ACHIEVEMENT REWARDS FOR COLLEGE SCIENTISTS
ARCS® FOUNDATION, INC. - PHOENIX CHAPTER
2017-2018 ARCS® SCHOLAR AWARD AMOUNT: $8,500

SECTION 1: Student Information Data Sheet

Select tab button or arrow keys to navigate between columns. Use mouse to scroll up and down.

Last Name	Petrie
First Name	Cody
Middle Name	Lee
Name of University	Arizona State University
School/Department	Liberal Arts and Sciences/Physics
Area of Study in which You Seek a Degree	Computational Nuclear Physics
Current GPA (Must be 3.5 or above)	4.0
PhD Start (month/year)	August/2014
PhD Anticipated Graduation (month/year)	May/2019
Master's Degree Area of Study	N/A
Master's Degree Institution	N/A
Master's Degree Start (month/year)	N/A
Master's Graduation, if applicable	N/A
Undergraduate Institution	Brigham Young University
Undergraduate Major	Physics
Undergraduate Minor, if applicable	Astronomy
Birth Date (month/day/year)	02/23/1989
Birthplace	Mesa, Arizona
Last 4 Digits of Social Security Number	9379
Are you a U.S. citizen?	Yes
If Foreign Born, Date and Place of Citizenship	N/A
Permanent Address: Street	178 E. Redfield Rd.
City	Chandler
State, Zip Code	AZ, 85225
Local Mailing Address: Street	553 S. Ash St.
City	Gilbert
State, Zip Code	AZ, 85233
Local Phone Number	480-392-3214
Email Address	clpetrie@asu.edu
Faculty Advisor Name	Kevin Schmidt
Faculty Advisor Email Address	Kevin.Schmidt@asu.edu
Faculty Advisor Phone Number	480-965-8240
Academic References (List three)	
Name #1	Kevin Schmidt
Email Address	Kevin.Schmidt@asu.edu
Name #2	Steve Turley
Email Address	turley@byu.edu
Name #3	Thomas Leitner
E-mail Address	tkl@lanl.gov

SECTION 2: Applicant Information Release Form and University Representative Verification Form

I understand that my professional and academic information is important to both ARCS® members and donors in order that ARCS can keep its records and statistics current.

In consideration of any Scholar Award presented to me by ARCS Foundation Inc., Phoenix Chapter, I hereby authorize ARCS Foundation, Inc., Phoenix Chapter and ARCS Foundation, Inc., National Office, and/or any ARCS Foundation, Inc. Chapter to make available any information in its/their files, including my photograph(s), concerning my academic and professional activities to ARCS members, donors, potential donors, and news outlets. I also agree to provide ARCS with my future addresses and academic and professional activities.

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NOMINEE'S SIGNATURE

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PLEASE PRINT NAME AND DATE

I, as the University Representative of the Graduate College, have reviewed the above ARCS Scholar Award Nomination and certify that it is complete and will furnish twelve (12) copies of this nomination to the designated ARCS Phoenix Chapter representative.

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UNIVERSITY REPRESENTATIVE'S SIGNATURE

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PLEASE PRINT NAME, TITLE, AND DATE

SECTION 3: Faculty Letter of Recommendation

Insert one letter of recommendation from a faculty member at your university. The faculty member must be a Dean, Department Chair, Professor, or Advisor. If you are a returning ARCS Scholar, please have your faculty member include a section on the progress you have made since last year.

NOTE: The letter of recommendation must be on official university letterhead and include the following information in the closing of the letter.

- ☐ Signature of the Dean, Department Chair, Professor, or Advisor
- ☐ Typed Name of the Dean, Department Chair, Professor, or Advisor
- ☐ Official Title or Position
- ☐ Telephone Number
- ☐ E-mail

SECTION 4: Career, Research, Academic and Personal Statements (Boxes A - F)

Answer A – F in the boxes provided unless otherwise indicated.

