

# Cody L. Petrie - Curriculum Vitae

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## Education

- PhD Physics, Arizona State University, August 2019.
- INT Program INT-18-2b: Advances in Monte Carlo Techniques for Many-Body Quantum Systems, July-August 2018.
- XSEDE HPC Workshop: Summer Boot Camp, June 2018.
- M.S. Physics, Arizona State University, August 2017.
- TALENT Summer School on Nuclear Quantum Monte Carlo Methods, July 2016.
- B.S. Physics, Brigham Young University, August 2014.
  - Minor: Astronomy

## Research Experience

### **Sloppy Modeling of Complex Systems (BYU):** July 2019 - Present

Sloppy models are multiparameter models, whose predictions are only dependent on a few stiff parameter combinations. I have used sloppy model analysis to identify key mechanisms that drive model behavior, build simple transferable models, and identify key plot holes in the story uncertainty quantification. Sloppy models are shockingly ubiquitous in science and I've been able to apply these methods to models from systems biology, neuroscience, materials, combustion, and machine learning. These are only a few examples of possible applications, which are as ubiquitous as sloppy models themselves. Especially with the advent of big data and machine learning, I suspect that the principle of sloppy model analysis will find application in almost any field that utilizes predictive models.

### **Quantum Monte Carlo for Nuclear Systems (ASU and LANL):** August 2014 - June 2019

I used Quantum Monte Carlo methods to solve many-body problems in nuclear physics. I added quadratic spin-isospin dependent correlations to the trial wave function which improved statistical errors and energy estimates. These improved correlations have the greatest effect on systems of many nucleons. I also used these improved wave functions to investigate particle clustering in neutron matter, a phenomenon that occurs in the crust of neutron stars. This research was done at ASU and in conjunction with collaborators at Los Alamos National Laboratory.

### **Coupling of Nano Systems with Electromagnetic Fields (ASU):** January 2015 - April 2015

I used the Finite Difference Time Domain method to calculate the interaction coupling between nano particles such as Ag islands or spheres with surface plasmons on a Si substrate. This was done as part of a research rotation during my second semester at ASU.

### **HIV Incidence Estimation (LANL):** May 2012 - July 2012

I computationally estimated HIV incidence based on serological data of diagnosed cases. I used a combination of survey and Bayesian statistics. This research was part of a summer Science Undergraduate Laboratory Internship (SULI) through the DOE during the summer of 2013.

### **Experimental/Computational Extreme Ultraviolet (EUV) Optics (BYU):** March 2011 - August 2014

I used geometrical optics, physical optics and direct calculations using Maxwell's equations to calculate reflection from thin film surfaces. These calculations were compared to reflection measurements that I took of EUV light from thin film surfaces of varying roughness. Comparing the calculated reflectances from surfaces with various roughnesses to the measured reflectances I was able to estimate the roughness of the thin films.

## Grants & Awards

- Nominated as a College of Liberal Arts and Sciences Student Leader at ASU, 2018.
- Outstanding Graduate Student Presentation Award at 4CS APS meeting, 2018.
- Nominated as a College of Liberal Arts and Sciences Student Leader at ASU, 2017.
- Department of Physics, Wally Stoelzel Fellowship at ASU, Fall 2017.
- Summer University Graduate Fellowship at ASU, Summer 2015.
- Department of Physics Graduate Fellowship at ASU, Fall 2014.
- Office of Research and Creative Activities Grant at BYU, Academic year of 2013-2014.

## Computational Experience

### *Languages*

Python  
Julia  
Fortran  
MPI and some OpenMP and OpenACC  
Mathematica  
R  
C++  
Matlab

### *Operating Systems*

Linux  
Windows  
Mac

## Teaching Experience

I have experience doing **online** physics courses as well as labs, lectures, and combined lecture-lab courses.

**Teaching Assistant:** General Physics Laboratory 1 (non-calculus based, online format), May 2018-June 2018, ASU.

**Teaching Assistant:** University Physics Laboratory 1 (calculus based, online format), August 2018-December 2018, ASU.

**Teaching Assistant:** General Physics Laboratory 1 (non-calculus based, online format), August 2018-October 2018, ASU.

**Teaching Assistant:** General Physics Laboratory 1 (non-calculus based, online format), May 2017-June 2017, ASU.

**Adjunct Faculty:** University Physics I: Mechanics (calculus based, lecture+lab combination), August 2017-December 2017, Mesa Community College.

**Instructor:** Clubes de Ciencia México: Frank Wilczek course, July 2017.

**Teaching Assistant:** University Physics Laboratory 1 (calculus based, online format), January 2017-December 2017, ASU.

**Teaching Assistant:** General Physics Laboratory 1 (non-calculus based, online format), January 2017-March 2017, August 2017-October 2017, ASU.

**Teaching Assistant:** Introduction to Physics (non-calculus based), August 2016-December 2016, ASU.

**Teaching Assistant:** General Physics Laboratory 2 (non-calculus based), January 2016-April 2016, ASU.

**Teaching Assistant:** University Physics Laboratory 2 (calculus based), August 2015-December 2015, ASU.

**Teaching Assistant:** University Physics Laboratory 1 (calculus based), August 2014-April 2015, ASU.

**Physics Tutor:** Tutor for both calculus and non-calculus based classes on waves, optics, thermodynamics, special relativity, and electricity and magnetism, Jan-Apr 2014, BYU.

