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# ROBERT W. PATTIE JR.

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## Education

- **North Carolina State University**—Raleigh, NC  
*Ph.D. in Physics 2012*
  - Thesis Title : “A Precision Measurement of the Neutron  $\beta$ -Asymmetry using Ultracold Neutrons”
- **Virginia Polytechnic Institute and State University**—Blacksburg, VA  
*B.S. in Physics 2003*
  - Minor in Mathematics

## Professional Appointments

- **2018-Present** : Assistant Professor, East Tennessee State University (ETSU)
- **2014-2018** : Postdoctoral Research Associate, Los Alamos National Laboratory (LANL)
- **2017** : Postdoctoral Teaching Assistant, Indiana University (IU)
- **2013-2014** : Postdoctoral Research Associate, North Carolina State University/FermiLab (NCSU/FNAL)

## Research Interests

- I use cold and ultracold neutrons to study the fundamental symmetries of nature. Precision measurements of the neutron decay parameters can search for physics beyond the standard model. Searching for the neutron’s permanent electric dipole moment probes for new sources of charge-conjugation and parity violation, key components in understanding why we live in a matter dominated universe. Over last 15 years I have developed data acquisition and analysis software for the UCNA and UCN $\tau$  experiments.
  - Collaboration member: UCN $\tau$ , UCNA, LANL nEDM, UCNProbe
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## Courses Taught

- Phys-2020 - General Physics II, ETSU
- Phys-2021 - General Physics I Lab, ETSU
- Phys-2010 - General Physics I, ETSU
- Phys-2011 - General Physics I Lab, ETSU
- P202 - Intro. Physics II, IU

## Outreach Activities

- Spring 2019 : East Tennessee Regional Science Fair Judge
- Spring 2019 : Skype-A-Scientist
- Spring 2019 : Science Olympiad Event Coordinator
- Fall 2017 : Adopt-A-Physicist (<https://www.adoptaphysicist.org>)

## Professional Memberships

- American Physical Society (Division of Nuclear Physics) (APS-DNP)
- South Eastern Section of the American Physical Society (SESAPS)
- American Academy for the Advancement of Science (AAAS)

## Other Experience

- **United States Marine Corps**—Bravo Company 4<sup>th</sup> Combat Engineer Battalion, Roanoke, VA 1999–2007
  - Honorably discharged at the rank of Sergeant (E5).
  - Deployed during “Operation Iraqi Freedom” January – October, 2005.
  - Was responsible for the maintenance of equipment and training of personnel in the heavy equipment section in support of a combat engineer company.

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## Professional Presentations and Publications

- **Highlighted Publications**

1. “Measurement of the neutron lifetime using an asymmetric magneto-gravitational trap and *in situ* detection,” R. W. Pattie Jr., N. B. Callahan, C. Cude-Woods, *et al.*, *Science*, 10.1126/science.aan8895 (2018) ([arXiv:1707.01817](https://arxiv.org/abs/1707.01817))
2. “Evaluation of commercial nickel-phosphorus coating for ultracold neutron guides using a pinhole bottling method,” R. W. Pattie Jr., E. R. Adamek, T. Brenner, *et al.*, *Nucl. Instrum. and Meth. in Phys. Res. A*, **872C**, 64 (2017) ([arXiv:1703.00508](https://arxiv.org/abs/1703.00508))
3. “Neutron-Antineutron Oscillations: Theoretical status and Experimental Prospects”, D. G. Phillips II, W.M Snow, K. Babu, *et al.*, *Physics Reports* **612** (2016) ([arXiv:1410.1100](https://arxiv.org/abs/1410.1100))
4. “Limits on Tensor Coupling from Neutron  $\beta$  Decay,” R. W. Pattie Jr, K.P Hickerson, A.R. Young, *Phys. Rev. C*, **88**, 048501 (2013) ([arXiv:1309.2499](https://arxiv.org/abs/1309.2499))
5. “First Measurement of the Neutron  $\beta$ -Asymmetry using Ultracold Neutrons,” R. W. Pattie Jr., J. Anaya, H. O. Back, *et al.*, *Phys. Rev. Lett.* **102**, 012301 (2009) ([arXiv:0809.2941](https://arxiv.org/abs/0809.2941))

