

## EVE ARMSTRONG

[evestrong.physics@gmail.com](mailto:evestrong.physics@gmail.com)  
646.269.9941  
<https://reality-aside.com/research/>

Department of Physics, New York Institute of Technology  
Department of Astrophysics, American Museum of Natural History

---

### CURRENT APPOINTMENTS

*Assistant Professor:* Department of Physics, New York Institute of Technology (Sep 2019 – )  
*Research Associate:* Department of Astrophysics, American Museum of Natural History (Sep 2019 – )

### EDUCATION and POSTDOCTORAL APPOINTMENTS

*Postdoctoral fellow* (Nov 2017 – Aug 2019) **Computational Neuroscience Initiative  
University of Pennsylvania (UPenn)**  
*Mentors:* Vijay Balasubramanian, Department of Physics and Astronomy; Marc Schmidt,  
Department of Biology

*Postdoctoral scholar* (Sep 2014 – Oct 2017) **BioCircuits Inst., U. of CA, San Diego (UCSD)**  
*Mentor:* Henry Abarbanel, Physics Department and Scripps Institution of Oceanography

*Ph.D. Physics* (2013) **UCSD**  
*Dissertation:* “Probing the Nature of Cataclysmic Variables via Photometric Studies on  
Multiple Timescales”  
*Advisors:* Richard Rothschild, Center for Astrophysics and Space Sciences, UCSD;  
Joseph Patterson, Department of Astronomy, Columbia University

*B.A. Astrophysics* (2002) **Columbia College; Columbia University**  
*Mentor:* David Helfand, Department of Astrophysics

---

### RESEARCH INTERESTS

*Scientific contexts:*

- neutrino astrophysics, biological neuronal networks, and epidemiology
- the information content of communication signals
- analysis of information flow in nonlinear systems

*Approaches:*

- inference methods for state and parameter estimation in nonlinear models
  - dynamical systems modeling
- 

### CURRENT RESEARCH FOCUS

*Inference frameworks to predict neutrino flavor evolution following supernova core collapse*

Use inference to predict neutrino flavor evolution following cosmological events. Inference is a powerful means to augment and complement existing tools in the field of neutrino physics.

*Collaborators:* George Fuller (UCSD), Amol Patwardhan (Institute for Nuclear Theory, U. Washington), Eermal Rrapaj (UC Berkeley), Baha Balantekin (U. of WI, Madison), Mark Paris (Los Alamos National Labs), Shashank Shalgar\* (U. of Copenhagen, Denmark), Paul Rozdeba\* (U. of Potsdam, Germany), Sina Fallah Ardizi (NYIT).

***Inference for completing unknowns in a population model tailored to COVID-19***

Identify the degree of uncertainty permitted in the measured populations of infected individuals, to estimate unknown parameters in an epidemiological model tailored to minimize strain on hospital capacity.

Collaborators: Jaline Gerardin and Manuela Runge (Department of Preventive Medicine, Northwestern University).

***Inference for the classification of binary systems in large astrophysical data sets***

Train a classifier to operate on data sets of time series photometry containing  $10^9$  objects, for the purposes of informing theory on the evolutionary history of galaxies.

Collaborators: Michael Shara (AMNH), Jax Apollon (NYIT).

---

**OTHER ONGOING AND FUTURE PROJECTS**

***Inference for retrieval of exo-planet atmospheres***

Estimate parameters governing the atmospheric chemical composition of exo-planets, using as Measurements directly-imaged emission spectra. Compare the advantages – including computational efficiency and degeneracy breaking – of Monte Carlo versus optimal estimation, for tackling this problem.

Collaborators: Jacqueline Faherty (AMNH), Emily Rice (AMNH), Kelle Cruz (AMNH).

***A mechanistic learning model of the zebra finch song system, with capacity for “un-learning”***

Expand upon current models of the avian neural song system to explain recent observations that juvenile males, when challenged to learn a new song midway through their development, will employ a range of alternate strategies in response to that challenge. This project expands upon work in my previous postdoctoral position (at UCSD), on creating a dynamical model of zebra finch song-related nucleus HVC.

Collaborators: Ofer Tchernichovski (Hunter College, CUNY), Julia Hyland Bruno (Columbia U.), Tiberiu Tesileanu (Flatiron Institute).

