

Bret Underwood

Associate Professor of Physics

Pacific Lutheran University
Department of Physics
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EDUCATION

- Ph.D. Physics: Theoretical Physics** August 2008
University of Wisconsin-Madison, Madison, WI
Dissertation: *Warped String Phenomenology: Topics in Cosmology and Particle Physics*
Advisor: Professor Gary Shiu
- Masters of Arts, Physics** January 2006
University of Wisconsin-Madison, Madison, WI
- Bachelor of Science: Physics** June 2003
The Ohio State University, Columbus, OH
Magna Cum Laude, With Honors in the Liberal Arts, With Distinction in Physics.
Undergraduate Research Thesis: *Renormalization of the n -dimensional delta function potential.*
Advisor: Professor Robert Perry

PROFESSIONAL EXPERIENCE

- Associate Professor of Physics:** Pacific Lutheran University 2017 – present
- Assistant Professor of Physics:** Pacific Lutheran University 2011 – 2017
Instructor for introductory and upper-level physics courses. Serve as student academic advisor, provide service to department and campus. Conduct independent and undergraduate student research projects in theoretical physics.
- Instructor:** McGill University 2010 – 2011
Instructor for advanced undergraduate-level (Phys 362) “Statistical Mechanics” and graduate-level (Phys 743) “Physics of the Very Early Universe” courses.
- Postdoctoral Research Fellow:** McGill University 2008 – 2011
Actively involved in theoretical cosmology and high energy physics research, organizer of weekly seminars on theoretical high energy physics, and mentoring of graduate students on research topics.
- Curriculum Development Project, “A Model Building Lesson”:** UW-Madison 2006 – 2008
Led group of educators in applying curriculum development and instructional techniques including “backward design,” making student thinking visible, and rubric-based assessment of student work to develop a new lesson on model building for an introductory physics course.
- Research Assistant:** UW-Madison 2005 – 2008
Actively involved in theoretical cosmology and high energy physics research for fulfillment of Ph. D.
- Laboratory Instructor, A Modern Introduction to Physics:** UW-Madison 2003 – 2005
Taught laboratory and discussion sessions for introductory undergraduate physics courses.

Undergraduate Research Assistant: Ohio State University	2002 – 2003
Applied ideas of renormalization to quantum mechanical scattering and bound state computations with “regularized” delta-function potentials.	
Physics Instructor, Young Scholars Program: Ohio State University	2003
Taught two-week long introductory physics summer program for minority high school students from throughout Ohio emphasizing mathematical and graphical representations of motion through lab exercises.	
Undergraduate Teaching Fellow, NSF GK-12 program: Ohio State University	2001 – 2003
Worked with interdisciplinary team of science students, elementary school teachers, and faculty to develop and teach active learning science lessons in inner-city schools.	
Science Team Co-Explorer: COSI, Columbus, OH	1999 – 2002
Interacted with visitors to the science museum through inquiry-based engagement methods; designed and performed science shows for audiences.	

SCHOLARSHIP ACTIVITIES

Note: It is common in Theoretical Physics research publications to list authors alphabetically, so the order of authorship does not correspond to the level of involvement in research.

Refereed Publications since Tenure and Promotion to Associate Professor:

1. S. S. Haque, C. Jana, and B. Underwood, “Operator Complexity for Quantum Scalar Fields and Cosmological Perturbations”, *Physical Review D*, **106**, no.6, 063510 (2022), [arXiv:2110.08356 \[hep-th\]](#).
2. S. S. Haque, C. Jana, and B. Underwood, “Saturation of Thermal Complexity of Purification”, *Journal of High Energy Physics* **01** (2022), [arXiv:2107.08969 \[hep-th\]](#).
3. S. S. Haque and B. Underwood, “Squeezed out-of-time-order correlator and cosmology,” *Physical Review D*, **103**, no.2, 023533 (2021), [arXiv:2010.08629 \[hep-th\]](#).
4. A. Bhattacharyya, S. Das, S. S. Haque and B. Underwood, “Rise of cosmological complexity: Saturation of growth and chaos,” *Physical Review Research* **2** (2020) no.3, 033273, [arXiv:2005.10854 \[hep-th\]](#).
5. A. Bhattacharyya, S. Das, S. Shajidul Haque and B. Underwood, “Cosmological Complexity,” *Physical Review D* **101**, no.10, 106020 (2020), [arXiv:2001.08664 \[hep-th\]](#).
6. S. Das, S. S. Haque and B. Underwood, “Constraints and Horizons for de Sitter with Extra Dimensions,” *Physical Review D* **100**, no.4, 046013 (2019), [arXiv:1905.05864 \[hep-th\]](#).
7. D. J. Burger, N. Moynihan, S. Das, S. Shajidul Haque and B. Underwood, “Towards the Raychaudhuri Equation Beyond General Relativity,” *Physical Review D* **98**, no. 2, 024006 (2018), [arXiv:1802.09499 \[gr-qc\]](#).
8. S. Shajidul Haque, B. Underwood, “Consistent Cosmic Bubble Embeddings”, *Physical Review* **D95**, 103513 (2017), [arXiv:1701.07771 \[hep-th\]](#).
9. B. Cownden, A. R. Frey, M. C. David Marsh, B. Underwood, “Dimensional Reduction for D3-brane Moduli”, *Journal of High Energy Physics*, 1612, 139 (2016), [arXiv:1609.05904 \[hep-th\]](#).

Refereed Publications completed prior to Tenure and Promotion to Associate Professor at PLU:

An asterisk * denotes PLU undergraduate co-author.

10. B. Underwood and Y. Zhai*, *Moving Phones Tick Slower: Creating an Android App to Demonstrate Time Dilation*, *The Physics Teacher*, **54**, 277 (2016).
11. B. Underwood and Y. Zhai*, *“Non-Linear Resonance in Relativistic Preheating”*, *Journal of Cosmology and Astrophysics*, **1404**, 002 (2014), arXiv:1312.3006 [hep-th].
12. P. Caputa, S. S. Haque, J. Olson* and B. Underwood, *“Cosmology or Catastrophe? A non-minimally coupled scalar in an inhomogeneous universe”*, *Classical and Quantum Gravity*, **30**, 195013 (2013), arXiv:1306.0012 [hep-th].

Refereed Publications completed before arriving at PLU:

13. J. Karouby, B. Underwood, A. Vincent, *“Preheating with the Brakes On: The Effects of a Speed Limit”*, *Physical Review* **D84**, 043528 (2011), arXiv: 1105.3982 [hep-th].
14. B. Underwood, *“A Breathing Mode for Warped Compactifications”*, *Classical and Quantum Gravity* **28**, 195013 (2011), arXiv:1009.4200 [hep-th].
15. P. Franche, R. Gwyn, B. Underwood and A. Wissanji, *“Initial Conditions for Non-Canonical Inflation”*, *Physical Review* **D82**, 063528 (2010), arXiv:1002.2639 [hep-th].
16. P. Franche, R. Gwyn, B. Underwood and A. Wissanji, *“Attractive Lagrangians for Non-Canonical Inflation”*, *Physical Review* **D81**, 123526 (2010), arXiv:0912.1857 [hep-th].
17. S. Horibe and B. Underwood, *“Making connections to the ‘real world’: a model building lesson”*, *Physics Education* 44 (2009) 633-638. The full lesson can be found online [here](#).
18. J. M. Cline, L. Hoi and B. Underwood, *“Dynamical Fine Tuning in Brane Inflation”*, *Journal of High Energy Physics*, **0906**, 078 (2009), arXiv:0902.0339 [hep-th].
19. A. R. Frey, G. Torroba, B. Underwood and M. R. Douglas, *“The Universal Kahler Modulus in Warped Compactifications”*, *Journal of High Energy Physics*, **0901**, 036 (2009), arXiv:0810.5768 [hep-th].
20. S. S. Haque, G. Shiu, B. Underwood and T. Van Riet, *“Minimal simple de Sitter solutions”*, *Physical Review* **D 79**, 086005 (2009), arXiv:0810.5328 [hep-th].
21. G. Shiu, G. Torroba, B. Underwood and M. R. Douglas, *“Dynamics of Warped Flux Compactifications”*, *Journal of High Energy Physics*, **0806**, 024 (2008), arXiv:0803.3068 [hep-th].
22. B. Underwood, *“Brane Inflation is Attractive”*, *Physical Review D* **78**, 023509 (2008), arXiv:0802.2117 [hep-th].
23. M. Huang, G. Shiu, B. Underwood, *“Multifield DBI Inflation and Non-Gaussianities”*, *Physical Review D* **77**, 023511 (2008), arXiv:0709.3299 [hep-th].
24. G. Shiu, B. Underwood, D. Walker, K. Zurek, *“Probing the Geometry of Warped String Compactifications at the LHC”*, *Physical Review Letters*, **100**, 031601 (2008), arXiv:0705.4097 [hep-th].
25. O. DeWolfe, L. McAllister, G. Shiu, B. Underwood, *“D3-brane Vacua in Stabilized Compactifications”*, *Journal of High Energy Physics*, **0709** 121 (2007), arXiv:hep-th/0703088.
26. G. Shiu, B. Underwood, *“Observing the Geometry of Warped Compactification via Cosmic Inflation”*, *Physical Review Letters*, **98**, 051301 (2007), arXiv:hep-th/0610151.

