eco-evolutionary processes, with applications to prehistoric human migration.
Meiji University (Tokyo), Visiting Scholar. October 2016. Development of reaction-diffusion models of human migration. Guest of Profs. Joe Yuichiro Wakano and Kenichi Aoki.
Stanford University, Spakowitz Group, Spring 2015 (rotation). Modeling epigenetic regulation as anomalous diffusion of polymers. [code]
Stanford University, Pande Lab, Winter 2015 (rotation). A renormalization group approach to modeling protein folding kinetics. [code]
Khan Academy, 2014-2016. Content Specialist: Write and review physics content for Khan Academy's free online physics and chemistry videos; ∼10 million viewers to date. [example]
Princeton University, Brangwynne Lab. Research Assistant 2011-2014. Microfluidic experiments and stochastic modelling of mechanical properties of *C. elegans*.
Harvard University, Lončar Group, NSF REU Summer intern 2012. Manipulate spectroscopic properties of diamond qubits using a nanofabricated MOSFET/Hall probe.
Princeton University, Callan Group, Research Assistant Spring 2013. Using nonequilibrium thermodynamics to model computation in biological sensing networks.
Mote Marine Laboratory, Kirkpatrick Group, NSF REU Summar Intern 2011. Machine learning for spectroscopic discrimination of phytoplankton taxa.
Venice Theatre, Apprentice technician 2008-2011. Apprentice certification for high-wattage lighting systems.

Invited Talks

2018 MIT Pappalardo Interview seminar: "Chaos in biological fluid flows"
2018 Princeton University CPBF Symposium: "Vortex arrays and chaotic mixing by swimming starfish larvae"
2018 Princeton University PCTS seminar: "Predicting chaotic dynamical systems from sparse data"
2018 Harvard University Quantitative Biology Symposium: "Untangling dimensionality and dynamics in animal locomotion"
2016 Meiji University (Tokyo): Mathematical biology seminar, invited by Prof. Joe Yuichiro Wakano and Prof. Kenichi Aoki.
2016 Tokyo University of Agriculture and Technology: "Dynamic vortex arrays and topological defects created by starfish larvae" Invited by Prof. Yoshiyuki Tagawa.
2012 NNIN Convocation: "Controlling the charge occupancy of nitrogen vacancy centers in diamond"

Contributed Talks

2019 PhD thesis defense: "Swimming and hashing using chaotic fluids" [video]
2018 American Physical Society March Meeting: "Low-dimensional behavior and chaotic mixing by swimming starfish larvae" [video]
2016 American Physical Society, Division of Fluid Dynamics Meeting: "Vortex arrays and ciliary tangles underlie the feeding-swimming tradeoff in starfish larvae" [video]
2013 Harvard REU Convocation: "Manipulating the charge state of nitrogen vacancy centers in diamond."
2012 Harvard REU Convocation: "Controlling the charge occupancy of nitrogen vacancy centers in diamond."
2011 Mote Laboratory REU Convocation: "Improving taxal resolution in the Optical Phytoplankton Discriminator"

Community

Research supervisor for one undergraduate student (Duke University, Harvard QBio REU).
Grant Referee for National Geographic Society (2019-present), European Research Council (2020).
Peer review for *The Proceedings of the National Academy of Sciences*, *Bioinformatics*, *Journal of Experimental Biology*, *Theoretical Population Biology*, *International Journal of Bifurcation and Chaos*, and *Journal of Archaeological Science*
Educational content developer. Write and develop widely-distributed educational videos for the non-profit education startups Khan Academy (2014-2016), and Osmosis (2018, ongoing).
Invited judge for the 2018 American Physical Society "Gallery of Fluid Motion" competition
EDGE-STEM mentor. Mentor and advise early-career doctoral students at Stanford (2016–2019).