\* *International collaboration*

---

**PAST POSITIONS and PROJECTS**

***Postdoctoral fellow*** (Nov 2017 – Aug 2019)

**Computational Neuroscience Initiative, U. of PA**

Developed a dynamical systems method to analyze the acoustic structure of songs of the male cowbird, using time-delay embedding. Combining this method with an optimization procedure, generated synthetic songs for playback to female cowbirds, to assess song potency.

***Postdoctoral scholar*** (Sep 2014 – Oct 2017)

**BioCircuits Inst., UCSD**

Created a functional dynamical model of the avian neuronal circuit associated with song generation. Use optimization to estimate parameters governing the dynamics, using whole-cell recordings of HVC neurons obtained by collaborators at the University of Chicago.

***Volunteer researcher*** (2013 – 2014)

**Weill Cornell Medical Center / NY Presbyterian Hospital**

*Principal Investigator*: Kevin Brown, M.D., Ph.D.; Department of Otolaryngology

*Co-investigator*: Kaleb Yohay, M.D.; Neurofibromatosis II (NF II) Clinic

Retrospective study of Neurofibromatosis II (NF II) patients to identify predictors of vestibular

schwannoma (VS) progression, for clinical use. (NFII is a degenerative disease of high morbidity, characterized by the growth of multiple tumors, particularly VS).

**Graduate researcher** (2011-2013) **UCSD, Columbia U.**

*Thesis:* optical time series photometry of double-degenerate binary stars with white dwarf accretors. *Aim:* Understand post-main-sequence evolution and conditions for core electron degeneracy.

**Observer** (2001-2013) **Columbia U.**

Time series CCD photometry of 1) binary star systems and 2) gamma-ray bursts, at Kitt Peak National Observatory (KPNO) and the Cerro Tololo Inter-American Observatory (Chile). Training of new students. *Aims:* 1) understand late binary-star evolution; 2) interpret gamma-ray bursts as signatures of black-hole versus neutron-star formation.

---

## MEETINGS and PRESENTATIONS

**Institute for Nuclear Theory** (June 2020) **University of Washington**

*Invited talk:* "Inference offers a metric to constrain dynamical models of neutrino flavor transformation"

**Department of Engineering Sciences & Applied Math** (June 2020) **Northwestern University**

*Invited talk:* "Identifying the measurements required to estimate rates of COVID-19 transmission, infection, and detection, using variational data assimilation"

**CANCELED DUE TO COVID-19: SIAM Conference on the Life Sciences** (June 2020)

*Host of mini-symposium:* "Dynamical modeling approaches to the study of birdsong"

**SIAM Conference on Dynamical Systems** (May 2019) **Snowbird, UT**

*Host of mini-symposium:* "Got rhythm? - a dynamical systems survival guide for biology"  
*Talk:* "A geometric spatial reconstruction for analyzing the information content of song"

**American Physical Society annual meeting** (March 2019) **Boston, MA**

*Talk:* "Can vocalizations predict mating pairs in a society of songbirds? A maximum-entropy Ising model approach"

**International Symposium on Data Assimilation** (Jan 2019) **Kobe, Japan**

**RIKEN Center for Computational Science**

*Invited talk:* "From synaptic connections among neurons to energy-changing collisions among neutrinos: using inference to map information flow".

**The Physics of Behavior workshop** (May – Jun 2018) **Aspen Center for Physics; Aspen, CO**

*Talk:* "Using nonlinear dynamics to unfold the geometry of birdsong"

**Nuclear Physics and Cosmology Workshop** (July 2018) **Los Alamos National Laboratories**

*Invited talk:* "Optimization predicts neutrino flavor evolution following SNe core collapse"

**Department of Physics seminar** (Jun 2019) **University of Wisconsin, Madison**

*Invited talk:* "Optimization predicts neutrino flavor evolution following SNe core collapse"

**Neutrinos, Nuclear Astrophysics, and Symmetries Conference** (Jan 2018) **UCSD**

*Talk:* “An optimization approach to inferring neutrino astrophysics”

**Mathematical Biology seminar** (Dec 2017) **New Jersey Institute of Technology**  
*Talk:* “Crafting functional architectures for pattern-generating networks”

**SIAM annual meeting** (July 2017) **Pittsburgh, PA**  
*Talk:* “Data assimilation for the testing of stochastic models in mathematical biology”

**SIAM Conference on Dynamical Systems** (May 2017) **Snowbird, UT**  
*Talk:* “A path-integral approach to data assimilation for mapping small neuronal networks”

**MURI Winter School** (Jan 2017) **BioCircuits Institute, UCSD**  
*Talk:* “Building models of small neuronal networks and model-testing via data assimilation”

