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
Pine View High (Sarasota, FL), 2008-2010, Cascia Hall High (Tulsa, OK), 2006-2008

Fellowships & Grants

NSF & Simons Independent Fellow at Harvard QuantBio Initiative, 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 graduate grants: EDGE-STEM Fellowship and H&S Fellowship, 2014-2019
Princeton research grants: ODOC, Class of 1984, Fred Fox. 2013
NSF REU awards: NNIN/Harvard 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 winner, National Science Foundation "Vizzies" visualization competition, 2017
Featured winner, Physics Today "Backscatter" photography contest [url]
Grand prize winner, Nikon Small World in Motion video contest, 2016 [article] [video]
Grand Prize (Milton van Dyke Award), APS Gallery of Fluid Motion, 2016. [video]
Nikon Small World photograph finalist, 2016 [image]
American Physical Society Travel Award, 2016.
Kusaka Memorial Prize, top graduating seniors in Princeton physics, 2014.
Allen G. Shenstone Prize, top juniors in Princeton physics, 2013.
Sigma Xi, the scientific research society, 2014.
National AP Scholar, 2010.

Upcoming

W. Gilpin, M. S. Bull, M. Prakash. "The multiscale physics of cilia and flagella" **Nature Reviews Physics**, 2019. *Invited, peer review complete*.

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. "Lagrange2D: A Mathematica package for Lagrangian analysis of two-dimensional fluid flows" *Submitted*. [arXiv]

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

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* by Fernandez and Stocker, *Nature Physics*, 2016 [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]

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]

W. Gilpin "Engineering the Charge Occupancy of Nitrogen Vacancies in Diamond." NNIN REU Convocation, 2012. [pdf] [cover image]

Career

Harvard University, Quantitative Biology Initiative. 2019–present.
Osmosis Education. 2018–present: Write and develop free educational videos about undergraduate level physics and chemistry for an audience of ∼800,000 YouTube subscribers.
Stanford University, Prakash Lab. 2014–2019: Dissertation research on soft matter physics and mathematical biology.
Stanford University, Feldman Group. 2015–2019: Development of mathematical models of eco-evolutionary processes, with applications to understanding 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. 2011-2014: Microfluidic experiments and stochastic modelling of mechanical properties of *C. elegans*.
Harvard University, Lončar Group. Summers 2012, 2013 (NSF/NNIN REU): Manipulate spectroscopic properties of diamond qubits using a nanofabricated MOSFET/Hall probe.
Princeton University, Callan Group. Spring 2013: Using nonequilibrium thermodynamics to model computation in biological sensing networks.
Mote Marine Laboratory, Kirkpatrick Group. Summer 2011 (NSF REU): Machine learning methods for optical discrimination of phytoplankton taxa.
Venice Theatre, 2008-2011: Apprentice certification as a technician for industrial lighting systems.

Invited Talks

2018 MIT Pappalardo seminar: "The hydrodynamics of invertebrate development"
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

Peer review for *Bioinformatics*, *Theoretical Population Biology*, *International Journal of Bifurcation and Chaos*, and *Journal of Archaeological Science*
Content developer for free online courses by Khan Academy (2014-2016) and Osmosis (2018–present)
Invited judge for the 2018 American Physical Society "Gallery of Fluid Motion" competition
Educational content developer. Wrote physics passages and videos for the non-profit education startup Khan Academy (2014-2016), and for the medical education startup Osmosis (2018, ongoing)
EDGE-STEM mentor. Mentor and advise early-career doctoral students at Stanford (2016–2019).

Interests

Fossil and mineral collecting since elementary school; currently catalogue of ∼8000 fossil shark teeth, 400 other fossils, and 200 unique rocks and fluorescent minerals. [collection]
Hobby photography. Several photographs have been used as backgrounds in the Yahoo! Weather mobile app. [images]
Latin. Five years of coursework.
Certified HAM radio operator, call sign KJ4NLQ.