27. S. Keckskemeti, J. Maiden, G. Shiu, B. Underwood, “*DBI Inflation in the Tip Region of a Warped Throat*”, *Journal of High Energy Physics*, **0609**, 076 (2006), [arXiv:hep-th/0605189](#).
28. D. Chialva, G. Shiu, B. Underwood, “*Warped Reheating in Multithroat Brane Inflation*,” *Journal of High Energy Physics*, **0601** 014 (2006), [arXiv:hep-th/0508229](#).

Presentations and Talks since Tenure and Promotion to Associate Professor:

- “Cosmological Chaos, Complexity, and the OTOC” (Invited Seminar) **November 2020**
University of Cape Town, Cape Town, South Africa
- “Cosmological Chaos, Complexity, and the OTOC” (Invited Seminar) **October 2020**
University of Vienna, Vienna, Austria
- “Constraints on dS from Higher Dimensions” (Conference, Invited Speaker) **December 2019**
de Sitter Constructions in String Theory Workshop
Institut de Physique Theorique, CEA Saclay, Paris, France
- “Science is Biased...Or Is It? Scientists and Philosophers in Dialogue” **April 2017**
Pacific Lutheran University, Tacoma, WA
- “SageMathCloud in the Physics Classroom” **October 2017**
 (Contributed) *AAPT Washington Section Meeting*,
Pierce College, Lakewood, WA

Presentations and Talks prior to Tenure and Promotion to Associate Professor at PLU:

- Poster: “Moving Phones Tick Slower: Creating an Android App to Demonstrate Time Dilation” **July 2016**
 (Contributed) *AAPT Summer Meeting 2016, Sacramento, CA*
- “Apps, Augmented Reality, and VR: Oh My!” **April 2016**
Presentation for PLU Physics Club
- “Which Questions Matter: Scientists and Philosophers in Dialogue” **April 2016**
Part of “Day of Vocation”, Pacific Lutheran University, Tacoma, WA
- “The Value of Falsehood: Scientists and Philosophers in Dialogue” **April 2015**
Pacific Lutheran University, Tacoma, WA
- “Non-Linear Resonance in Relativistic Preheating” (Contributed) **May 2014**
Canadian Conference on General Relativity and Relativistic Astrophysics
University of Winnipeg, Winnipeg, MB, Canada
- “Non-Canonical Scalar Fields in Inflation and Reheating” (Invited) **May 2014**
Winnipeg Institute for Theoretical Physics,
University of Winnipeg, Winnipeg, MB, Canada
- “The Game of Truth: Scientists and Philosophers in Dialogue” **April 2014**
Pacific Lutheran University, Tacoma, WA
- “Pac-Man’s Paradox” **October 2013**
PLU Math Department Seminar, Tacoma, WA
- “Big Bang Theory Guide to the Liberal Arts”, **May 2013**
Faculty Keynote Speaker, PLU Arete Society, Tacoma, WA
- “Cosmosis” PLU Wind Ensemble Performance and Demonstration **May 2013**
Created scientific demonstration and interpretive video that resonated with the themes of Wind Ensemble performance, including “Rubens Tube”
- “Is the Universe Knowable? A Conversation among Scientists Philosophers, and You!” **March 2013**
Pacific Lutheran University, Tacoma, WA