**Teaching Assistant:** Introduction to Analog and Digital Circuits, Sep-Dec 2013, BYU.

**Teaching Assistant:** Classical Mechanics, Sep-Dec 2013, BYU.

**Teaching Assistant:** Introduction to Waves, Optics, and Thermodynamics (Physics Major Section), Jan-Apr 2013, BYU.

**Teaching Assistant:** Introduction to Electricity and Magnetism, Sep-Dec 2012, BYU.

## Publications

1. **Cody Petrie**, Christian Anderson, Casie Maekawa, Travis Maekawa, Mark K. Transtrum. The supremum principle selects simple, transferable models. arXiv:2109.10449 [q-bio.QM] (2021) (submitted for publication at PRL).
2. **Cody L. Petrie**, Improved Trial Wave Functions for Quantum Monte Carlo Calculations of Nuclear Systems and Their Applications, Arizona State University (2019), PhD Dissertation.
3. D. Lonardonì, S. Gandolfi, J. E. Lynn, **C. Petrie**, J. Carlson, K. E. Schmidt, A. Schwenk. Auxiliary field diffusion Monte Carlo calculations of light and medium-mass nuclei with local chiral interactions. Phys. Rev. C, 97 (4), 044318 (2018).
4. Ethan Obie Romero-Severson, **Cody L. Petrie**, Edward Ionides, Jan Albert, Thomas Leitner. Trends of HIV-1 incidence with credible intervals in Sweden 2002-09 reconstructed using a dynamic model of within-patient IgG growth. Int. J. Epidemiol., 2015, Vol. 0, No. 0.
5. **Cody L. Petrie**, Joshua Marx, David Squires, R. Steven Turley. Determining thin-film roughness with extreme ultraviolet reflection. J. Utah Acad. Sci. Arts Letts., 92, 239-255 (2015).
6. **Cody L. Petrie**, Determining thin film roughness with EUV reflection, Brigham Young University (2014), Senior Thesis.
7. Quintin Nethercott, **Cody L. Petrie**, R. Steven Turley. Non-specular reflection in the extreme ultraviolet. J. Utah Acad. Sci. Arts Letts., 89, 181-193 (2012).

## Talks and Posters

1. "Using analogical reasoning to build transferable models," **Cody L. Petrie**, Christian Anderson, Casie Maekawa, Travis Maekawa, Mark Transtrum. APS March Meeting, Chicago Illinois, March 14-18, 2022.
2. "Supremum modeling to extend model transferability in systems biology," **Cody L. Petrie**, Christian Anderson, Mark Transtrum. APS March Meeting (Virtual), March 15, 2021.

3. “An Information Geometry Approach to Uncertainty Quantification of Sloppy Interatomic Models,” **Cody L. Petrie**, Yonatan Kurniawan, Kinamo Jahali Williams, Mark Transtrum. Annual Meeting of the Four Corners Section of the APS, Albuquerque NM, Oct 23, 2020.
4. “Information Geometry to Explore the Parameter Space of Interatomic Models,” **Cody L. Petrie**, Yonatan Kurniawan, Kinamo Jahali Williams, Mark Transtrum. The Virtual Technical Meeting of the Society of Engineering Science, Sep 29 – Oct 1, 2020.
5. “Can model reduction replace expert intuition for modeling complex biological systems?,” **Cody L. Petrie**, Dane Bjork, Mark Transtrum. APS March Meeting (submitted recorded presentation), Denver CO, March 5, 2020.
6. “Discovering Emergent Behaviors in Cellular Networks Using Supremum Models,” **Cody L. Petrie**, Mark Transtrum, Travis Maekawa, Casie Maekawa. Annual Meeting of the Four Corners Section of the APS, Prescott AZ, Oct 12, 2019.
7. “Improved trial wave functions with 4-body correlations for Nuclear Quantum Monte Carlo,” **Cody L. Petrie**, Kevin Schmidt. APS April Meeting, Denver Colorado, April 15, 2019.
8. “Alpha particle formation in neutron star crusts with an improved trial wave function for nuclear Quantum Monte Carlo,” **Cody L. Petrie**, Kevin Schmidt. Annual Meeting of the Four Corners Section of the APS, Salt Lake City Utah, October 13, 2018.
9. “Improved Trial Wave Functions for Nuclear Quantum Monte Carlo,” **Cody L. Petrie**. INT Program INT-18-2b, Seattle Washington, August 8, 2018.
10. “Determining Thin Film Roughness with Extreme Ultraviolet Reflection,” **Cody L. Petrie**, R. Steven Turley. Utah Academy of Sciences, Arts and Letters, St. George Utah, April 11, 2014.
11. “Determining Thin Film Roughness with Extreme Ultraviolet Reflection,” **Cody L. Petrie**. BYU Student Research Conference, Provo Utah, March 15, 2014
12. “Using EUV Reflection to Understand Thin Film Surfaces,” **Cody L. Petrie**, R. Steven Turley. Utah Academy of Sciences, Arts and Letters, Orem Utah, April 12, 2013.
13. “Using EUV Reflection to Understand Thin Film Surfaces,” **Cody L. Petrie**. BYU Student Research Conference, Provo Utah, March 9, 2013
14. “Determining Thin Film Roughness with Extreme Ultraviolet Light,” **Cody L. Petrie**, R. Steven Turley. Annual Meeting of the Four Corners Section of the APS, Socorro New Mexico, October 26, 2012.
15. “Nonspecular reflectance in the extreme ultraviolet,” Quintin Nethercott, **Cody L. Petrie**, R. Steven Turley. Utah Academy of Sciences, Arts and Letters, Logan Utah, April 13, 2012.
16. “Improving thin film thickness uniformity,” Jordan Bell, **Cody L. Petrie**. BYU Student Research Conference, Provo Utah, March 12, 2012