- **All Publications**

1. “A next-generation inverse-geometry spallation-driven ultracold neutron source,” K. K. H. Leung, G. Mührer, T. Hügler, *et al.*, [arXiv:1905.09459](https://arxiv.org/abs/1905.09459) (2019)
2. “A boron-coated CCD camera for direct detection of Ultracold Neutrons,” K. Kuk, C. Cude-Woods, C.R. Chavez, *et al.*, [arXiv:1903.01335](https://arxiv.org/abs/1903.01335) (2019)
3. “Monte Carlo of trapped ultracold neutrons in the UCN $\tau$  trap,” N. Callahan, C.-Y. Liu, F. Gonzalez, *et al.*, *Phys. Rev. C* **100**, 015501, (2019) [arXiv:1810.07691](https://arxiv.org/abs/1810.07691)
4. “Solid deuterium surface degradation at ultracold neutron sources,” A. Anghel, T.L. Bailey, G. Bison, *et al.*, *Eur. Phys. J. A* **54**, (2018), ([arXiv:1804.08616](https://arxiv.org/abs/1804.08616))
5. “Search for dark matter decay of the free neutron from the UCNA experiment:  $n \rightarrow \chi + e^+ e^-$ ,” X. Sun, E. Adamek, B. Allgeier, *et al.*, *Phys. Rev. C*, **97**, 052501 (2018) ([arXiv:1803.10890](https://arxiv.org/abs/1803.10890))
6. “Search for the Neutron Decay  $n \rightarrow X + \gamma$ , where  $X$  is a dark matter particle,” Z. Tang, M. Blatnik, L. J. Broussard, *et al.*, *Phys. Rev. Lett.* **121**, 022505, (2018) ([arXiv:1802.01595](https://arxiv.org/abs/1802.01595))
7. “New result for the neutron  $\beta$ -asymmetry parameter  $A_0$  from UCNA,” M. A.-P. Brown, E. B. Dees, E. Adamek, *et al.*, *Phys. Rev. C*, **97**, 035505 (2018)
8. “Performance of the upgraded ultracold neutron source at Los Alamos National Laboratory and its implication for a possible neutron electric dipole moment experiment,” T. M. Ito, E. R. Adamek, N. B. Callahan, *et al.*, *Phys. Rev. C*, **97**, 012501(R) (2018)
9. “Measurement of the neutron lifetime using an asymmetric magneto-gravitational trap and *in situ* detection,” R. W. Pattie Jr., N. B. Callahan, C. Cude-Woods, *et al.*, *Science*, 10.1126/science.aan8895 (2018) ([arXiv:1707.01817](https://arxiv.org/abs/1707.01817))
10. “First direct constraints on Fierz Interference in free neutron  $\beta$ -decay,” K. P. Hickerson, X. Sun, Y. Bagdasarova, *et al.*, *Phys. Rev. C*, **96**, 042501(R) (2017)
11. “Evaluation of commercial nickel-phosphorus coating for ultracold neutron guides using a pinhole bottling method,” R. W. Pattie Jr., E. R. Adamek, T. Brenner, *et al.*, *Nucl. Instrum. and Meth. in Phys. Res. A*, **872C**, 64 (2017)
12. “Total cross sections for ultracold neutrons scattered from gases,” S. J. Seestrom, *et al.*, *Phys Rev C* **95**, 015501 (2017)
13. “A new method for measuring the neutron lifetime using an in situ neutron detector,” C. L. Morris, E. R. Adamek, L. J. Broussard, *et al.*, *Rev. Sci. Instrum.* **88**, 053508 (2017)

