

# 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. Shenhstone 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](#) | [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**. “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 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.