**Dynamical systems and Data Analysis  
in Neuroscience Workshop** (Oct 2016) **Mathematical Biosciences Inst.  
Ohio State U.**  
*Poster:* “Model of the avian nucleus HVC as a network of central pattern generators”

**SIAM Conference on the Life Sciences** (July 2016) **Boston, MA**  
*Host of mini-symposium:* “Experiment and theory combined: an ideal vantage point upon  
neurodynamics”  
*Talk:* “Model of the songbird nucleus HVC as a network of central pattern generators”

**Dynamics Days U.S.** (Jan 2016) **Durham, NC**  
*Talk:* “From the nonlinear behavior of a single neuron to the robust pattern of a network”

**Janelia Theoretical Neuroscience Workshop** (Nov 2015) **Janelia Research Campus  
Howard Hughes Medical Institute; Ashburn, VA**  
*Talk and tutorial:* “Methods of statistical nonlinear data assimilation, and what they can reveal  
about connectivity in small neural networks”

**Dynamics Days Europe** (Sep 2015) **Centre for Systems, Dynamics, and Control: U. of Exeter, UK**  
*Talk:* “From the nonlinear behavior of a single neuron to the robust pattern of a network”

---

## NEWS & MEDIA

SIAM News Blog. “Empirical model aims to predict female cowbird responses to mating calls.” Sorg, Lina. May 20, 2019. <https://sinews.siam.org/Details-Page/empirical-model-aims-to-predict-female-cowbird-responses-to-mating-calls>

*Retraction Watch.* “A scientist models a potential prom date.” Oransky, Ivan. Apr 1, 2017. <https://retractionwatch.com/2017/04/01/publications-questionable-scientific-value-scientist-models-potential-prom-date/>

*Vice.* “This is the only good April Fool’s joke so everybody else can shut up.” Pearson, Jordan. Apr 1, 2017. [https://www.vice.com/en\\_us/article/yp9kyx/this-is-the-only-good-april-fools-joke-so-everybody-else-can-shut-up](https://www.vice.com/en_us/article/yp9kyx/this-is-the-only-good-april-fools-joke-so-everybody-else-can-shut-up)

*The New Stack.* “Wistful researcher applies a neural network to questions about her 1997 junior prom.” Cassel, David. Apr 9, 2017. <https://thenewstack.io/wistful-researcher-applies-neural-network-questions->

1997-junior-prom/

*Retraction Watch*. “Clue fans, here’s scientific proof that it was Colonel Mustard with the Candlestick.” Oransky, Ivan. Apr 1, 2018. <https://retractionwatch.com/2018/04/01/clue-fans-heres-scientific-proof-that-it-was-colonel-mustard-with-a-candlestick/>

---

## TEACHING

*Assistant Professor for physics courses* (2019 - ) NYIT  
*Adjunct Professor: physics* (2010-13) Cooper Union for the Advancement of Science and Art, NY  
*Adjunct Professor: astronomy* (2011) Lehman College, City University of NY  
*Adjunct Instructor: astronomy* (2009) College of Staten Island, City University of NY

---

## MEMBERSHIPS

American Physical Society (APS)  
Society for Industrial and Applied Mathematics (SIAM)  
National Association of Science Writers

---

## OUTREACH and SERVICE

*Reviewer* (Fall 2019 – ) **Bellevue Literary Review**  
Review nonfiction articles submitted for publication in the Bellevue Literary Review, a journal of fiction, nonfiction, and poetry about health, illness, and healing.

*Volunteer* (March 2014) **Weill Cornell Medical Center neurotrauma course: Tanzania, Africa**  
Accompanied a neuro-trauma team to host a course at the Muhimbili Orthopedic and Neurological Institute in Dar Es Salaam, Tanzania, on modern methods of neurological surgery. Recorded surgeries; wrote report for distribution to affiliates and donors.

*Volunteer* (2009-2014) **Weill Cornell Medical Center: Department of Neurological Surgery, NY**  
Accompanied neurological patients to surgery, with follow-up visits in recovery. Served as liaison between nursing staff and families. Shadowed a neurosurgery physician’s assistant.

*Volunteer* (2004-6; 2011-13) **Center for Astrophysics and Space Sciences, UCSD**  
Co-hosted free outreach events throughout San Diego. Mentored students visiting from schools with little access to extracurricular activities and quality science programs.

*Co-founder, co-artistic director* (2007-2011) **Reality Aside Theatre, Inc., NY**  
Produced dark comedic and interactive theatre in Midtown Manhattan, including the science-themed sketch comedy show “Spin-1/2”.