14. "Detection System for Neutron  $\beta$  Decay Correlations in the UCNB and Nab experiments," L. J. Broussard, B. A. Zeck, E. R. Adamek, et al, Nucl. Instr. and Meth. in Phys. Res. A **849**, 83 (2016)
15. "Position-sensitive detection of ultracold neutrons with an imaging camera and its implications to spectroscopy", W. Wei, L. J. Broussard, M. A. Hoffbauer, et al, Nucl. Instr. and Meth. in Phys Res A, **830** (2016)
16. "Neutron-Antineutron Oscillations: Theoretical status and Experimental Prospects", D. G. Phillips II, W.M Snow, K. Babu, et al., Physics Reports **612** (2016)
17. "Measurement of spin-flip probabilities for ultracold neutrons interacting with nickel phosphorus coated surfaces", Z. Tang, E.R. Adamek, A. Brandt, et al, Nucl. Instr. Meth. in Phys Res. A, **827** (2016)
18. "A multilayer surface detector for ultracold neutrons", Z Wang, C. L. Morris, N. B. Callahan, et al., Nucl. Instr. and Meth. in Phys Res. A, **798** 30 (2015)
19. "Characterization of large area, thick, and segmented silicon detectors for neutron  $\beta$ -decay experiments", A. Salas-Bacci, P.L. McGaughey, S. Baeßler, et al, Nucl. Instrum. Meth. in Phys. Res. A, **735**, 408 (2014)
20. "Determination of the Free Neutron Lifetime", J.D. Bowman, L.J. Broussard, S.M. Clayton, et al, arXiv:1410.5311 (2014)
21. "Measurement of the Half-life of the T=1/2 Mirror Decay of  $^{19}\text{Ne}$  and its implications on Physics Beyond the Standard Model", L.J. Broussard, H.O. Back, M.S. Boswell, et al., Phys Rev Lett **112** (2014)
22. "A method for measuring coherent elastic neutrino-nucleus scattering at a far off-axis high-energy neutrino beam target", S. J. Brice, R. L. Cooper, F. DeJongh, et al, Phys Rev D, **89**, 072004 (2014)
23. "Limits on Tensor Coupling from Neutron  $\beta$  Decay," R. W. Pattie Jr, K.P Hickerson, A.R. Young, Phys. Rev. C, **88**, 048501 (2013)
24. "Measurements of ultracold neutron upscattering and absorption in polyethylene and vanadium," E. I. Sharapov, C. L. Morris, M. Makela, et al., Phys Rev C, **88**, 037601 (2013)
25. "Upscattering of Ultracold Neutrons from the polymer  $[C_6H_{12}]_n$ ," E. I. Sharapov, C. L. Morris, M. Makela, et al., Phys Rev C, **88**, 064605 (2013)
26. "Project X: Physics Opportunities", A.S. Kronfeld, R.S. Tschirhart, U Al-Binni, et al., arXiv:1306.5009 (2013)
27. "Precision Measurement of the Neutron Beta-Decay Asymmetry," M. P. Mendenhall, R. W. Pattie Jr, Y. Bagdasarova, et al., Phys. Rev. C **87**, 032501 (2013)
28. "Performance of the Los Alamos National Laboratory spallation-driven solid-deuterium ultra-cold neutron source," A. Saunders, M. Makela, Y. Bagdasarova, et al., Rev. Sci. Instrum. **84** 013304 (2013)
29. "Measurement of the neutron  $\beta$ -asymmetry parameter  $A_0$  with ultracold neutrons," B. Plaster, R. Rios, H. O. Back, et al., Phys Rev C **86**, 055501 (2012)
30. "A High-Field Adiabatic Fast Passage Ultracold Neutron Spin Flipper for the UCNA Experiment," A. T. Holley, H. O. Back, L. J. Broussard, et al. , Rev. Sci. Instrum. **83**, 073505 (2012)
31. "Preparation of a  $^{114m}\text{In}$  Low Energy Conversion Electron Source," C. Wrede, B. W. Filippone, A. Garcíá, et al., Nucl. Instrum. Methods B **269**, 1113 (2011)
32. "Sealed Drift Tube Cosmic Ray Veto Counters," R. Rios, E. Tatar, J. D. Bacon, et al., Nucl. Instrum. Methods A **637** 105-108 (2011)
33. "Determination of the Axial-Vector Weak Coupling Constant with Polarized Ultracold Neutrons," J. Liu, M. P. Mendenhall, A. T. Holley, et al., Phys. Rev. Lett. **105**, 181803 (2010)
34. "First Measurement of the Neutron  $\beta$ -Asymmetry using Ultracold Neutrons," R. W. Pattie Jr., J. Anaya, H. O. Back, et al., Phys. Rev. Lett. **102**, 012301 (2009)
35. "Multi-wire proportional chamber for ultra-cold neutron detection," C.L Morris, T. J. Bowles, J. Gonzales, et al., Nucl. Instrum. Methods A A, **599**, 248-250 (2008)

● **Invited Talks and Seminars**

1. "Prospect and progress: new experimental searches for neutron-antineutron oscillations with free neutron beams," Conference on Science at the Sanford Underground Research Facility, 2019, South Dakota School of Mines, Rapid City, SD
2. "UCN $\tau$  : A magneto-gravitational trap for measuring the neutron lifetime," Nuclear Physics Seminar, February, 2019, North Carolina State University, Raleigh, NC
3. "UCN $\tau$  : Status and Implications of current results" Nuclear Physics Seminar, January, 2019, University of Kentucky, Lexington, KY