A. What is/are your career goal(s)?

After earning a PhD in Physics from ASU I would like to continue research in nuclear quantum Monte Carlo at a major research facility, such as a National Laboratory. After gaining experience as a career physicist doing research I would like to teach and continue research at a University so that I can help train the next generation of physicists.

B. Provide a brief student profile that includes, where applicable, undergraduate school degrees, current research, and any other relevant information. This information will be used for the ARCS® Awards Dinner program in the event you receive an award. DO NOT list honors and awards (see sections 5 and 6).

I completed my undergraduate degree in Physics, minoring in Astronomy, at Brigham Young University doing research in experimental and computational optics. Since being at ASU I have been using and improving quantum Monte Carlo calculations to solve for interesting properties of nuclear systems.

C. Describe how your research will contribute to science, technology, education and the benefit of humanity. (Please be brief.)

We have seen a boost in science and technology in the last century or so. This is largely due to our understanding of how particles are interacting on a quantum level. We can use these interaction to make safer, smarter, and more efficient materials and technologies. One of the less understood of the fundamental forces in nature is the strong force, yet it is so prevalent around us. It is responsible for holding some of the smallest things in nature together, like the nucleus of an atom. Yet it is also responsible for maintaining some of the largest structures in the universe, like stars. My research helps us understand the details of this force and, as a result, could be responsible for many technological breakthroughs, from creating novel materials to understanding the universe around us.

D. Part I - Write a brief essay describing your current research. If applicable, include methods, materials and findings. Part II - If you are an ARCS Scholar who is being re-nominated, indicate research findings obtained since your last award. If you need more space, you may add no more than one page to section D.

Solving problems for quantum mechanical systems with many particles can be very difficult, especially when the interaction between the particles isn't completely understood. This is the case with the nuclear many-body problem. Because of the large number of difficult integrals that needed to be solved for these problems I use an approximate method to solve them. This method is called Auxiliary Field Diffusion Monte Carlo (AFDMC).

One of the most computationally expensive and crucial parts of the AFDMC method is having a good estimate of the wave function, or state, of the system from which to start. This estimate is called the trial wave function, and it guides the calculation toward the true answer. I have added extra correlations, which induce particle interactions, to this trial wave function. However, these additional correlations only add part of the correlations that we believe to really exist between the nucleons. I have used this wave function to then calculate the binding energy of the helium and oxygen nuclei. I have also calculated the binding energy per particle of symmetric nuclear matter, which is matter with an equal number of protons and neutrons. After working through a few final things we plan to publish this work in a peer reviewed journal.

In the future I plan to include these correlations in a more complete form. This is difficult to do and so I will be employing a mathematical technique called a Hubbard-Stratanovich transformation. I will then be using this improved wave function to study interesting properties of nuclear systems such as alpha particle clustering in nuclear, mostly neutron, matter.

E. Describe any significant academic milestones that remain in your program, including but not limited to coursework, qualifying/comprehensive exams and thesis/dissertation proposal and defense. If applicable, provide your thesis statement or research question.

I have completed the core coursework for my program of study. I have also formed an advisory committee. I will soon be taking the comprehensive exams which will test my knowledge of the fundamental concepts involved in the field of research that I am involved in. I am working with my advisor to form an exact research question, however it will be centered on forming an effective and efficient trial wave function to use in nuclear physics, and its application to calculating some interesting nuclear properties, like alpha clustering in nuclear matter. After I have formed this research question I will be presenting my dissertation proposal, at which point the only remaining milestone will be my dissertation defense.

F. Explain how this ARCS Scholar Award will assist you in completing your graduate degree program.

Much of my time goes to into teaching as a teaching assistant (TA) and into grading papers. On weeks that I do not have any TA responsibilities I have found that I make large strides in research. Receiving the ARCS Scholar Award would give me the ability to focus more of my efforts on research, which will rocket me into the field of physics research after graduate school.

SECTION 5: Undergraduate Degree Information

List Undergraduate Honors and Awards Received.

None

List Undergraduate Community Service and/or Extracurricular Activities.