*Guest lecturer* (2007-8) **American Museum of Natural History: Haydn Planetarium, NY**

*Volunteer* (June 2002) **African Israelites Community Orphanage: Ghana, West Africa**  
Taught English and math; helped orphanage founders plan a viable future for their organization.

---

## PUBLICATIONS

### *Articles in preparation*

1. Rrapaj, E., Patwardhan, A., **Armstrong, E.**, Fallah Ardizi, S., Fuller, G.M. Neutrino flavor

evolution, data assimilation, and neural differential equations.

2. **Armstrong, E.**, Zeng, A., Perkes, A., Andersen, L., Balasubramanian, V., Schmidt, M. An attractor representation of birdsong, together with inference, predicts song preferences in female cowbirds.
3. Hyland Bruno, J., Tchernichovski, O., **Armstrong, E.**, Tesileanu, T. Songbirds learn vocal sequences within a rhythmic framework.

#### **Articles in press**

1. **Armstrong, E.**, Patwardhan, A., Rrapaj, E., Fallah Ardizi, S., Fuller, G.M. Inference offers a metric to constrain dynamical models of neutrino flavor transformation. *In press: Physical Review D*; <https://arxiv.org/abs/2006.07725>, 2020

#### **Articles submitted for publication**

1. **Armstrong, E.**, Runge, M., Gerardin, J. Identifying the measurements required to estimate rates of COVID-19 transmission, infection, and detection, using variational data assimilation. *Submitted: Journal of Theoretical Biology*; <https://arxiv.org/abs.2005.12441>, 2020

#### **Articles published**

1. **Armstrong, E.** Statistical data assimilation for estimating electrophysiology simultaneously with connectivity within a biological neuronal network. *Physical Review E* 101, 012415, 2020
2. **Armstrong, E.**, Patwardhan, A.V., Johns, L., Kishimoto, C.T., Abarbanel, H.D.I., Fuller, G.M. A Path-integral-based Approach to Neutrino Flavor Evolution. *Physical Review D* 96(8): 083008, 2017
3. Abarbanel, H.D.I., Shirman, S., Breen, D., Kadakia, N., Rey, D., **Armstrong, E.**, Margoliash, D. A Unifying View of Synchronization for Data Assimilation in Complex Nonlinear Networks. *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 27(12): 126802, 2017
4. **Armstrong, E.**, Abarbanel, H.D.I. Model of the songbird nucleus HVC as a network of central pattern generators, *J. Neurophysiol.* 116(5): 2405-2419, 2016
5. Kadakia, N., **Armstrong, E.**, Breen, D., Morone, U., Daou, A., Margoliash, D., Abarbanel, H. D.I., Nonlinear Statistical Data Assimilation for HVC<sub>RA</sub> Neurons in the Avian Song System. *Biological Cybernetics* 110.6:417-434, 2016
6. Breen, D., Shirman, S., **Armstrong, E.**, Daou, A., Margoliash, D., Abarbanel, H.D.I. HVC Interneuron Properties from Statistical Data Assimilation. *arXiv preprint arXiv: 1608:04433*, 2016
7. **Armstrong, E.**, Patterson, J., Michelsen, E., Thorstensen, J., Uthas, H., Vanmunster, T., Hamsch, F.-J., Roberts, G., Dvorak, S., Orbital, Superhump, and Superorbital Periods in the Cataclysmic Variables AQ Mensae and IM Eridani. *Monthly Notices of the Royal Astronomical Society (MNRAS)* 435, 707, 2013
8. **Armstrong, E.**, Patterson, J., Kemp, J. Two Photometric Periods in the AM CVn System CP Eridani. *MNRAS* 421, 2310, 2012
9. Skinner, J., Thorstensen, J., **Armstrong, E.**, Brady, S. The New Eclipsing Cataclysmic Variable SDSS 154453+255. *Publications of the Astron. Soc. of the Pacific (PASP)* 123, 901, 2011
10. Copperwheat, C.M., Marsh, T., Dhillon, V., Littlefair, S., Woudt, A., Warner, B., Patterson, J., Steeghs, D., Kemp, J., **Armstrong, E.**, Rea, R. The Photometric Period in ES Ceti. *MNRAS* 413, 3068, 2011
11. Dai, X, Halpern, J., Morgan, N., **Armstrong, E.**, Mirabal, N., Haislip, J., Reichart, D., Stanek, K., Optical and X-Ray Observations of GRB 060526: A Complex Afterglow Consistent with an Achromatic Jet Break. *Astrophysical Journal (Ap J)* 658, 509, 2007
12. **Armstrong, E.** et. al. GRB 060102: MDM Observation, *GRB Coordinates Network, Circular Service* 4427, 1, 2006

