

# 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 H&S Fellowship, 2014-2019  
Stanford EDGE-STEM Fellowship, 2014-2019  
Various Princeton 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 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.  
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 (in press). [\[arXiv\]](#)

**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

**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 prehistoric 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 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” [\[video\]](#)

## 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”

## Outreach

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

**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 (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.