Volunteer at Astrofest (Astronomy outreach activity at BYU, July 2015).

List any work experiences and/or internships from the end of your undergraduate program until your entry into graduate school (include start and end dates).

None

List Undergraduate Level Scholarships and/or Grant Funding Received.

Name of Scholarship	Year	Award Amount
Office of Research and Creative Activities Grant	2013-2014	$1500

SECTION 6: Graduate Degree Information

List Graduate Level Honors and Awards Received

None

List Graduate Community Service and/or Extracurricular Activities.

Volunteer science fair judge at Chandler High School in Arizona (Feb 2016).

List any work experiences, including teaching or research assistantships and/or internships from the start of your graduate program to the present (include start and end dates).

TA for Introduction to Physics recitation: August 2016 – Present
TA General Physics Laboratory (non-calculus based): January 2016 – April 2016
TA for University Physics Laboratory 1-2 (calculus based): August 2014 – December 2015
RA (unfunded) doing computational optics: January 2015 – April 2015
RA doing computational quantum Monte Carlo: August 2014 – Present (funded May 2015 – July 2015 and May 2016 – July 2016)

List Graduate Level Scholarships, Awards, Fellowships and/or Grants Received.

Name of Scholarship/Fellowship/Award	Year	Award Amount
Summer 2015 University Graduate Fellowship	2015	$1551
ASU Department of Physics Graduate Fellowship	2014	$5000

SECTION 7: History of Financial Assistance

If applicable, list history of any of the following financial aid programs received and/or anticipated.

PELL GRANT

Graduate/Undergraduate	Year	Award Amount
Federal Pell Grant (FAFSA), Undergraduate, BYU	2013-2014	$5645
Federal Pell Grant (FAFSA), Undergraduate, BYU	2012-2013	$5550
Federal Pell Grant (FAFSA), Undergraduate, BYU	2011-2012	$5550

STAFFORD LOAN

Graduate/Undergraduate	Year	Award Amount

OTHER STUDENT LOANS

Graduate/Undergraduate	Year	Award Amount

SECTION 8: Publications and Presentations

Boxes will expand as needed in Sections A – D

A. List bibliographic citations for research that has been published in peer-reviewed journals. You may also cite research accepted, but not yet published, in peer-reviewed journals. If known, include journal acceptance rates.

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- patiend IgG growth. Int. J. Epidemiol., 2015, Vol. 0, No. 0.

Cody L. Petrie, Joshua Marx, David Squires, R. Steven Turley. Determining thin-film roughness with extreme ultraviolet reflaction. J. Utah Acad. Sci. Arts letts., 92, 239-255 (2015)

Quintin Nethercott, Cody L. Petrie, R. Steven Turley. Non-specular reflection in the extreme ultraviolet. The Journal of the Utah Academy of Sciences, Arts, & Letters. 2012.

B. List major meetings, conferences, consortiums, or workshops in which you have presented your research. If known, include acceptance rates.

"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.

"Using EUV reflection to Understand Thin Film Surfaces," Cody L. Petrie, R. Steven Turley. Utah Academy of Sciences, Arts and Letters, Oren Utah, April 12 2013.

"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.

"Non-Specular Reflectance in the Extreme Ultraviolet," Quintin Nethercott, Cody L. Petrie, R. Steven Turley. Utah Adademy of Sciences, Arts and Letters, Logan Utah, April 13 2012.

C. List any publications in preparation for potential publication but not yet submitted.

Cody L. Petrie, Kevin Schmidt. Auxiliary field diffusion Monte Carlo calculation of nuclei with improved trial wave functions. In progress.

D. List any other forums or media in which your work has been presented or published (i.e., poster presentation, local news, magazine, etc.). Include dates.

"Trial wave functions for auxiliary field diffusion Monte Carlo," Kevin E. Schmidt (Presenter), Stefano Gandolfi, Francesco Pederiva, J. Carlson, Alessandro Lovato, Cody Petrie. Equations of state in quantum many-body systems workshop, Trento, Italy, June 1 2016.