13. Thorstensen, J., **Armstrong, E.** Is FIRST J102347.6+003841 Really a Cataclysmic Binary? *Astronomical Journal (AJ)* 130, 759, 2005
14. Patterson, J., Thorstensen, J., **Armstrong, E.** The Dwarf Nova PQ Andromedae. *PASP* 117, 922, 2005
15. Patterson, J. **and 19 co-authors**, Superhumps in Cataclysmic Binaries. XXV.  $q_{\text{crit}}$ ,  $\epsilon(q)$ , and Mass-Radius. *PASP* 117, 1204, 2005
16. Patterson, J., Thorstensen, J., Vanmunster, T., Fried, R., Martin, B., Campbell, T., Robertson, J., Kemp, J., Messier, D., **Armstrong, E.**, Rapid Oscillations in Cataclysmic Variables. XVI. DW Cancri. *PASP* 116, 516, 2004
17. Pretorius, M.L. Woudt, P., Warner, B., Bolt, G., Patterson, J., **Armstrong, E.**, High-speed photometry of SDSS J013701.06 - 091234.9. *MNRAS* 352, 1056, 2004
18. Mirabal, N. Halpern, J., Chornock, R., Filippenko, A., Terndrup, D., **Armstrong, E.**, Kemp, J., Thorstensen, J., Tavarez, M., Espaillat, C., GRB 021004: A Possible Shell Nebula around a Wolf-Rayet Star Gamma-Ray Burst Progenitor. *Ap J* 595, 935, 2003

#### *Articles of questionable scientific content*

1. **Armstrong, E.** An Artificially-intelligent Means to Escape Discreetly from the Departmental Holiday Party; guide for the socially-awkward. *arXiv preprint arxiv: 2003.14169 (2020)*.
2. **Armstrong, E.** Forecasting Future Murders of Mr. Boddy by Numerical Weather Prediction. *arXiv preprint arxiv: 1903.12604*
3. **Armstrong, E.** Colonel Mustard in the Aviary with the Candlestick: a limit cycle attractor transitions to a stable focus via supercritical Andronov-Hopf bifurcation. *arXiv preprint arxiv: 1803.11559*
4. **Armstrong, E.** A Neural Networks Approach to Predicting How Things Might Have Turned Out Had I Mustered the Nerve to Ask Barry Cottonfield to the Junior Prom Back in 1997. *arXiv preprint arxiv:1703:10449*, 2017 April 1
5. **Armstrong, E.** Pipe-cleaner Model of Neuronal Network Dynamics. *arXiv preprint arxiv:1603:09723*, 2016 April 1
6. **Armstrong, E.** Non-detection of the Tooth Fairy at Optical Wavelengths. *arXiv preprint arxiv:1204.0492* 2012 April 1; *Journal of Irreproducible Results* 52, 3: 22-25, 2014

#### *Educational material*

1. Developed a textbook for Columbia College course “Frontiers of Science” (2004), which is a core requirement for undergraduates (as of 2005). Helfand, David. *A survival guide to the misinformation age: Scientific habits of mind*. Columbia University Press, 2016
2. Developed an educational science-themed sketch comedy group “Spin ½”, a project by Reality Aside Theatre, Inc. Performed in Manhattan and surrounding areas for general and student audiences (2009-2011).

---

## REFERENCES

### **Roger Yu**

Chair, Department of Physics  
New York Institute of Technology  
ryu@nyit.edu

### **Ellen Katz**

President, local chapter of Amer. Assoc.  
of U. Professors  
New York Institute of Technology  
ekatz@nyit.edu

### **George Fuller**

Department of Physics  
Director, Ctr for Astrophys. and Space Sciences

### **Michael Shara**

Curator, Department of Astrophysics  
American Museum of Natural History

University of California, San Diego  
gfuller@ucsd.edu

mshara@amnh.org

**Jaline Gerardin**

Department of Preventive Medicine  
Northwestern University, Chicago, IL  
jgerardin@northwestern.edu

**Jacqueline Faherty**

Senior Scientist, Dept. of Astrophysics  
Department of Education  
American Museum of Natural History  
jfaherty@amnh.org