4. "UCNA/UCNA+," November, 2018, **South East Section of the American Physical Society**, Knoxville, TN
5. "Precision tests of the Standard Model with Ultracold Neutrons," February 2018, Seminar, **East Tennessee State University**, Johnson City, TN
6. "A sub second measurement of the neutron lifetime with a magneto-gravitational trap," February 2018, Colloquium, **University of Tennessee**, Knoxville, TN
7. "A sub second measurement of the neutron lifetime with a magneto-gravitational trap," January 2018, Physics and Theory Seminar Series, **Los Alamos National Lab**, Los Alamos, NM
8. "A sub second measurement of the neutron lifetime with a magneto-gravitational trap," November 2017, Particle Physics Seminar, **Brookhaven National Lab**, Brookhaven, NY
9. "A sub second measurement of the neutron lifetime with a magneto-gravitational trap," October 2017, **American Physical Society Division of Nuclear Physics**, Pittsburgh, PA
10. "Commissioning of the LANSCE UCN Source Upgrade," Oct 2017, **nEDM 2017**, Triumf, Vancouver, BC
11. "UCN $\tau$ : A magneto-gravitational trap for measuring the neutron lifetime," May 2017, **University of Rochester**, Rochester, NY
12. "UCN $\tau$ : A magneto-gravitational trap for measuring the neutron lifetime", February 2017, **North Carolina State University Nuclear Physics Seminar**, Raleigh, NC
13. "Upgrading the Ultracold Neutron Source and Measuring the neutron lifetime at Los Alamos Neutron Science Center", **ORNL-SNS Seminar**, October 2016, Oakridge, TN
14. "Searching for Baryon Number Violation with Cold Neutrons", **Tennessee Technical University Seminar**, October 2016, Cookeville, TN
15. "Precision measurements of fundamental symmetries with cold and ultracold neutrons", **Los Alamos Neutron Science Center Summer Postdoc Seminar Series**, July 2015
16. "A next generation neutron – antineutron oscillation experiment at the ESS", **LANL P-25 Seminar**, February, 2015
17. "Detector prototype evaluation at spallation neutron sources", **Transformative Hadron Beamlines Workshop**, July 2014, Brookhaven National Lab, NY
18. "A next generation neutron – antineutron oscillation experiment at Project X", **LANL P-25 Seminar**, February, 2014
19. "A precision measurement of the neutron  $\beta$ -asymmetry using ultracold neutrons", **LANL P-25 Seminar**, January, 2013
20. "A next generation neutron-antineutron oscillations experiment using very cold and ultracold neutrons", **Conference on the Intersections of Particle and Nuclear Physics**, May 2012, St. Petersburg, FL

- **Contributed Talks**

1. "Status of the Los Alamos Room Temperature neutron electric dipole moment search," **American Physical Society April Meeting**, April, 2019, Denver, CO
2. "A comparative study of scintillators for ultracold neutron detection," **Symposium on Radiation Measurements and Applications**, June 2018, Ann Arbor, MI
3. "Status of the UCN $\tau$  Experiment," **International Workshop on Particle Physics with Slow Neutrons**, May 2018, Institut Laue-Langevin, Grenoble, France
4. "Overview of Neutron Beta Correlation Parameter Analysis from the UCNA Experiment", **American Physical Society Meeting**, January 2017, Washington DC
5. "Preliminary results from the UCN $\tau$  experiment", **American Physical Society Meeting**, January 2017, Washington DC
6. "Status and commissioning of the upgraded ultracold neutron source at LANSCE", **American Physical Society Division of Nuclear Physics**, October 2016, Vancouver, BC
7. "Status of the Los Alamos Ultracold neutron source upgrade", **International workshop: Probing fundamental symmetries and interactions with ultracold neutrons**, April 2016, Mainz, DE
8. "Upgrade of the Los Alamos Ultracold neutron source", **American Physical Society Division of Nuclear Physics**, October 2015, Santa Fe, NM
9. "Systematic Uncertainties in the UCN $\tau$  experiment", **American Physical Society Division of Nuclear Physics**, October 2014, Hawaii

10. "A next generation neutron-antineutron oscillations experiment using very cold and ultracold neutrons", **American Physical Society Division of Nuclear Physics**, October 2012, Newport Beach, CA
  11. "Results from UCNA 2010," **American Physical Society Division of Nuclear Physics**, Oct. 26-29, 2011, East Lansing, MI
  12. "Electron Scattering Systematics in Neutron Angular Correlation Measurements," **American Physical Society Division of Nuclear Physics**, Nov 2-6, 2010, Santa Fe, NM
  13. "Systematic Error Overview for the UCNA Experiment," **American Physical Society Division of Nuclear Physics**, Oct 17-20, 2009, Hawaii
  14. "Initial Asymmetry Results from the UCNA Experiment," **American Physical Society Meeting**, Apr 5-8, 2008, St. Louis, MO
  15. "First neutron beta-decay results from the UCNA experiment," **American Physical Society Meeting**, Apr 5-8, 2007, Jacksonville, FL
  16. "Results of UCN Depolarization and Transport Measurements on Quartz Guide Tubes Coated with Pulsed-Laser Deposited Diamond-Like Carbon," **American Physical Society Meeting**, Apr 5-8, 2003, Philadelphia, PA
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