

William C. Gilpin

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Education

Stanford University, PhD candidate in Applied Physics
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

National Geographic Young Explorers Grant, 2017.
NDSEG Graduate Research Fellowship, 2016-2019.
National Science Foundation Graduate Research Fellowship, 2014-2017.
Stanford H&S Fellowship, 2014-2019
Stanford EDGE-STEM Fellowship, 2014-2019
ODOC Award & Class of 1984 memorial research grants. 2013
The Fred Fox Fellowship, 2013.
National Science Foundation REU: NNIN/Harvard SEAS, 2012, 2013
National Science Foundation REU: Mote Marine Laboratory, 2011
Princeton Class of 1930 tuition waiver, 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 magazine “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.
“Art of Science” acceptee, Princeton (2013) and Stanford (2015,2017) [\[image\]](#)
National AP Scholar, 2010.

Upcoming

W. Gilpin, M. S. Bull, M. Prakash. “Emergent physics and collective behavior in ciliary ensembles” **Nature Reviews Physics**, 2019. *Invited review article*.

W. Gilpin. “Cellular automata as convolutional neural networks” *Under review*. [\[arXiv\]](#)

W. Gilpin, V. N. Prakash, M. Prakash. “Rapid behavioral transitions produce chaotic mixing by a planktonic microswimmer” *Under review*. [\[arXiv\]](#)

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](#) | [futura](#)

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, M. W. Feldman. “Cryptic selection forces and dynamic heritability in generalized phenotypic evolution” **Theoretical Population Biology**, 2018. [\[bioRxiv\]](#)

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

Stanford University, Prakash Lab. 2014–present: Dissertation research on soft matter physics and mathematical biology.

Stanford University, Feldman Group. 2015–present: Development of mathematical models of eco-evolutionary processes and phenotypic evolution, with applications to understanding Neanderthal extinction and early human migration.

Osmosis Education. 2018–present: Content creator: Write and develop free educational videos about undergraduate level physics and chemistry for an audience of ~800,000 subscribers.

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 illustrate physics passages and questions for an AAMC/Khan Academy program to create free online MCAT preparation materials. Confer with teachers to select topics and improve passages. [\[example passage\]](#)

Princeton University, Brangwynne Lab. 2011–2014: Characterizing and modelling the mechanical properties of *C. elegans* using a novel microfluidic approach. Development of a Fokker-Planck model for growth in a population 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 (junior thesis): Using nonequilibrium thermodynamics to model computation in biological sensing networks. [\[thesis\]](#)

Mote Marine Laboratory, Kirkpatrick Group. Summer 2011 (NSF REU): Machine learning methods for optical discrimination of phytoplankton taxa.

Venice Theatre, 2008–2011: Received journeyman certification as a technician for industrial lighting. Designed and built numerous stage lighting schemes; travelled to Ontario, Canada for stage technician workshop.

Invited Talks

2018 Harvard University Quantitative Biology Symposium: "Untangling dimensionality and dynam-

ics 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” [\[video\]](#)

Contributed Talks

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”

Outreach

Peer review for *Bioinformatics*, *Theoretical Population Biology*, *International Journal of Bifurcation and Chaos*, and *Journal of Archaeological Science*

Expert 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 (2017, ongoing).

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.