<p>"A Breathing Mode for Compactifications", Northwest Meeting (Contributed) <i>American Physical Society, Vancouver, B. C.</i></p>	<p>October 2012</p>
<p>"String Cosmology: Connecting the Physics of the Very-Big and the Very-Small," <i>Pacific Lutheran University, Tacoma, WA.</i></p>	<p>March 2011</p>
<p>Research Mentorship since Tenure and Promotion to Associate Professor at PLU:</p>	
<p>Thato Thapo, Masters Degree Co-Advisor, University of Cape Town <i>"The Carroll Limit of General Relativity"</i></p>	<p>Fall 2022-present</p>
<p>Alexander Johnson, Hannah Tate, Capstone Projects <i>Supervised research on horizons in extra dimensions in General Relativity.</i></p>	<p>Spring 2022</p>
<p>Travis Bejines, Alex Bray, and Robert Joegerst, Capstone Projects <i>Supervised research on cosmic bubbles in General Relativity.</i></p>	<p>Spring 2017</p>
<p>Research Mentorship prior to Tenure and Promotion to Associate Professor at PLU:</p>	
<p>Michelle Zhai, Capstone Project <i>Supervised development of Time Dilation app for Capstone project.</i></p>	<p>Spring 2015</p>
<p>Michelle Zhai, NSCI Summer Undergraduate Researcher <i>Supervised research of dynamics of inflation in the very early Universe</i></p>	<p>Summer 2013</p>
<p>Auberry Fortuner, Capstone Project <i>Supervised research of modified dynamics in the very early Universe</i></p>	<p>Spring 2013</p>
<p>Auberry Fortuner, NSCI Summer Undergraduate Researcher <i>Supervised research of modified dynamics in the very early Universe</i></p>	<p>Summer 2012</p>
<p>Joseph Olsen, Capstone Project <i>Supervised research of alternative models of General Relativity</i></p>	<p>Spring 2012</p>
<p>Grants since Tenure and Promotion to Associate Professor at PLU:</p>	
<p>Asia Pacific Center for Theoretical Physics <i>"Applications of Quantum Information Theory in QFT and Cosmology"</i> <i>Conference Grant, \$6,500 (USD)</i></p>	<p>Fall 2021</p>
<p>Perimeter Institute for Theoretical Physics <i>"Applications of Quantum Information Theory in QFT and Cosmology"</i> <i>Conference Grant, \$1,500 (USD)</i></p>	<p>Fall 2021</p>
<p>Pacific Institute for Mathematical Sciences <i>"Applications of Quantum Information Theory in QFT and Cosmology"</i> <i>Conference Grant, \$2,000 (USD)</i></p>	<p>Fall 2021</p>
<p>Winnipeg Institute for Theoretical Physics <i>"Applications of Quantum Information Theory in QFT and Cosmology"</i> <i>Conference Grant, \$1,100 (USD)</i></p>	<p>Fall 2021</p>
<p>PLU Teaching with Technology Grant <i>Grant for purchase of technology for Experimental Physics course</i> \$5,750 (USD)</p>	<p>Fall 2018</p>
<p>Grants prior to Tenure and Promotion to Associate Professor at PLU:</p>	
<p>PLU NSCI Undergraduate Research Program Grant <i>"Dynamics of Inflation in the Very Early Universe"</i></p>	<p>Summer 2013</p>
<p>PLU NSCI Undergraduate Research Program Grant <i>"Modified Dynamics in the Very Early Universe"</i></p>	<p>Summer 2012</p>
<p>Referee for:</p>	
<p><i>European Physics Letters</i></p>	
<p><i>Physical Review D</i></p>	
<p><i>Journal of High Energy Physics</i></p>	

Journal of Cosmology and Astrophysics
Classical and Quantum Gravity
International Journal of Modern Physics A
The Physics Teacher

Member, Professional & National Societies

American Association of Physics Teachers (2009), Sigma Pi Sigma (2002),
 Phi Beta Kappa (2001)

PROFESSIONAL DEVELOPMENT, SERVICE, AND OUTREACH

University and Professional Service since Tenure and Promotion to Associate Professor:

Chair, Department of Physics	2020-present
Governance Committee	2021-2022
Chair	
Governance Committee	2020-2022
Member	
Physics Tenure Track Search Committee	2021-2022
Chair	
Organizing Committee,	2021
“ Applications of Quantum Information Theory in QFT and Cosmology ”	
International Conference Co-Organizer	
Physics Visiting Assistant Professor Search Committee	2021
Chair	
Formal Dismissal Hearing Committee	2019-2020
Member	
Strategic Enrollment and Management Committee (SEMAC)	2018-2019
ARTS Representative	
Admission and Retention of Students (ARTS)	2018-2019
Member	

University and Professional Service prior to Tenure and Promotion to Associate Professor at PLU:

Faculty Joint Committee on the Reduction and Reallocation of Force (FJC)	2016-2017
Member	
University Committee on Honorary Degrees	2015 – 2017
Member	
Educational Policies Committee (EPC)	2014 – 2017
Member	
Physics Department Library Liaison	Fall 2012 – 2017
Coordinate physics department library purchases and acquisitions.	
Co-Advisor: Society of University Physicists (SUP)/Physics Club	2011 – 2013, 2014 – 2017
Provide advice and logistical support for PLU’s Physics Club.	
Judge: Tacoma MESA Day	2012-2017
Judge for Regional MESA Science Fair at PLU.	
Interviewer: Regent and President’s Scholarship Program	2012, 2013, 2016 & 2017
Interview potential students competing for top PLU scholarships.	
“Sandbox” Innovative Teaching Space Working Group	Spring 2016 – Fall 2016
Member. Renovate Rieke 212 as an active-learning classroom suitable and assess results.	

Participant: Workshop on Student Learning and Rieke Renovation Generated ideas on the importance of learning spaces for student learning for a future renovation of Reike Science Center.	2015
SIST Search Committee: Member, Search for Scientific Instructional Support Technician (SIST)	2013 – 2014
Speaker: Tacoma MESA Summer Academy Presented a Summer Academy workshop on the physics of “Angry Birds” to high school students.	Summer 2013
Search Committee Member: Visiting Assistant Professor of Physics	Summer 2013

Conferences & Workshops Attended since Tenure and Promotion to Associate Professor:

“Applications of Quantum Information Theory in QFT and Cosmology” Co-organizer and Attendee, <i>Virtual</i>	November 2021
“Partnership for the Integration of Computation in Undergraduate Physics (PICUP) Virtual Workshop” Attendee, <i>Virtual</i>	June 2021
“de Sitter Constructions in String Theory” Workshop Speaker and Attendee, <i>Institut de Physique Theorique, CEA Saclay, Paris, France</i>	December 2019
American Association of Physics Teachers 2016 Washington Section Meeting <i>Pierce College, Lakewood, WA</i>	October 2017

Conferences & Workshops Attended prior to Tenure and Promotion to Associate Professor at PLU:

American Association of Physics Teachers 2016 Summer Meeting <i>Sacramento, CA</i>	July 2016
Canadian Conference on General Relativity and Relativistic Astrophysics <i>Winnipeg, MB, Canada</i>	May 2014
New American Colleges and Universities Innovation Summit <i>Chicago, IL</i>	November 2013
Northwest Meeting of the American Physical Society <i>Vancouver, B. C.</i>	October 2012
New Faculty Workshop for New Physics Faculty <i>American Association of Physics Teachers, Washington, D. C.</i>	June 2012
American Association of Physics Teachers (AAPT) 2011 Summer Meeting <i>Philadelphia, PA</i>	July 2012

SELECTED ACADEMIC HONORS, FELLOWSHIPS, AND AWARDS

Institute for Particle Physics (IPP) Postdoctoral Fellowship	2008 – 2011
McGill Lorne Trottier Fellowship	2008 – 2010
“Exceptional Service” TA award (Campus-wide), (<i>UW-Madison</i>)	2007
<i>Excellent</i> TA ratings (highest possible) for all four semesters of teaching (<i>UW-Madison</i>)	2003 – 2005
Sigma Pi Sigma Physics Honorary Society member	2002
Phi Beta Kappa Liberal Arts Society Member	2001